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MOONS

Moons — also called satellites — come in many shapes, sizes, and types. They are generally solid bodies, and few have atmospheres. Most of the planetary moons probably formed from the discs of gas and dust circulating around planets in the early solar system. Some moons are large enough for their gravity to cause them to be spherical, while smaller moons appear to be captured asteroids, not related to the formation and evolution of the body they orbit. The International Astronomical Union lists 146 moons orbiting planets in our solar system — this number does not include the moons awaiting official recognition and naming, the eight moons of the dwarf planets, nor the tiny satellites that orbit some asteroids and other celestial objects. Of the terrestrial (rocky) planets of the inner solar system, neither Mercury nor Venus has any moons at all, Earth has one, and Mars has its two small moons. In the outer solar system, the gas giants (Jupiter, Saturn) and the ice giants (Uranus and Neptune) have numerous moons. As these huge planets grew in the early solar system, they were able to capture objects with their large gravitational fields.

Earth's Moon probably formed when a large body about the size of Mars collided with Earth, ejecting material from our planet into orbit. This material accumulated to form the Moon approximately 4.5 billion years ago (the age of the oldest collected lunar rocks). Twelve American astronauts landed on the Moon during NASA's Apollo program in 1969 to 1972, studying the Moon and bringing back rock samples.

Usually the term "moon" brings to mind a spherical object, like Earth's Moon. The two moons of Mars, Phobos and Deimos, are somewhat different. Both have nearly circular orbits and travel close to the plane of the planet's equator, and they are lumpy and dark. Phobos is slowly drawing closer to Mars, and could crash into Mars in 40 or 50 million years, or the planet's gravity might break Phobos apart, creating a thin ring around Mars.

Jupiter has 50 known moons (plus 17 awaiting official confirmation), including the largest moon in the solar system, Ganymede. Many of Jupiter's outer moons have highly elliptical orbits and orbit "backwards" (opposite to the spin of the planet). Saturn, Uranus, and Neptune also have some "irregular" moons, which orbit far from their respective planets.

Saturn has 53 known moons (plus 9 awaiting official confirmation). The chunks of ice and rock in Saturn's rings (and the particles in the rings of the other outer planets) are not considered moons, yet embedded in Saturn's rings are distinct moons or "moonlets." Small "shepherd" moons help keep the rings in line.

Saturn's moon Titan, the second largest in the solar system, is the only moon with a thick atmosphere. Beyond Saturn, Uranus has 27 known moons. The inner moons appear to be about half water ice and half rock. Miranda is the most unusual; its chopped-up appearance shows the scars of impacts of large rocky bodies. Neptune's moon Triton is as big as the dwarf planet Pluto, and orbits backwards compared with Neptune's direction of rotation. Neptune has 13 known moons plus a 14th awaiting official confirmation.

Pluto's large moon, Charon, is about half the size of Pluto, and some scientists consider Pluto/Charon to be a double system. Like Earth's Moon, Charon may have formed from debris from an early collision of an impactor with Pluto. Scientists using the Hubble Space Telescope to study Pluto have found five additional smaller moons. Eris, a dwarf planet even more distant than Pluto, has a small moon of its own, named Dysnomia. Haumea, another dwarf planet, has two satellites, Hi'iaka and Namaka.

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FAST FACTS — PLANETS AND SELECTED MOONS

Planet	Moon	Mean Radius (km)	Mean Radius (mi)
Earth	Moon	1,737.4	1,079.6
Mars	Phobos	11.1	6.9
Mars	Deimos	6.2	3.9
Jupiter	Io	1,821.6	1,131.9
Jupiter	Europa	1,560.8	969.8
Jupiter	Callisto	2,410	1,498
Jupiter	Ganymede	2,631	1,635
Saturn	Mimas	198.6	123.4
Saturn	Enceladus	249.4	154.9
Saturn	Tethys	529.9	329.3
Saturn	Dione	560	348
Saturn	Rhea	764	475
Saturn	Titan	2,575	1,600
Saturn	Iapetus	718	446
Uranus	Miranda	235.8	146.5
Uranus	Ariel	578.9	359.7
Uranus	Umbriel	584.7	363.3
Uranus	Titania	788.9	490.2
Uranus	Oberon	761.4	473.1
Neptune	Triton	1,353.4	841
Neptune	Nereid	170	106

