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EYE ON SCIENCE

DUALITIES OF LIFE: The Earth and The Sky



BETWEEN

THE SECRET OF LIFE

the Sky and Earth lies



By: Maissa Azab

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In our first issue of this series dedicated to the "Dualities of Life", we welcomed 2020 with excitement as its uniqueness inspired our first issue about the "Duality of Past and Future". We have worked on this second issue dedicated to the "Duality of Earth and Sky" during the first few months of 2020; indeed, we ensure you a myriad of interesting articles about a diversity of topics that roam Earth and rove the Sky, unraveling the secrets of life in between. However, by the time we wrapped up the content for this issue, the coronavirus pandemic had already taken a grip over the world. Thus, I use this small space I have here to say a few words on behalf of *SCIplanet* Editorial Team on the subject.

This crisis has painfully demonstrated to everyone what the scientific and science engagement communities have been trying for decades to communicate to both decision makers and the public. The reality is humankind needs to stand united at all time, not just during adversity, because otherwise we are destroying each other, other lifeforms, and the planet itself. The entire global population needs education; it needs to be science-literate, to foster scientific culture, and practice scientific thinking.

Once again, what we thought of as dystopic science fiction has materialized practically from thin air. It is in these times that we most need true science, not pseudo-science or fake information; not just to overcome the health crisis itself by developing a medicine or vaccine, but to think and behave appropriately to mitigate the pandemic spread, helping our societies, health workers, and scientists curb the risk and losses. Yet again, it is not just about this devastating ordeal; it is about everyday life and what we have been doing to our planet and life on it.

Hopefully, by the time we publish our next issue, the crisis would have subsided already or on its way to. Nevertheless, we will definitely be tackling this truly life-changing ordeal that we must learn a lot from. Meanwhile, we will be working on sharing relevant contents via *SCIplanet* Online and *SCIplanet* social media pages, so make sure you follow us on social media and subscribe to our monthly e-newsletter via our website: www.bibalex.org/sciplanet.



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Earth

FROM ANOTHER PERSPECTIVE

By: Inas Essa

“Experience does not take place in the eyes, but in the soul” this quote by Ernst Barlach—German expressionist sculptor, printmaker, and writer—reflects how experiences and events we go through shape who we are, our perspectives, our decisions and actions as a result, especially when this experience is an eye-opening one.

Over centuries, scientists in different fields have been trying to make our life on Earth easier and enhance it by treading unpaved paths and conquering the unknown; in turn, life continues surprising them with what it has in store. In psychology, for example, we can find an explanation for unpleasant feelings and thoughts. Also, we can enrich our knowledge of social behavior by reading in sociology. However, is it possible to learn more about our life on Earth by reading in astronomy? It seems that the correct answer is “No”; however, astronauts can change that to a big “Yes”.

“That is one small step for a man; one giant leap for mankind.”

Neil Armstrong

The Apollo missions started as a dream as old as humanity: landing on the Moon and returning safely to Earth. Astronauts went on these missions with a bunch of goals mainly linked to space science; no one expected there was a life-changing experience awaiting them in space. An experience that would urge them to change their perspective of life on Earth, and lead them to seek fulfilling astronomy and social goals as a carefully integrated whole.

Apollo 8 was the start, when its crew—James Lovell, William Anders, and Frank Borman—went where no human being had been before; they were not prepared for the striking vision of Earth glowing blue and green above a barren lunar surface. This experience was unique and made them see Earth from a different perspective; after the flight, William Anders said “I think we went to the Moon to explore

the Moon, and what we did on Apollo 8 was we really explored the Earth”.

This exploration echoed deep inside, causing a mind shift called “Overview Effect”, which was experienced by many astronauts afterwards. This concept can be described as a cognitive shift in awareness caused by viewing the Earth from outer space and experiencing the reality of Earth in space. To see this tiny, fragile ball hanging in the void, shielded and nourished by a paper-thin atmosphere. That increased sensitivity to their place in the universe and acted as an interconnected euphoria with a striking tendency to focus on the unity of the planet and humankind.

This shift in awareness was described by Michael Collins (Apollo 11) as follows: “The thing that really surprised me was that Earth projected an air of fragility. And why? I do not know; I do not know to this day. I had a feeling it is tiny, it is shiny, it is beautiful, it is home, and it is fragile”. While Rusty Schweickart (Apollo 9) described it as a feeling that the whole universe was profoundly connected. “When you go around the Earth in an hour-and-a-half, you begin to recognize that your identity is with that whole thing. That makes a change... it comes through to you so powerfully that you are the sensing element for Man.”

Edgar Mitchell (Apollo 14) described it as a sensation that gave him a profound sense of connectedness, with a feeling of bliss and timelessness. He was overwhelmed by the experience as he became profoundly aware that each and every atom in the universe was connected

in some way; all humans, animals, and systems were a part of the same thing, a synergistic whole. From their position in space, distant places on Earth appeared inseparably close, all borders that once rendered division vanished, and humanity appeared joined together.

Perhaps, forming such perspective about Earth was not that important for space science; however, astronauts on these missions were directly affected and impressed by the possibility of vanishing national boundaries and ending conflicts that divide people for political, economic, or any other reasons. It has inflamed their desire to speak out the possibility of bridging the gap between people for a better life with no poverty, hunger, diseases, etc.

“We went up as technicians, and we came down as humanitarians.”

Edgar Mitchell

In short, this experience was a turning point and a catalyst for change in self-awareness and social experience for astronauts. The effect of this cognitive shift had not faded from their minds and it opened their eyes to possibilities for a better world by using the tools we already have to enhance our life.

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The Secrets of Earth

By: Hossam Ragab

When we talk about planet Earth, that big planet brimming with secrets, we usually envision the familiar image of the internal form of Earth consisting of four huge main layers: the crust, the mantle, the inner core, and the outer core. However, we rarely think about the main layer, which is the Earth's crust, and what it contains of multiple layers formed throughout millions of years, enclosing millions of fossils of creatures that once roamed the Earth in Ancient Times.

All that aside, we have all the peculiar and magical forms of the deposited layers that have formed Earth's crust; this is what specialists name "stratigraphy". It is the science field concerned with studying the layers of sedimentary rocks and what they contain from deposits and fossils, indicating how these layers were created and formed. First, we need to know some of the important terminologies to understand the subject better.

"Stratification" is the classification of rock layers on top of each other, and it is a characteristic that distinguishes sedimentary rocks from other types of rocks; the unit of stratification is known as "stratum". It is the smallest lithostratigraphic unit; it is known to be a homogeneous rocky thickness differentiated from what is above and what is below it.

The reasons why we can distinguish between strata in nature is known as "the basis of stratification"; if you examine two adjacent strata, you will definitely find out what makes them two strata and not one stratum. We can identify the reasons based on the types of rock that form the strata and their colors, the differences in the size and form of rock sediments, the variation in the degree of cohesion of sediments, as well as the differences of the cohesive material keeping the sediments together to form the strata.

Just as stratification has its basis, strata could be deposited in one of two manners: "flat-lying", which is the original nature, or "inclined", which could be original or structural. As for originally inclined strata, they are the result of rock sedimentation on a non-horizontal and rough surfaces—

such as the sedimentation on the sides of sand dunes, beaches, or sea bottoms full of bumps.

The formed stratum is at the same angle as the surface's slope on which it is deposited, and that is the feature it gained during its formation. As for structurally inclined strata, they are formed due to structural movements after the formation and stiffening of the strata; when the sediments settle down above the crooked surfaces in great thicknesses, the original inclination starts to gradually fade away, eventually making the strata horizontal.

As for the forms of stratification, there is "cross-stratification", which is the common type in nature; in this form, the stratas are horizontal and there is nothing to characterize them—such as repetition, gradation, or intersection. Then



there is “imbricate stratification”, which occurs when grainy sediments deposit at a certain angle on a sloping surface, as we find in estuaries; the inclination of the angle is about 20 degrees. There is also “graded stratification”, which occurs when the speed of water currents decreases, causing the sedimentation of rock fragments carried by these currents. The sediments will be filtered so that the coarse-textured sediments (gravel, for example) is deposited first, followed upward by pebbles, granules, sand, silt, and clay.

Uniformitarianism, also known as the “Doctrine of Uniformity” is one of the fundamentals of geology; it states that “the present is the key of the past”, meaning that the different geological processes that are at work in the present time to form the surface of the Earth are the same processes that formed the surface of the Earth in ancient geological times.

To learn the geological history of a certain region, we have to describe the highlighted rocks in that region; in order to describe the stratification of layers, we should cut it into pieces using a scientific method. A stratigraphic unit is a volume of rock of identifiable origin and relative age range that is defined by the distinctive and dominant features (facies) that characterize it. Sequences of sedimentary and volcanic rocks are subdivided on the basis of their lithology; going from smaller to larger in scale, the main units recognized are Bed, Member, Formation, Group, and Supergroup.

Planet Earth is filled with all that is amazing, bewildering, and curious; scientists are continuously attempting to unravel its mysteries and riddles, and the greater picture is gradually becoming clearer. This was but a tiny journey into the world of stratification and folds; I can hardly wait to take you on another trip to uncover more secrets soon.

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By: Mostafa Abo-Elmakarem

We are always concerned about bad weather; being it a hurricane or just a bit of cold wind. However, the world might have much bigger weather-like issues to be concerned about from outer space. If you are a science nerd, you already know a thing or two about solar wind; if not, let us tell you about it, and what it has to do with our Earth. The big question is: Will solar wind ever reach Earth? If yes, what would happen if it did? Is humanity at stake?

A solar wind is simply particles charged with a stream of energy; mainly electrons and protons. It is wind that outgrows in the Sun and carries energy waves through the Solar System at total speeds of 900 km/s. These heat waves are made of plasma with temperatures as high as one million degrees. This wind is most likely to be caused by the solar corona, which is the solar atmosphere's outer layer that is seen to the public during a solar eclipse.

Solar wind is said to have two essential forms: slow solar wind and fast solar wind; yet, they do not only differ in speed. Slow solar wind is most likely to have a velocity of 300–500 km/s and a temperature of one million degrees, which matches the corona. Fast solar wind, on the other hand, has a higher velocity of 750 km/s along with a temperature of eight million degrees, which most likely matches the Sun's photosphere.

With all these charged particles that a solar wind carries from the Sun wandering the outer space, they cannot completely reach our planet's surface. Our magnetic field plays a great role in protecting us from such radiations; it redirects them around the planet leaving some eye-catching effects, such as Auroras. If we did not have this magnetic shield surrounding Earth, we would easily be doomed by such powerful radiations and everything, including our planet, would be wiped out of existence!

Solar wind, however, can have greater effects on some outer technology related to Earth. For example, it can totally bring down the satellites we now use almost in everything; from navigation, communication, to outer space exploration. Being classified as a Category 5 hurricane, solar wind is dangerous to space astronauts, as well as the orbiting satellites. Power grids failure and blackouts might be some of the common effects of solar winds; yet, some aesthetic phenomena are also among the effects, such as breathtaking auroras that decorate the sky.

Going In-Depth

Solar winds have been known since the 1950s; however, scientists still do not know how they evolve. With several missions over the years, the whole phenomenon is still a total mystery! NASA is exerting a lot of effort to obtain more intel concerning this matter. On 6 October 1990, NASA launched a mission named Ulysses that was meant to study the Sun, as well as measuring the properties of its stream of energized particles entitled “Solar Winds”.

That said, there is a satellite known as NASA's Advanced Composition Explorer (ACE) that orbits at a point between Earth and Sun, equally. This particular point is known as the Lagrange Point L1 and is considered one of the special space areas because its gravity keeps the satellite stable. The core responsibility of this satellite is measuring the solar wind, as well as providing information about the particles flow.

As per NASA's efforts, scientists now have a considerable grasp on what has been a mystery for so long; given that we do have now a full picture of what happens on the surface of the Sun, and what it is like to have the space weather affecting Earth. Moreover, for more than 25 years of studying and exploring the Sun and its stream of energies, solar wind still has the energy to wander outer space with full power, and might be still orbiting for more years to come, which means it is still a kind of a mystery to us!

Solar wind appears to be no threat to our planet, but what if our magnetic shield became weaker? Would that make any difference? Of course, it would be fatal if this stream of energies made it through to the planet; the result will no longer be mesmerizing colorful auroras, it would be a nightmare. Let us hope it will not ever make it through to Earth.

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EARTH'S HEALTH FROM PLANTS HEALTH

Trees and plants in general, play a major role in the life of living creatures; it is not only necessary for the human environment, it is also the base of a sustainable life for all living organisms. Plants provide us with our nutritional needs; it manufactures its own food, and from there starts all the food chains. It is also a source of fuel, wood, fabrics, and medical and herbal products.

By: Naglaa Hassan

Plants get rid of air pollutants, contributes in removing heavy minerals, and limits noise pollution. Trees contribute in maintaining ground water, soil stabilization through its roots that combines soil together, and through its leaves that block a huge amount of rain water off the soil to prevent its erosion. Usually, areas without trees due to soil erosion and deposition in streams and lakes; which limits the value of water in it.

Trees cool the temperature and add some coolness to the weather; in which the leaves block the strong sun rays. Through the transpiration process (water evaporation through the pores of the plant), plants cool its surrounding environment; as the transpiration process consumes all the heat, especially in the decreased relative humidity. Individuals might tend to plant a set of trees to prevent winds and the erosion factors from destroying the soil.

Trees, especially the short ones, represent home and shelter to an endless number of animals, birds, and insects. Observing plants and flowers also limits the tension and emotion for those who observe it. Planting some roses, or distributing number of plant containers inside the houses or work places, is enough to add joy and ease anger and tension between people. All that beside its effective role in creating oxygen and getting rid of carbon dioxide.

For all the previously mentioned, and for the many other factors that make plants a necessity of our existence, everyone should not only plant land and spread the green spaces in our cities and houses, it is also necessary to search and explore how to maintain trees and plants, and protect them from pests and insects and epidemics that may lead to sickness or perish.

Then, how can we maintain plants alive and healthy?



Soil is considered one of the most important factors to plant healthy plants; in which plants cannot grow in poor or pollutant soil. Soil must be characterized through a number of essential factors, such as fertility, Loam, required permeability, and a certain degree of acidity. In the case of using chemical treatment, it is preferable to be an organic soil.

Among the necessary factors for a healthy plant, capable of fighting diseases: providing sufficient space for plants and paths for air to run through them in order for the plant to acquire sufficient Sun and grow without overcrowding or fighting over nutrition. Crowded plants create their own humidity, that makes an easy prey to be vulnerable to injuries, such as rust, powdery mildew, and soft mold. In that manner, creating areas allowing air flow and sun ray infiltration can limit high humidity, accelerate the dryness of these wet leaves, and prevent the infected plant parts from touching their healthy counterpart. As a result, this decreases the rate of disease and transmission.

As such, the method of watering plants affects its growth quality and its ability to resist fungi and diseases. Incorrect watering could harm a plant completely or infect it with humidity, which ruins it. It also becomes an easy prey for fungi and epidemics. Therefore, it is recommended to be careful when watering plants, and to collect sufficient information on how to water each plant species. It is usual for plants to be watered in the early morning, to limit the transpiration percentage, and avoid strong winds. Moreover, experts always recommend prevent overwatering plants or drowning them. In the case of watering plants inside containers, it is better to ensure there are drainage holes at the bottom of the containers to get rid of the excess water.

As for the rainy areas, we should calculate the watering time, so it will not coincide with the raining days,

or at least wait until the soil is dry before watering plants. Moreover, a kind of protection or a cover should be provided to prevent plants from drowning in the case of excess rain.

In order to keep plants safe and healthy, we should first be aware of “How plants get sick”

Infecting plants with a disease, requires three components: (1) a weak or eutrophic plant, (2) fungi, viral, or bacterial infection, (3) assisting environmental condition that could enhance diseases, such as high humidity or extreme dryness. When one of those three factors is missing, the plant does not get affected and stays healthy and in a good condition. Therefore, we should neutralize one of these factors as a preventive factor until the problem occurs, then the treatment begins.

One of the most important factors in planting a healthy aging plant, is choosing the healthy seeds to be planted. We should not cultivate a plant with brown or colored spots on its leaves, having rotten stems, or an insects environment. In addition to that plant being sick and will not grow well, it will also infect the rest of the healthy plants. Moreover, plants roots need to be examined as well as their crown, as these roots need to be strong and far from each other. The damaged or sick root ends the plant's life at some point, even if the crown is well.

It is also necessary to prevent insects, as they allow viruses to attack crops through the damage they make to plants. Insects are indeed contagious; as they work on spreading viruses from one plant to another. Agriculture experts recommend cleaning gardens and farms every Autumn; as diseases and pests that exist in the remains of

plants, and those on the ground, can attack the new leaves and crops as soon as they are planted. The end of Winter is considered the perfect time to trim trees and shrubs, and it is certainly better than waiting until Spring, as not to allow diseases to settle inside the wounded plant's tip and transmit it to the newly-grown parts. It is also recommended to use sharp instruments to make clean trims that are capable of speed recovery, and the trimming process should deepen to reach the living tissue of the plant.

When choosing the plant's fertilizer, quantity and suitable type should be considered. Over fertilizing could damage the roots, which limits its ability to absorb water and food. It also reflects on the plant to become more vulnerable to dryness and heat; therefore, we should first examine the soil to know how much food it needs, to avoid adding unnecessary quantities of fertilizers, or choosing unsuitable types.

It is always preferable to choose disease-resistant plants, as those genetically-modified plants; as these types are better in resisting diseases and speed recovery in the case of infection. As such, it is recommended to choose plants that are suitable to the geographical area and its climate, and also to distinguish if they are sun-loving plants or shade plants. As exposing part of shade plants to the Sun gets it infected, as it becomes under pressure and unsuitable conditions, which weakens its ability to resist and these vulnerable plants give up to the infection.