Exercise 01

Answer the following questions:

1. Moons come in many sizes. What is the largest moon in the solar system ?
2. One planet has a moon with no other official definite name. Which one is it ?
3. Which moon is known for its giant ice geysers?
4. Which moon has the thickest atmosphere ?
5. Name the moons that are almost the same orbit, close to Saturn's rings ?
6. Why is there no life on the moon ?
7. How does the moon stay in orbit ?
8. How does moon's earth differ from other moons in the solar system?

Exercise 02

Define the following words and use each one of them in a sentence of your own.

- Spherical
- Lumpy
- Impactor
- Debris

Exercise 03

1. *Analyze the* ***first*** *paragraph in terms of rhetorical functions.*

2. *Analyze the text in terms of grammatical features, cohesive markers and technical and semi technical terms.*

Exercise 04

Summarize the text (not more than 10 lines).

EARTH

Earth, our home, is the third planet from the sun. It is the only planet known to have an atmosphere containing free oxygen, oceans of water on its surface and life. It is the fifth largest of the planets in the solar system. It is smaller than the four gas giants - Jupiter, Saturn, Uranus and Neptune - but larger than the three other rocky planets, Mercury, Mars and Venus. Earth has a diameter of roughly 8,000 miles (13,000 kilometers) and is round because gravity pulls matter into a ball. However, it's not perfectly round. Earth is really an "oblate spheroid" because its spin causes it to be squashed at its poles and swollen at the equator.

Water covers roughly 71 % of Earth's surface, and most of that is in the oceans. About a fifth of Earth's atmosphere consists of oxygen, produced by plants. While scientists have been studying our planet for centuries, much has been learned in recent decades by studying pictures of Earth from space.

While Earth orbits the sun, the planet is simultaneously spinning on an imaginary line called an axis that runs from the North Pole to the South Pole. It takes Earth 23.934 hours to complete a rotation on its axis and 365.26 days to complete an orbit around the sun. Earth's axis of rotation is tilted in relation to the ecliptic plane, an imaginary surface through the planet's orbit around the sun. This means the Northern and Southern hemispheres will sometimes point toward or away from the sun depending on the time of year, and this changes the amount of light the hemispheres receive, resulting in the seasons. Earth's orbit is not a perfect circle, but rather an oval-shaped ellipse, similar to the orbits of all the other planets. Our planet is a bit closer to the sun in early January and farther away in July, although this variation has a much smaller effect than the heating and cooling caused by the tilt of Earth's axis. Earth happens to lie within the so-called "Goldilocks zone" around the sun, where temperatures are just right to maintain liquid water on our planet's surface.

Scientists think Earth was formed at roughly the same time as the sun and other planets some 4.6 billion years ago, when the solar system coalesced from a giant, rotating cloud of gas and dust known as the solar nebula. As the nebula collapsed because of its gravity, it spun faster and flattened into a disk. Most of the material was pulled toward the center to form the sun. Other particles within the disk collided and stuck together to form ever-larger bodies, including Earth. Scientists think Earth started off as a waterless mass of rock.

"It was thought that because of these asteroids and comets flying around colliding with Earth, conditions on early Earth may have been hellish," Simone Marchi, a planetary scientist at the Southwest Research Institute in Boulder, Colorado, previously told Space.com. But in recent years, new analyses of minerals trapped within ancient microscopic crystals suggests that there was liquid water already present on Earth during its first 500 million years, Marchi said. Radioactive materials in the rock and increasing pressure deep within the Earth generated enough heat to melt the planet's interior, causing some chemicals to rise to the surface and form water, while others became the gases of the atmosphere. Recent evidence suggests that Earth's crust and oceans may have formed within about 200 million years after the planet took shape.