In the case of dealing with plants in containers, it is preferable not to fill the containers from the garden's or the farm's soil, as it is full of weeds, insects, and fungal infections that can

easily affect plants; therefore, it is recommended to add soil mixture you can get from markets. It is light, spongy and made from dissolved organic matter. Trees must keep its leaves clean, while accumulated dust on tree leaves are harboring insects and block the light. Therefore, continual cleaning of trees by wiping it with a wet towel or lightly spraying it with water, helps in maintaining trees in a good health.

Pets are considered the enemies of indoor plants, as they might damage it, cut its leaves, or eat it; which causes damage to the plant and a possibility of the pet getting poisoned as well. Therefore, it is preferable to keep plant containers away from animals. As such, outdoor plants are not safe from animals curiosity, such as rabbits and birds. That is why, it is recommended to build a fence around the crops, or put it in high baskets, if it is applicable. There are also other methods providing sufficient protection to plants.

What is our role in maintaining plants health?

Maintaining plants health and keeping them fresh and alive, is something that needs effort and unity. Governments, however, must prevent phenomena, as deforestation, which threatens the ecological balance of the entire planet. They should instead, look for alternatives to furniture manufacturing that does not require using tree stems that we need to maintain the planet. As such, vegetative awareness has to be raised in cities and villages. In addition, individuals should plant trees and flowers in their gardens, on their roof, and inside their balconies, as plants represent life itself.

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Underwater Volcanoes

Eruptions We Do Not See!

By: Basma Fawzy

In 2018, an underwater volcano was born near the Island of Mayotte—between Madagascar and Mozambique—in the Indian Ocean. Its birth was preceded by unusual activities near the area where it appeared. Vibrations due to changes in the Earth's crust, known as “seismic activities”, which accompany earthquakes and volcanoes, are what led scientists to discover the Mayotte underwater volcano.

Those vibrations or frequency waves were recorded on 11 November 2018; they did not cover only the area of the volcano's birthplace, but traveled across the world to Canada and Hawaii, creating a hum that got louder and louder, and lasted sometimes for up to half-an-hour. This hum was different because it was in ultralow frequency, and normally other seismic events are in several frequencies.

This underwater volcano is not the first one to be discovered, but it is unique; as seismologist Simone Cesca observed, it is “the first time we have really observed the birth of a volcano on the seafloor”. Observing the birth of an underwater volcano was definitely an invaluable experience for scientists; let us seize the opportunity and learn more about underwater or submarine volcanoes.

The Formation of Hawaii

How many underwater volcanoes are there? Scientists estimate there are more than 5000 volcanoes submerged under the sea, which means that they are responsible for 75% of lava that erupt yearly. Scientists find that underwater volcanoes are hard to study because some of them are very deep underwater; they do not just erupt, they build up over time until they reach the surface. This is exactly what happened to the Island of Hawaii.

Submarine volcanoes differ from volcanoes on land. Some of them exist in shallow waters; therefore, their presence is noticed because of the steam and rock debris that reaches the surface of the sea. Others, however, are covered by huge amounts of water that controls their eruptions and make their presence unnoticed. When lava meets seawater, it cools so rapidly that it forms sand and rubble. The beaches of Hawaii with its black sand are a great example of what seawater does to lava.

Who does not want to go to Hawaii; this fascinating island with its beauty, adventures, and lots of fun? Five million years ago, Hawaii was formed. In 1934, scientists made a fascinating discovery. Hawaii was very deep in the seawater; if there was no seawater around it, it would look higher than Mount Everest. Hawaii came into being because of volcanoes. Rocks moving on the Earth's crust are known as tectonic plates; volcanoes form when those tectonic plates come together, and Hawaii sits above the Pacific Plate. Over years and years of eruptions, Hawaii was formed; the five volcanoes responsible for creating Hawaii are Mauna Kea, Mauna Loa, Hualalai, Kilauea, and Kohala.

The Study of Volcanoes

Volcanology, also spelled Vulcanology, is the science that studies volcanoes and the different areas of volcanic phenomena; structure, origins, etc. Interest in volcanoes is as old as time but they were not properly researched until the 19th century. As for the study of submarine volcanoes, scientists need special equipment because of their depth. A few machines that work are Remotely Operated Vehicles (ROVs) that are used for video observations and also Autonomous Underwater Vehicles (AUVs) that map the seafloor. Scientists study a number of phenomena; evolution of hydrothermal systems, origin and evolution of oceanic volcanoes, and explosive volcanism in the deep sea.

A Striking Phenomenon

When we think of volcanoes, we think of danger as images of extremely hot lava come to our minds. Yet, scientists have found that sometimes life thrives whenever there is an active underwater volcano. They noticed “a significant increase in the population of animals”. Scientists have yet to unravel the mystery of the increase in marine life at the areas of volcanic activities.

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Moon, Volcanoes, and Earth

By: Nour Hany

When we think of volcanoes, we tend to consider them as a 100% earthly behavior; however, scientists have taken time to discover if there is something else urging volcanoes to erupt. In many research papers and for decades, philosophers and scientists have raised a remarkable question: Could the phases of the Moon control or predict volcanic eruptions? Every day, Earth's tides ebb and flow because of the gravitational tug of the Moon; if the Moon is capable of affecting water, causing waves, why cannot it affect the ground as well? From here, a study was conducted to investigate the Moon's ability to cause volcanic eruptions on Earth.

Based on geologists' beliefs, there is likely to be a connection between volcanic eruptions and Moon phases. They believe that when it is a full Moon, and the Moon and the Sun are both lined up behind Earth, or when it is a new Moon and it is placed between the Earth and the Sun, Earth's gravitational pull—also known as Earth's tide—is at its strongest condition and could set off a volcano. However, scientists are still not sure whether or not it can cause a volcano due to the lack of evidence; on the other hand, they say that it is very likely for tidal force to play an important role in indicating the exact time of when a major volcanic eruption might occur.

Volcanism on the Moon

Is Earth the only object in the universe that has volcanoes? Scientists believe that volcanism on the Moon has been there since the age of dinosaurs and for most of the 4600 million years of Moon's history. However, when first discovered, astronomers wrongly thought that they were looking at seas of lunar water, as the vast plains of basaltic lavas covered much of the lunar surface, and were deposited about millions of years ago, back when the Moon was wracked by violent eruptions.

NASA's Lunar Reconnaissance Orbiter (LRO) stated that the volcanic activity on the Moon did not stop abruptly a billion years ago; instead, it slowed gradually, providing researchers strong evidence to support their statement. We have long thought of the Moon as a cold, dead place; however, scientists discovered clues and evidence of dozens of burps of volcanic activity during the past 100 million years, which is considered a mere spot on the geological timescale. They also think that it is likely for an eruption to occur, but probably not within the human lifetime. Moreover, that discovery uncovered a place in which internal heat is still being released in fits and starts. Scientists also say that the Moon turned out to be warmer than they thought.

Ina

In 1971, aboard Apollo 15, a peculiar small crater on the Moon was photographed; it was so unique yet mysterious. No one knows its origins, nor its purpose; however, scientists have called it Ina, and started

raising assumptions and theories around its formation. One of those theories says that, in real volcanoes, calderas, as Ina, are caused when the material at the volcano's top collapses after magma from below drained away following an eruption. It is possible that, when Ina was sitting on the top of the low volcanic dome, it collapsed unevenly, and relatively recently, to form the patchwork, which exists now. Another theory says that trapped gases like carbon dioxide and water were heated to such high temperatures by magma from below that they violently blasted right through the crust. As a result, rock and debris hovered everywhere for miles.

A group of other researchers from the LRO mission gathered to agree that the two terrains of Ina are a contrast of both young and old. However, they do not think, as other scientists assume, that the brighter areas are as young as what was said before. Other high-resolution photos were taken from the orbiter, indicating the presence of a good number of craters there.

For astronomy lovers who are disappointed, thinking they cannot spot Ina unless they were Apollo 15 passengers, the good news is you can actually see it from right here on Earth. You can always do that via the ACT-REACT map, as most people do; however, if you are someone who is generally familiar with the Moon and have an 8-inch or larger telescope, choose a night when it is a quarter Moon, with calm air and no clouds, and you will probably be able to see it. As Ina becomes easily visible when light strikes it from a low angle; you should always use high power light while hunting for it.

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IS THE SKY REALLY BLUE?

By: Shahenda Ayman

A frequently asked question by children is “Why is the sky blue?” Some answer “because it reflects the color of the ocean”, while others assume that this is because the oxygen is a blue-colored gas. However, if you do a quick search on the Internet, you will find that the sky is blue because of three simple factors: (1) sunlight is made out of light of many different wavelengths, (2) the Earth’s atmosphere is made out of molecules that scatter different-wavelength light by different amounts, and (3) how our eyes perceive light.

As proved by Sir Isaac Newton with a triangular prism, when light passes through a prism; it breaks the white light into its constituent colors: red, orange, yellow, green, blue, indigo, and violet. Each color has a different wavelength like a unique fingerprint of its own, so when it passes through the prism, it travels at different speeds and refracts at different angles.

When the sunlight reaches the Earth’s atmosphere, it is scattered in all directions by all the gases and particles in the air. The white light from the Sun passes through the atmosphere; colors with longer wavelengths—such as red, orange, and yellow—pass through, while blue and violet wavelengths are absorbed by the gas molecules and are scattered across the sky. Your eyes see these reflected wavelengths as blue color because blue and violet are just the right wavelengths to bounce off the particles of gas in the atmosphere, so they get separated from the other colors making the sky appear blue to us.

Since scattering by the atmosphere causes the sky to be blue, a planet with no atmosphere cannot have a bright sky. The Moon’s atmosphere is so thin; when the air is too thin, gas molecules do not collide with each other. As a result, sunlight is not scattered and, whether it is daytime or nighttime on the Moon, the sky appears black. This was proven by the photographs taken by Apollo astronauts on the Moon, showing a completely dark sky in all directions during daylight.

Likewise, Mars has a very thin atmosphere mostly made of carbon dioxide and filled with fine dust particles; these fine particles scatter light differently than the gases and particles in Earth’s atmosphere. Photos from NASA’s rovers and landers on Mars have shown the opposite of what you would experience on Earth. During daytime, the Martian sky takes on an orange or reddish color; but, as the Sun sets, the sky around the Sun begins to take on a blue-gray tone.

The blue color of the sky is a result of a specific type of scattering called Rayleigh scattering; this type of scattering

depends on the wavelength of light and it scatters light off particles that are no bigger than one-tenth the wavelength of the light. In the lower atmosphere, tiny oxygen and nitrogen molecules scatter short-wavelength light—such as blue and violet light—to a far greater degree than long-wavelength light—such as red and yellow.

If both blue and violet have short-wave lengths, why do we see the sky blue and not violet although the atmospheric particles scatter violet more than blue? The answer is simply because some of the violet light is absorbed in the upper atmosphere and our eyes are more sensitive to blue light than violet.

When the Sun is high in the sky, the sky appears a brighter blue because there is more atmosphere to see in those directions and therefore, more blue light. During sunrise/sunset or moonrise/moonset, the light coming from the Sun, or the Moon, has to pass through tremendous amounts of atmosphere; the closer to the horizon it is, the more atmosphere the light must pass through. While the blue light gets scattered in all directions, the red light scatters much less efficiently. This means that both the light from the Sun’s disk, or Moon’s, turns to a reddish color, but also the light from the neighborhood of the Sun and Moon—the light that hits the atmosphere and scatters just once before reaching our eyes—is reddened at that time.

In addition to the scattering of light in the atmosphere, our eyes have a specific technique to perceive colors. The eyes have three types of cones for detecting colors, in addition to the monochromatic rods; when it comes to detecting a color, our brain receives signals from all four to be interpreted into a color. Each type of cone, and the rods, are sensitive to the light of a different wavelength. Our eyes respond more strongly to blue, cyan, and green wavelengths of light than they do to violet; even if there is more violet light, it is not enough to overcome the strong blue signal our brains deliver.

The next time you are asked why the sky is blue, you will probably know what to say without hesitation. The sky is just our atmosphere as we see it from underneath, in addition to the sensitivity of our eyes to colors. If there was no scattering or absorption, the sky would appear black in the day time and if there was more absorption or scattering going, the sky might appear to be yellow, orange, or red all day long

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Horizon

Where Sky and Earth Meet

By: Fatma Asiel

The horizon is the apparent line separating the sky from Earth, or the boundary that makes the sky and Earth appear to intersect. In Astronomy, it is also defined as the intersection of a plane perpendicular to a vertical line with the celestial sphere—a hypothetical sphere of infinite radius and concentric with Earth, encompassing all celestial bodies. However, do you know that there are several types of horizons? What are they? What is the difference between them? What is the importance of horizons in navigation? How far is the horizon?

Horizons have two main types: the first is the “geoidal celestial horizon”, which is the horizon that an ordinary person can see by the naked eye, because it is completely visible no matter how far it is; it is, in turn, divided to several types. First, the nautical horizon is the geographic horizon at the sea surface and is the most common type of horizons; it can be clearly seen at seashores when the sea intersects with the sky within sight. If you are standing on the seashore at a flat location, the intersecting point between the sea and the horizon is called offing. Second, the local or geometric horizon is less common than the nautical horizon, as it is not observed by many people despite being visible; it includes buildings, trees, and highlands. Third, the geographic horizon is the visible line

between the sky and the Earth; it does not include what is previously mentioned.

The second main type of horizon is the “celestial horizon”; it is divided in turn into two types. The first is the astronomical horizon, which is a hypothetical horizon tilted at a 90 degrees angle; the second is the true horizon. Both types are used as reference to astronomers, to identify a specific location, whether on the surface of the Earth or on the surface of any other celestial body, or to identify the location of the Earth itself from the sky.

From this perspective, we find that the horizon has a great importance; as mentioned before, the celestial horizons are used in positioning, but it is not just about that. Horizons have a significant importance on several fronts; such as in aerial and maritime navigation. Pilots sometimes turn to horizon to maintain the level of the plane during flight; through simple calculations to distinguish the correlation between the front of the plane or the front end, the pilot can control the plane’s altitude more accurately.

It is known that ancient sailors resorted to the stars and celestial constellations to set the direction of their ships; however, most stars and constellations only appear at night, so they depend more on the horizon to set directions in daylight. With the tremendous development in the use of the Global Positioning System (GPS) in defining directions, the use of the horizon is currently limited in this field.

How far is the horizon?

It is not difficult to identify the distance between us and the horizon, because it is not an estimation as some people think; it

must be borne in mind that the higher the location of detecting the horizon is from the sea, the farther the distance of the horizon is. For example, if a person stands at sea level, the horizon is about five kilometers away; whenever the person rises 1.5 meters above sea level, the distance between the person and the horizon increases by 4.5 kilometers, so, if a person stands on the summit of Everest, which rises above sea level 8,848 meters, then the horizon will be 370 kilometers far.

All the previously mentioned numbers are an approximation, except the height of the summit of Everest; this is due to the presence of many factors that may influence the accuracy of identifying the distance of the horizon, including the weather, the clouds, and light refraction. Experiments proved that the cold weather can make the horizon look farther, and the clouds obscure observing the horizon clearly.

The horizon is not just a breathtaking natural scene we experience on seashores, and it is not a mere inspiration for artists, but a scientific term of many types and major astronomical significance. It has helped ancient sailors set their directions, and helps modern-day scientists in many fields

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NOCTURNAL ANIMALS:

When Stars Guide the Way

By: Nour Hany

Have you ever wondered what would happen if you got lost in the desert? What if you have nothing to light up the dark except for groups of stars dispersed in the night sky? Well, that will not be a problem if you were a dung beetle, a bird, or even a seal. Getting lost in the desert could be fatal for those who do not have navigation mechanisms—the ability to find the way accurately without maps or instruments. How exactly can stars help some creatures find their way through the dark?

Nocturnal Magic

Nocturnal animals are those who become active at night for several reasons; migrating, hunting, mating, or foraging. They take night as a way of protection from predators, the burning Sun, or other elements threatening their safety. That is when all the magic happens.

Based on a study from Lund University in Sweden, nocturnal animals follow groups of stars and observe individual stars to guide their way. This ability is not as easy as it seems, it is actually very complicated and requires a more thorough investigation. It is worth mentioning that each species has its own way of navigation. For example, some animal species along with humans have camera eyes that make them navigate similarly and observe individual stars. On the other hand, insects have compound eyes that help them navigate using a completely different method.

Avian GPS

Birds' migration is always taken for granted; yet, it is an impressive and quite intelligent procedure. While some birds use Earth's magnetic field to navigate, others are guided by the Moon and the sky to

show them the way. Scientists concluded that birds identify the starry sky's center of rotation during their orientation process. This orientation strategy could be used at any hour of any night.

Wildly-caught birds were brought to the Longway Planetarium to study their orientation strategies. The experiment revealed some very interesting information; for indigo buntings, it does not really matter whether or not they can see individual stars, as they are more concerned with seeing the rotation of close star patterns around a center point. In the wild, this enables them to detect the direction of north, and they use that piece of information to head south for their winter migration.

Milky Way Orientation

Surprisingly, scientists discovered that, not only animals and birds can navigate, but these abilities also exist in insects. As previously mentioned, insects, such as dung beetles, have compound eyes. This means they cannot observe individual stars, as their eyes are too small to see them; instead, they navigate using the light that comes from the Milky Way to know the correct direction, making them the only

insects known to orient by the galaxy. Not only that, dung beetle's ability to navigate using polarization patterns in moonlight, makes it the first animal known to use this method for orientation. What makes all this truly incredible is that this dung beetle is a very small creature with a brain the size of a grain of rice; yet, it has an impressive ability that most of us dream of having.