Earth's moon is 2,159 miles (3,474 km) wide, about one-fourth of Earth's diameter. Our planet has one moon. The leading explanation for how Earth's moon formed is that a giant impact knocked the raw ingredients for the moon off the primitive, molten Earth and into orbit. Scientists have suggested that the object that hit the planet had roughly 10 % the mass of Earth, about the size of Mars.

Earth is the only planet in the universe known to possess life. The planet boasts several million species of life, living in habitats ranging from the bottom of the deepest ocean to a few miles into the atmosphere. Furthermore, scientists think far more species remain to be discovered.

Researchers suspect that other candidates for hosting life in our solar system — such as Saturn's moon Titan or Jupiter's moon Europa — could house primitive living creatures. Scientists have yet to precisely nail down exactly how our primitive ancestors first showed up on Earth. One solution suggests that life first evolved on the nearby planet

Mars, once a habitable planet, then traveled to Earth on meteorites hurled from the Red Planet by impacts from other space rocks.

Exercise 01

Answer the following questions

1. Why is the shape of Earth called an oblate spheroid?
2. Why does Earth does not float into the space ?
3. What type of planet is Earth?
4. How is the surface of planet Earth best described ?
5. What makes the Earth different from the other planets in the Solar System?
6. What is the outside rocky layer of the Earth called ?
7. What is the name given to the imaginary line at latitude zero?
8. What two elements make up the majority of the Earth's core ?

Exercise 02

Define the following words and use each one of them in a sentence of your own.

- Tilted
- Ellipse
- Coalesced
- Hellish
- Molten
- Hurled

Exercise 03

1. Analyze the 3rd paragraph in terms of rhetorical functions.
2. Analyze the text in terms of grammatical notions, cohesive devices and technical/semi technical terms.

Exercise 04

Summarize the text (not more than 15 lines).

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STARS

Stars are born inside clouds of gas and dust known as nebulas which exist throughout the galaxy. Some nebulas form from the gravitational collapse of gas in the interstellar medium while others are the result of the death throws of a massive star. Hydrogen clumps together inside these clouds of gas growing ever larger and hotter until eventually the early stage of a star called a protostar is formed. As gravity collapses the protostar temperatures and pressure in its core become high enough to trigger nuclear fusion. The star is now fusing hydrogen atoms creating an enormous amount of energy, this stage of a star's existence is known as its main sequence and depending on its size it could remain in this state for billions or possibly even trillions of years. Together the stars light up the universe in a variety of colors and most importantly our own star also provides the energy which allows life to flourish on our planet.

When a star is in its main sequence, it is fusing hydrogen atoms in its core which creates energy. Stars in their main sequence are referred to as 'dwarfs', the sun being an example of a dwarf star, all stars will spend the majority of their lifespan in this state before they exhaust their supply of hydrogen. After this stage most stars become giants. For example, when our sun can no longer fuse hydrogen in its core, it will begin to fuse hydrogen in its outer shell causing it to expand greatly and become a red giant. The color of a main sequence star depends on its surface temperature, which is usually related to its mass. Low mass stars generally have a lower surface temperature and appear red, high mass stars generally have higher surface temperatures and appear blue. It's worth noting that all stars emit light from every color of the spectrum but will appear as one color to us.

Some types of Main Sequence Stars

Stars are classified with a letter depending on their surface temperatures, either A, B, F, G, K, M, or O. They are not in alphabetical order, stars with similar surface temperatures to our sun are classified as G, whereas a much hotter star may be classified as B or O.

The Red Dwarfs are by far the most common type of star in our galaxy. They have less than 50% the mass of our own Sun, as a result they are much cooler and emit far less energy. As Red Dwarfs burn their fuel at a very slow rate, their lifespan is much longer than those of other stars; it is possible some could exist for over a trillion years. Some red dwarfs with a high enough mass may become giants but will never achieve core temperatures high enough to begin fusing helium. Red dwarfs are classified with the letter M.