Hidden Navigational Intelligence

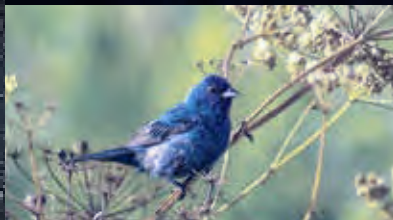
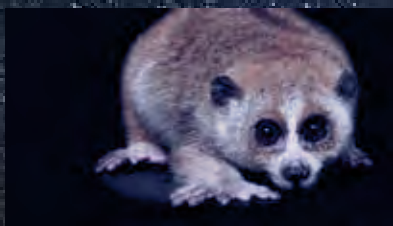
The story of harbor seals, these friendly marine mammals, does not stop at being cute and funny, there is so much more! As they consume much of their time foraging for food at night without terrestrial landmarks, an experiment had to be conducted to investigate the seals' navigational abilities. In 2006, two captive seals from the Marine Science Center in Germany were placed in a floating planetarium, specifically constructed for them. The two pinnipeds, Nick and Matte, were trained to swim in specific lodestars' direction. It was then discovered that both of them were able to identify a single star out of a realistic projection of the Northern Hemisphere night sky. These results indicate that seals might use specific lodestars as navigational cues to walk far from shore; this makes it the first scientific evidence of a marine mammal orienting by the stars.

The Maori

Once upon a time, humans could navigate too! A primitive tribe from Eastern Polynesia, named the Maori, arrived at New Zealand between the years 1280–1300. They did not carry any instruments or tables to consult; instead, they depended

CONNECT THE DOTS!

By: Esraa Ali



completely on the sky as their guide. Their navigational process relied on observing the night sky, local weather patterns, and ocean currents, to reach their destination.

Fascinating! In the time of GPS, maps, and navigational technology, it is almost impossible to see a human being naturally navigating. Does it mean that we can no longer navigate on our own as animals do? Actually, we can; just like any other skill, navigation needs practice. We were born with a navigational instinct; however, due to the technological development, we stopped using our stellar orientation skills gradually until we no longer know how to do that.

Some passionate navigators take time to teach others how to do a tech-free navigation, based on their experience. If you are also passionate and want to reach your deepest hidden instincts, read *The Natural Navigator* book.

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Have you ever looked at a cloud in a nice clear morning sky and tried to figure out the shape it looks like? Well, for thousands of years, people have done the same but with stars in the night sky.

The night sky is a treasure-trove of stories of heroes, animals, and objects of their adventures. If you observe the sky on a dark night, you will see a huge number of stars that you probably cannot count; some are bright and others are darker, based on your location on Earth. The more you look, the more things you see using your imagination; if you use binoculars or a telescope, you will see even much more!

People all over the world and throughout time have seen different images by connecting the dots between each group of stars. From the easily recognizable Ursa Major (Great Bear), to the trickier Cancer (Crab), each astronomical pattern, known as "constellation", is formed by a group of stars in our Milky Way galaxy. Constellations aid astronomers in locating objects in the sky by splitting the celestial sphere into different sections, similar to maps.

There are eighty-eight official constellations listed by the International Astronomical Union in 1930. About forty-eight constellations are "ancient", as they were known to ancient civilizations, such as the Greek, Roman, and ancient Middle Eastern cultures. They recorded the movements in the sky that influence day and night, time and seasons, tides and weather; star grouping helped them mark the passage of time between planting and harvesting. The ancient constellations are regarded as the brightest star groupings and could be observed easily by the unaided eye, such as Andromeda (Chained Lady) and Draco (Dragon).

In the age of world navigation and great discoveries, people started to identify new parts of the sky, where large gaps were filled up with stars. In more recent times, the sky has been explored using modern equipment,

and the rest of constellations were identified by astronomers. They connected the dimmer stars between the ancient constellations, and discovered "modern" ones, such as Pavo (Peacock) and Telescopium (Telescope). That is why, when astronomers talk about constellations, they do not only mean a few stars that look similar to a certain shape, but they consider everything in that part of the night sky.

Although there are billions of stars distributed in space, only a fraction of them form our constellations. These stars vary greatly in size, temperature, and distance from Earth although they appear in the same part of the night sky. As Earth spins around its axis, the stars appear to move across our night sky from East to West; exactly like our perception of the Sun rising in the East and setting in the West. By observing the different constellations through the year, they shift gradually to the West due to the Earth's orbit around the Sun. That is why stargazers of the night sky during the summer look at a different direction in space than they do in winter.

If you have not practiced any night-sky-related activities before, I encourage you to undertake some; to play, learn, and explore. As an activity, you can look at a certain star in the sky and try to find its related constellation. Still, with a bit of imagination, you can create your own story.

Nevertheless, reading and storytelling of ancient mythologies on how constellations came to be, and how different cultures have created stories about them, is also interesting for both adults and young people.

Star groupings are indeed a great source of entertainment and inspiration. They do not only help the lost find their way, or aid amateur astronomers; they can invade your mind and soul with a sense of timeless wonder. The next time you are outside on a clear night, look up at the night sky, and connect the dots!

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By: Maissa Azab

It is not a revelation dear reader that both Earth and Sky have played an expansive role in all artistic forms, especially visual arts. Naturally, they feature prominently in land- and seascapes, mostly as background to the main subject. In some cases, however, such as in the spectacular *Starry Night* of van Gogh, the sky is the subject; albeit solely for artistic expression of the artist's tormented psyche.

Earthy elements also have been the subject of several significant artworks in van Gogh's repertoire, and that of countless artists throughout history. Beyond aesthetics and emotional expression, art has also been intertwined with astronomy and earth sciences.

Blast from the Past



Since the dawn of time, the night sky has been an essential tool for timekeeping and navigation; as a result, some of the oldest human cultural artifacts involve astronomy. According to a study published in November 2018, in *The Athens Journal of*

REVEALING the Science Shrouded in Art

History, cave paintings suggest that, perhaps as far back as 40,000 years ago, cave-dwellers in what are now France, Germany, Spain, and Turkey, had relatively advanced knowledge of astronomy and kept track of time using knowledge of how the position of the stars slowly changes over thousands of years. Researchers now believe that the animal symbols in cave paintings actually represent star constellations in the night sky, and were used to mark dates and events.

Researchers from the Universities of Edinburgh and Kent studied details of Paleolithic and Neolithic art featuring animal symbols at cave sites and found they all used the same method of date-keeping based on sophisticated astronomy, even though the art was separated in time by tens of thousands of years. The team confirmed their findings by comparing the age of many examples of cave art—known from chemically dating the paints used—with the positions of stars in Ancient Times as predicted by sophisticated software.

When Seen by a Genius



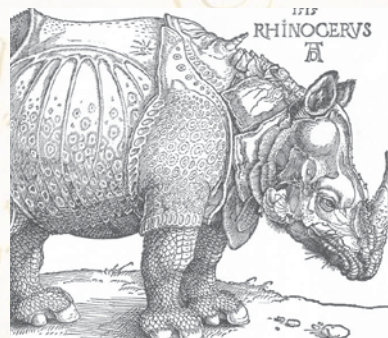
In his 16th-century *Codex Leicester*—currently the most expensive manuscript in the world, having been purchased by Bill Gates in 1994 for USD 30.8 million—Leonardo da Vinci focuses on earthly matters, such as geology and paleontology; still, he discusses the “ashen glow” of the

Moon. The phenomenon da Vinci is referring to is the ghostly glow of the Moon's full orb visible as a backdrop to the brightly lit horns of the crescent Moon. People had observed this phenomenon for centuries, but he was the first to conceive that it was caused by sunlight reflecting off Earth and onto the Moon, faintly illuminating the otherwise unlit portion of the lunar surface.

The concept of earthshine is, of course, present in other planet-moon systems, and astronomers have generalized “planetshine” to incorporate systems revealing moons otherwise not visible because they do not reflect enough direct sunlight. For instance, using the Cassini probe, scientists took advantage of the reflected light from Saturn to detect some of its satellites. Another modern application of earthshine includes defining the reflectance of Earth's vegetation, which can then be established as a biomarker for detecting potential life on other planets.

Leonardo's understanding of earthshine is remarkable because he lived in a time when most people misunderstood the nature of the solar system, believing the Sun, Moon, and planets orbited Earth. His correct conclusion about the cause of earthshine, despite this global ignorance, is one of many examples of his brilliance and foresight.

A Hidden Figure





A contemporary of da Vinci, the supremely gifted and versatile Albrecht Dürer was arguably the greatest German artist of the Northern Renaissance, famed for his masterful woodcuts, engravings, watercolors, and oils. Dürer was more than an artist, said Harvard art historian Susan Dackerman; in fact, he greatly influenced 16th-century science with his cartographic and anatomical work. It was so innovative, she said, that it shows Dürer as a science collaborator; an equal partner in creating knowledge, not simply charged with depicting it.

“His influence on the astronomy of the day was profound”, Dackerman said, “and helped visualize changing conceptions of the universe”. In a radical departure, Dürer used the same maps to move mankind to the center of the depicted science, replacing allegorical figures like Venus and Mars with portraits of four ancient astronomers, including Aratos and Ptolemy. “Dürer’s astronomers represent a changing worldview, one in which the universe is comprehended through human intervention rather than through spiritual or symbolic means.”

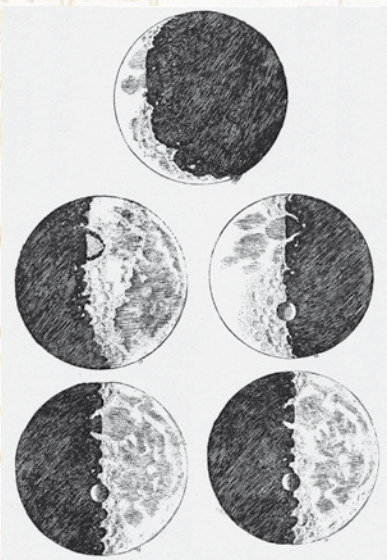
Dürer was 25 years old when the syphilis broadsheet appeared in 1496, including a swirl of planets above the victim’s head—Dürer’s collaborator, Nuremberg physician Dirk van Ulsem, believed syphilis was caused by a misalignment of the planets. The science was off, but not the young Dürer’s art, right down to the figure’s lumpy lesions and red, swollen face; proof yet again of an artistic partnership with science, said Dackerman, though this time in the realm of medicine.

The artist’s iconic rhinoceros woodcut was so enduring it was the animal’s staple scientific image until the 18th century; it was rendered from a sketch and a description of the animal. Dürer never saw the animal itself; yet, his depiction, including fanciful armor plating, scalloped edges, and an inaccurately placed dorsal horn, showed another dimension of the artist’s relationship with science, where his skills of making are rendered equal to, or better than, the results of direct observation.

Dürer is also famed for a groundbreaking terrestrial map; “the first perspectival rendering of a terrestrial hemisphere”, which greatly influenced the cartography of his time. It required knowledge of geometry and calculations that enabled him to depict a two-dimensional surface as if it were a globe. Indeed, he wrote an introductory manual of

geometric theory for students, which includes the first scientific treatment of perspective by a northern European artist. He also wrote *Four Books of Human Proportion*, only the first of which was published during his lifetime (1528).

The Interstellar



Art and science came together in the hands of the most famous astronomer in history, Galileo Galilei, whose careful drawings of the moons of Jupiter and the star fields of the Milky Way cemented the Copernican Revolution. By showing the Moon to not only have craters, but also features like valleys and mountains, he supported the “many worlds” idea that the Earth is not unique as a geological body in space.

As a young man, Galileo Galilei considered becoming a painter; he acquired extensive knowledge of perspective from Ostilio Ricci, the court mathematician in Florence. Galileo was a close friend of the painter Lodovico Cigoli, and was in great demand as an art critic; his trained eye and practice in drawing proved to be extremely useful when he suddenly turned to the study of astronomy at the age of 45.

Galileo was not the first scientist to observe the Moon through a telescope; Englishman Thomas Harriot did so a few months earlier, but Galileo built better telescopes using top-quality lenses. Galileo saw more and drew what he saw, delineating the features of the Moon’s landscape, its mountains and craters. German art historian

Horst Bredekamp contends that Galileo’s mastery of the modulation of light and shadow made drawing an instrument of learning for the great scientist, as well as a method of documentation.

The author of *Galileo the Artist* argues for the extent to which the astronomer’s artistic talent furthered his scientific achievements, as also illustrated by his discovery of sunspots, detailed in the second part of the book. Galileo studied these cloud-like structures on the surface of the Sun through drawings he made around 1612. Much as with the Moon, this solar phenomenon had previously been misidentified; this time by Jesuit astronomer Christoph Scheiner, who thought that they were heavenly bodies orbiting the Sun. Galileo’s sunspot drawings, Bredekamp argues convincingly, enabled him to discover that the Sun, like the Moon, is not the perfect sphere that Aristotle had claimed.

An Eternal Bond

Before photography, the only way to represent objects in the sky was through a drawing or a painting; artists of the past helped astronomers see and record natural phenomena. Indeed, art has long communicated ideas that have led to advances in visualizing remote and unfamiliar environments; even in the age of digital imagery, art is important for connecting us to the skies.

The sky, as seen by the naked eye, is limited to the Sun and the Moon, five planets that appear as little more than dots, a few dozen nebulae and star clusters, three galaxies, and the ragged beauty of the Milky Way. Modern telescopes provide astronomers enormous light grasp, but they are still limited by what telescopes can see and cameras can record. More fundamentally, our view of the universe is limited by our position in time and space. An artist can visualize a scene that no telescope or spacecraft will ever see: the fog deep within a star formation region, the event horizon of an accreting black hole, or the surface of an Earth-like exoplanet.

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The Sky and Earth

From an Artist's Point of View

By: Mahmoud Hagra

Head, Temporary Exhibitions Unit, BA Art Exhibitions and Collections Department

Since the beginning of time, the relationship between sky and earth has occupied human thought and imagination; it has always been a topic for various artistic works that express the artist's interpretation of this relationship.



Going back to the ancient Egyptian artist who was influenced by the legend of the creation of the universe, watching the Milky Way in the sky, and his belief in god Ra; he illustrated the sky as a beautiful woman whose body was inlaid with stars and called her Nut. He also imagined the Earth as a reclining man called Geb; both were the children of the god of wind and air Shu and the goddess of moisture Tefnut. When Nut and Geb married, Osiris, Isis, Set, and Nephthys were born, until their father Shu separated them. The artist imagined him a man holding the sky with his hands, wearing a crown with a feather symbol.

In many ancient Egyptians tombs, the ceilings are decorated with the color of water at night and studded with stars, as if the mother is protecting with her body the deceased in their graves. If you gaze at the sky on a winter day with the clouds filling the sky and sunlight penetrating them, you will notice this hierarchical shape that the ancient Egyptian artist imagined as the hand of Ra spreading goodness and growth in Earth. This was also the inspiration behind the construction of the Great Pyramids, one of the

Seven Wonders of the Ancient World; some scientists confirm the consistency of the Pyramids construction with the position of some stars in the sky. The ancient Egyptian artist also carved numerous obelisks that stand vertically with pyramidal tops, as if pointing to the sky.

With the descent of Abrahamic scriptures through the Prophets emerged the human belief and understanding of God creating the Earth, the Sky, and Adam—peace be upon him—and how Adam and his wife descended from Heaven to Earth, strengthening the human belief that heaven is in the sky, which increased humans' affinity to and bond with the sky. As a result, cathedral towers and mosque minarets penetrate the sky, as if elevating the people's voice to it; perhaps, the "Malwiya" minaret of Iraq is the best-known example and is considered one of the most important ancient Iraqi antiquities. The minaret of the Great Mosque of Samarra was built by Al-Mutawakkil billāh Abbasi in 237 AH. Its name was derived from its spiral cylindrical shape; it is built with clay at a height of about 52 meters, and surrounded from the outside by a 2-meter-wide spiral staircase that wraps the minaret's body counterclockwise, with 399 stairs. At the top of the minaret, there is a layer that the people of Samarra call the "Gown", which the muezzin ascends to call for prayer.



The famous minaret of the Ahmed Ibn Tulun Mosque in Cairo was inspired by this spiral minaret. The paths of Old Islamic Cairo included numerous minarets elevating the people's voice to the sky, the most famous of which is the minaret of Al-Azhar Mosque, the double minaret, which was built during the reign of

Qansuh al-Ghuri, closely resembling the shape of human hands held up for *dua*. Likewise, the minaret of Al-Hussein Mosque, which is a cylindrical minaret ending with a cone, is similar to a pencil or a rocket, as if awaiting departure to the sky. Perhaps the balconies that adorn mosques are what most express the desire to communicate with the sky. The most important and most famous such balconies are those in the Ahmed bin Tulun Mosque, which resemble paper dolls “*arais*”, raising their hands in prayer and supplication to God, as well as the Sultan Hassan and Al-Hakim bi-Amr Allah balconies, which represent decorative patterns symbolizing the connection between Sky and Earth.



Until now, the relationship between Sky and Earth continues to inspire artists; one of the most famous such artworks is the work of the Roman artist Constantin Brancusi entitled *Endless Column*, because it is the best evidence of the artist’s passion for the connection between Sky and Earth. The artwork is a 30-meter-high column consisting of 17 equal-angle geometrical shapes, as if carrying the Sky and connecting us to it.

Today, we are witnessing a daunting amount of huge architectural buildings known as skyscrapers, through which countries compete to build the tallest buildings; perhaps the most famous is Burj Khalifa in the United Arab Emirates with a height reaching about 828 meters, and the Mekka Clock Tower in Saudi Arabia with a height of 601 meters (you may be interested to read the list of the tallest buildings in the world on Wikipedia). As time passes, we realize that humans are always seeking to reach for the Sky and to connect it to Earth.

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Earth and Sky

Between Myth and Science

By: Basma Fawzy

Myths cover almost every area under the Sun. When humans wondered where echoes came from, we came up with the story of a girl named Echo that Zeus, the king of the gods in Greek mythology, fell for, to punish her; Zeus’s wife, Hera, made her repeat only the last words that she hears. Years later, science came to explain that we hear the echo because sound waves are reflected back. Let us discover what science has to say about these myths.