Orange Dwarfs are also very common in our galaxy; they generally have a mass of between 0.5 and 0.8 of the sun and have lower surface temperatures. Orange dwarfs stay in the main sequence period of their lifespan up to three times longer than yellow dwarfs such as our sun. As a result orange dwarf systems are considered very stable environments for the development of planets and the evolutionary process of life. Orange dwarfs are classified with the letter K.

The Sun in the center of our solar system is a **Yellow Dwarf**, these are stars that have approximately between 0.8 to 1.2 the mass of our sun. Most Yellow Dwarfs are actually more whitish in color, our sun only appears yellow due to the light interacting with Earth's atmosphere. The lifespan of a Yellow Dwarf in its main sequence is around 10 billion years. Yellow-White dwarfs have a mass of approximately between 1.2 and 1.4 times that of the sun and have slightly higher surface temperatures. The stellar classification for Yellow Dwarfs is G whereas Yellow-White Dwarfs are classified as F type stars.

Stars which appear white or whitish-blue generally have a mass approximately between 1.4 and twice that of the sun. Their surface temperatures can be almost twice as high as the sun and they are usually classified as A type stars. **Blue stars** generally have a mass of more than twice that of the sun, in some cases they can have a mass of more than a hundred times that of the sun with surface temperatures up to 10 times hotter and thousands of times brighter. Blue stars burn through their fuel at a far quicker rate than smaller stars meaning they have a lifespan of only a few million years, they are generally classified as B or O type stars.

Stars create energy by fusing hydrogen atoms into helium in their core, at some point though the

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hydrogen available for fusion will eventually run out signaling the beginning of the end for any star. A Yellow Dwarf such as our sun has enough hydrogen to last 10 to 12 billion years, after this point fusion activity in its core will cease. Instead the star will begin to fuse hydrogen in a shell surrounding the core causing it to expand to hundreds of times its original size and cooling its surface, becoming what is known as a red giant. During this process the star's helium rich core contracts and heats up, at a certain point the core reaches a high enough temperature to begin fusing helium into carbon and oxygen. After the star has exhausted its supply of helium it will shed its outer layers leaving only the core remaining. At this stage the star is now a **White Dwarf**, the burning embers of a dead star around the size of the Earth. It will exist in this state for billions of years until it eventually cools down.

Facts about Stars

- The Sun in the center of our solar system is a star.
- There are around 200 billion stars in the Milky Way alone.
- VY Canis Majoris is the largest known star in our galaxy. If this star was in the center of our solar system, its outer atmosphere would reach the orbit of Saturn.
- One of the smallest known stars in our galaxy is VB 10, it is only around 20% larger than Jupiter.
- Very large stars have a lifespan of only a few million years while very small stars can exist for trillions of years.
- The lifespan of our own star, the Sun, is around 10 billion years.
- Supernovas are explosions generated by large stars when they come to the end of their lifespan.
- There is a maximum of 2,500 stars visible to the naked eye at any one time in the night sky.
- The nearest star to our solar system is Proxima Centauri which is 4.2 light years away.
- The Sun is part of a single star system, but there are also binary and multiple stars where two or more stars orbit around each other.
- Antares, Arcturu, Betelgeuse, Capella, Eta Carinae, Polaris, Proxima Centauri, R136a1, Rigel, Sirius, Tau Ceti, Vega, VY Canis Majoris are notable stars.

Exercise 01

Answer the following questions.

1. What does a star begin as?
2. What is meant by a nebula ?
3. What happens to a star in its main sequence ?
4. Why do stars have different colors ?
5. How do stars create energy?
6. How are stars classified?
7. How many stars can be seen in the night sky ?
8. Is our Sun different from the other stars ?
9. What is a supernova ?
10. How long does it take to produce a star?
11. Why do they twinkle ?

Exercise 02

Define the following words and use each one of them in a sentence of your own.

- Emit
- interstellar
- clump
- Spectrum

Exercise 03

1. Analyze the first paragraph in terms of rhetorical functions.

2. Analyze the text in terms of grammatical features, cohesive markers and technical terms.

Exercise 04

Summarize the text (not more than 10 lines).