Humanity has always been curious about its place in the universe, the origins of planet Earth, etc. When humans could not find out the truth, they came up with myths. A recurring pattern in ancient mythology about the Earth and the sky is that they are almost always referred to as a mother and a father: the sky as the father and Earth as the mother. Both were seen as related, complementary to each other and responsible for life on Earth.

In other words, before science, there was myth, and when science emerged, myth subsided. Although the study of the Solar System, the outer space, and the Earth’s crust has come a long way, science is unable to specify exactly how Earth was formed. There are, however, some theories based on the information we know so far. The two theories about the formation of planet Earth are core accretion and the disk instability method.

The most famous and accepted theory is core accretion. According to this theory, the Solar System was nothing but gas and dust; due to the effect of gravity, material collapsed on itself, forming the Sun. Other heavy material came together forming our planet Earth billions of years ago. Myths were right about one thing: a strong attraction binds the sky (Uranus) and Earth (Gaia) together. It is not love though, but gravity; this strong attraction force keeps the planets in orbit and ensures the Moon does not roam far from Earth. It is what causes tides and is responsible for the creation of stars and planets. It is worth mentioning that Newton published his theory about gravity in 1687.

The Sun does not linger in the sky all day; it disappears at night. The ancients wondered where the Sun went; because of that, in mythology, the Sun is always depicted as a god or goddess riding a chariot or a boat, hence, always moving. It took human beings years to find out that the Sun does not go anywhere, but the Earth rotates around it; a fact that was emphasized by many scientists who said the Sun, not Earth, was the center of the Solar System.

When we look at the sky, we see the stars; in ancient mythology, however, stars were nothing but the daughters of the Titan Atlas, who were turned into stars by Zeus. According to science, the stars are gigantic “celestial bodies” that consist of helium and hydrogen. They produce light and heat; they are light years away from Earth and that is why they look so tiny in the sky.

Our understanding of the universe is not complete. Science has yet to unravel a lot of mysteries about the Earth and the sky. With time, science will bust a lot of myths.

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Earth and Sky

Myths Aside...

By: Dr. Omar Fikry

Head, Planetarium Section, BA Planetarium Science Center

There are lots of myths from all over the world about Earth and Sky; some are significant sources of storytelling and intellectual enjoyment, but they remain just tales and interpretations of thinkers and philosophers, whom history has praised. In these myths, the perceptions of ancient civilizations about Earth's formation and its relation to the Sky converged. Whoever wishes to know about these myths has only to read some books about Greek, Roman, and Ancient Japanese mythologies, in addition to Ancient Egyptian beliefs about Earth's parthenogenesis, or the sacred marriage of Earth and Sky.

I will not tackle these myths in my article; I will rather take you, dear readers, on a journey that begins from the smallest particles on Earth to the massive world of the Sky. Following the tremendous development of elementary particles science and cosmology, we have become able to identify the common force between the finest life components on Earth, and the largest celestial bodies in the universe. Let Us Start!

The journey starts inside the nucleus of an atom, where quarks vibrate with astonishing speed—up to 99.9% the speed of light. They form opposite pairs to equate the number of protons in any atomic nucleus with the number of positively charged neutrons in an almost infinitely small space—about 99.999999999996% empty space. In simple terms, we would say: if Earth is the size of an atom, a proton or an atomic nucleus will be about 65 meters only.

As we move outside the atomic nucleus and its space, we meet the first energy level of electrons at a great distance; in other words, if the nucleus is the size of a basketball, we will need to move 3.5 km to reach that level. The simplest atom on Earth is that of hydrogen; it has a volume of about 6.2×10^{-31} cubic meters. It is known to many that atoms make up the molecules, which form elements that in turn form objects; for example, a rose, which will be our next stop in this journey as we take a huge leap towards the farthest reach of the universe.

From this beautiful rose, the diameter of which is about 10 cm, on the Plaza of the New Library of Alexandria—a distinctive landmark of civilization in Alexandria with an area of 41,000 m²—we can see the borders of the Governorate, which forms an area of 2,679 km² on Earth. As we take off, we will see the Arab Republic of Egypt, which has an area of about one million km²; Africa, which has an area of

about 30.5 million km²; and our beautiful blue planet, which has a diameter of about 12,742 km, amid the darkness of space.

If we go farther in the sky, we will reach the orbit of the Moon, which has a diameter of 100,000 km, then we will reach the nearest asteroids orbiting cross Mars and the borders of the inner planets in our solar system, over a distance of 100 million km. The journey will become even more mysterious, as we see the borders of the outer planets at one billion km. At the second planetoid belt, known as the "Kuiper Belt", we will have traveled 10 billion km. Then, we will meet Sedna, the dwarf planet, which is 100 billion km away. Now, we reach the boundary of the inner Oort cloud—the main repository of comets in the solar system—at a distance of one trillion km; at its outer boundary, we will have traveled a distance of one light-year.

By reaching the nearest star to Earth, Alpha Centauri, we will have traveled 4.2 light-years, then we reach the local interstellar cloud at a distance of 100 light-years. Now, we are at the boundaries of the spiral arms of our Galaxy, at a distance of 10,000 light-years. When we see the boundaries of our galaxy in its famous form, we will be at a distance of 100,000 light-years from the beautiful rose in the New Library of Alexandria; yet, we will not have reached the end.

After exceeding the boundaries of our Galaxy, at a distance of 2 million light-years, we find the nearest galaxy to us, our neighbor: Andromeda Galaxy. At a distance of 10 million light-years from this spot, we will be at the Local Group of galaxies; our galactic neighborhood. Remember, a little while ago, we were inside the nucleus of the atom, but now we are almost halfway to reach the farthest reaches of the universe. In other words, we are at the limits of the objects we only know in the sky, thus far, which are the quasars and superconducting cosmic strings. After that lies an identical universe and a void, which we cannot realize today.

The linking force of the quarks inside an atomic nucleus, is the same linking force of electrons in the nucleus, and of molecules together. This force is a form of gravity, which pulls the Moon to the Earth, the planets to the Sun, the stars to the center of the Galaxy, and the galaxies together. Einstein attempted to link these forces together and to unite them in one power, but it remained a mysterious secret. Several scientists, following Einstein, have tried to uncover this link; nevertheless, this Earth–Sky relationship is a great mystery awaiting to be solved, completely diverging from the tales of ancient legends.



Drones: Planes Without Pilots

By: Naglaa Hassan

A "plane without pilot" is a flying robot that can be controlled remotely to divert its path or fly straight ahead, using the programs existing on its integrated systems by directing signals to the plane's sensors.

These planes acquired their name, drones, from bees; basically because the sound it makes as it works sounds very much like that of a group of male bees. Controlling drones sounds easy, with a remote control device and GPS; however, the truth is that it is much more complicated than that.

Drones work by electricity; they contain electric batteries supplying it with power. Drones move vertically first, using rotor blades that push the air down. As every action has a reaction equal to it but opposite in the direction, the air exerts the same amount of force in the opposite direction, which is the direction of rotors or fans, which then push the plane up. The greater the speed of the blades' spinning, the higher the plane rises; that is the main idea of how all upward and downward forces work. As such, the drone masters three vertical movements: flying, ascending, and descending.

For the plane to keep on flying, the forces' outcome of the four rotors that work on pushing the plane up must equal those of Earth's gravity, which pulls the plane down. To rise, the power of the blades that pushes the plane (its spinning speed) must increase to exceed the gravitational speed or what is known as weight force, and vice versa with the landing.

Benefits and Applications

Drones have countless benefits; for example, they can be used in geographical survey and mapping, where it is less expensive than traditional methods. Moreover, it is fast, works in different weather conditions, and covers vast areas. They can also discover groundwater using infrared rays, and in following up on construction work second by second; to know the exact time of imbalance and quickly interfere.

Using drones in search and rescue at the sites of natural disasters is one of the most important applications; it can help in the four stages of the disaster: prevention, preparation, responding, and recovering. They can be used in exploring and mapping before the disaster, as well as in structural assessment, discovering debris, and firefighting operations. They are useful in the locations of chemical, radiological, or nuclear leaks; in reporting on weather conditions in the polluted locations, which are considered dangerous for humans, such as forest fires and nuclear pollution.

After the disaster, drones contribute in search and rescue operations by locating survivors faster, analyzing the structure of damaged infrastructure, delivering supplements and equipment, assisting in evacuations, transporting casualties, in addition to protecting the rescue team from the dangers of being in these locations. That is all on top of difficult photography angles and their ability to spread and reach dangerous locations.

Defects and Dangers

Drones have numerous advantages; yet, they also have serious disadvantages. It threatens privacies and freedoms, because it comes in different shapes and sizes. In very small sizes, they can be used to spy on other people's lives without being noticed, with unknown sources or owners. This is in addition to a number of technical defects, such as short flight time, being easily affected by the weather, the possibility of crashing into people, buildings, or cultural sites, as well as entering areas where it is not allowed to fly, or when some try to use it in illegal procedures, such as smuggling drugs.

Drones need laws and regulations to organise their use, just as all the other modern fascinating techniques in our time.

Without a doubt, drones are one of the best inventions of modern technology. They have countless features and applications, as well as numerous defects and dangers that raise concerns and urge us to carefully deal with this technology, in order to make the best advantage out of it while limiting its defects as much as possible.

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Could A BLACK HOLE Bring THE END OF THE WORLD?

By: Mostafa Abo-Elmakarem

Black holes are a big concern; not just for NASA scientists, but for the whole world. The biggest question is: What would happen if a black hole reached us? Would it be our doom?

A black hole is most likely described to be a result of a dying star, or as it might be called “star dust”; black holes are one of the most dangerous objects, as they can be illustrated as giant cosmic vacuum cleaners. Having a gravitational force that is so strong that even light goes through it, is what makes them dangerous. These former stars or star dust have been the concern of many scientists, so they observe them and their surroundings with special telescopes.

What are the types of black holes?

Black holes have three types: stellar, supermassive, and intermediate-mass. The stellar type is the smallest; it is mainly formed out of a supernova—a super-powerful and luminous explosion of a star. Stellar black holes are all around our galaxy; the most distant one ever detected is about 13.1 billion light-years from Earth, so it cannot do us any harm. Each typically has a mass between about three and ten solar masses—a solar mass is a standard unit used in astronomy, defined as the mass of our Sun, and equals approximately 2×10^{30} kg.

The supermassive type, on the other hand, is mostly found in the center of

most galaxies, including our Milky Way. This type is colossally heavy, and has a mass range of more than millions, even billions, of solar masses. Scientists believe they are incredibly massive due to their centered presence in the galaxies. This particular type of black holes has the tendency of growing into heavier ones as the galaxies merge, making them the most dangerous type of black holes.

The third type is the Intermediate-Mass Black Hole (IMBH), which is estimated to have a mass between one-hundred and one-thousand solar masses. This type cannot be out of just a single star dust; it is believed that it might be formed by a single black hole devouring so many objects, or even merging with another black hole; leaving grand problems to scientists that have no answers until now.

Will our Sun become a black hole?

Some studies were conducted to show what would happen if the Sun became a black hole at some point of its existence. Those hypothetical studies claimed that, should the Sun become a black hole, Earth would fall into total darkness, and everything would immediately freeze.

However, the Sun will never turn into a black hole, because it is said to have less mass than needed to turn into one. When the Sun is about to reach its end and run out of its fuel, it will automatically throw off outer layers turning into a glowing gas ring known as a “planetary nebula”. After reaching this stage, there will only be a white dwarf star, which is a star of relatively small size.

Is Earth next on schedule?

Black holes obey the laws of gravity, which were first introduced to the world by the great scientist Isaac Newton. As stated in his law, there is a force that attracts all bodies making them move in calculated directions and measured speeds depending on the mass of those bodies.

That said, black holes cannot just wander the outer space or the universe swallowing planets that stand in their way. In order for a black hole to affect Earth, it needs to be so close to the solar system, which rarely happens. Even if our Sun is replaced by a black hole with the same mass, Earth would totally be in its normal position as the black hole will keep the same gravity as the Sun.



Why are scientists concerned?

Black holes may be thought of as far and distant objects of concern; nothing to worry about here and now. Yet, it might be a closer concern than we think, as groups of scientists studying black holes are managing to create one for an experiment! People fear that this might bring about the end of our world.

Researchers state that studying the mystery of those astonishing black holes is real fun, and will definitely lead to new discoveries that might be in great use to us. Some arguments by the famous physicist Stephen Hawking made scientists conclude that those tiny black holes would only stay for a tiny bit of time before they permanently vanish. Theoretically, they would immediately disappear, but what if they did not? What if they managed to stay for much longer? Would we be doomed then?

Of course not; those black holes would be moving so fast that they will head to outer space. Some of them would be moving slower than others, which is far from happening; they will be trapped on Earth due to its gravity, but would not be a threat to us at all, as they would only absorb a tiny amount of Earth's matter.



Until now, scientists have not succeeded in creating a black hole; however, as curiosity is the mother of science, we would be hearing of some successful experiments in the near future. It would be something that could be of great help for improving and proving some theories.

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GRAVITATIONAL WAVES

By: Muhammad Mabrouk

In 1950, German physicist Albert Einstein developed a theory known as the General Theory of Relativity*, in which he looked at gravity from a different perspective. This theory is based on a mathematical model that combines the time dimension with the three dimensions of space, forming a four-dimensional continuum known as the space-time fabric. According to Einstein's theory, gravity is nothing but warps and curves in the space-time fabric, and these curves are the reason why gravity exists.

Einstein pushed his ideas one step further when he realized that the space-time fabric is flexible and can fluctuate. So, if any luminary swimming in space fluctuates, it jostles the space-time fabric creating ripples; these ripples are what we call gravitational waves. Although any object with mass can make these ripples in the fabric, the effects of these ripples depend on the magnitude of the mass. In other words, the more mass the object has, the more severe the ripples in the fabric are, and accordingly the more noticeable the gravitational waves are.

The objects that have the biggest mass and are able to make the strongest gravitational waves are incontrovertibly black holes. Black holes are regions in space with a great amount of matter concentrated in a small area. Therefore, a black hole might have a very small size, but a huge mass; besides great mass, black holes exhibit very strong gravity that nothing, even light, can escape.

In September 2015, scientists managed to pick up the first gravitational waves resulting from the vibration of two black holes while colliding and merging together. It is worth mentioning that the mass of these black

holes is 30 times greater than the mass of the Sun. Originally, the two black holes orbited each other for millions of years, before getting gradually closer and ending up circling each other at tremendously high speed; at the end, they collided and merged to form a bigger black hole. The huge collision made frequent ripples in the space-time fabric, which started to fluctuate, generating gravitational waves that were noticeable enough to be picked up by a detector known as the Laser Interferometer Gravitational-Wave Observatory "LIGO".

In spite of the fact that the signal picked up by LIGO had a very short existence period of only one-fifth of a second, it is still considered a fabulous scientific discovery to prove the existence of gravitational waves for the first time. It is worth mentioning that not only can black holes generate gravitational waves, but also other luminaries such as neutron stars can. Taking into consideration that every object generates its distinct gravitational waves, gravitational waves can be considered fingerprints for different objects. By analyzing the gravitational waves picked up by LIGO, scientists can specify their source and determine whether they were generated by a black hole, neutron star or any other luminary.

*To know more about Einstein's *General Theory of Relativity* and better visualize the idea of the space-time fabric, we invite you to visit the Planetarium Science Center and enjoy watching *The Secrets of Gravity* planetarium show.



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MOONSTRUCK

By: Rania Farouk
Marketing Specialist, BA Planetarium Science Center

The Planetarium Science Center (PSC) has always been there for its followers under all circumstances and at all times; even during the COVID-19 pandemic, the PSC has been with you at home. Through a program tailored to suit all ages, the PSC has presented interesting scientific experiments, activities, shows, and competitions through its Facebook page.

The program also included a live astronomical observation of the Moon in its various phases, presented by Dr. Omar Fikry, Head of the Planetarium Theater at the PSC. In the second live lunar observation on the night of mid-Ramadan, the full moon appeared brighter than usual; that was because it was also a "supermoon".

The Moon is called a supermoon—which is not a scientific term—because of its large size appearance; in reality, it is because it is at its closest point to Earth on that night, which is about just 354,000 km. When the Moon reaches the farthest point from Earth, which is about 405,000 km, it is called a "micromoon".

Dr. Fikry said that this supermoon was the fourth and the last of 2020; it had already occurred thrice this year: in February, March, and April. The next supermoon will be in November and December 2021; the year will also witness a total solar eclipse that will not be visible in Egypt.

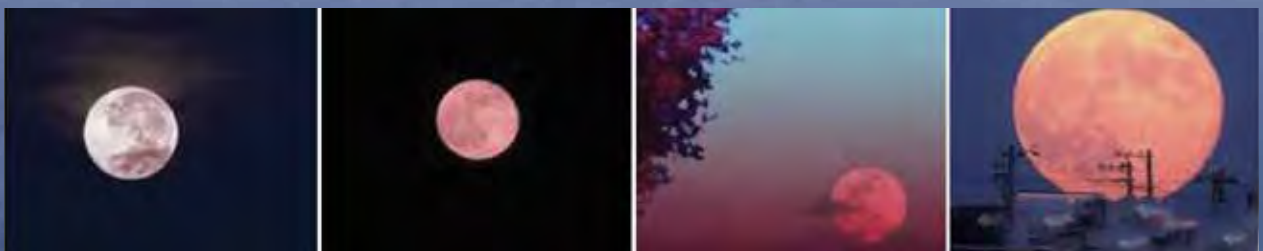
Astronomers in the United States of America are used to giving different names to each supermoon. For example, there is the "Super Pink Moon", as the Moon appears to be pinkish at sunrise; also, there is the "Flower Supermoon", which coincides with the blooming of certain flowers.

Dr. Fikry also tackled the issue of potential collisions between planets and celestial bodies; a subject that was raised several times before. He cited the comet SWAN, which was discovered on 25 March 2020 and will be at its closest point to the Sun on 27 May 2020; yet, no collisions are expected to occur. There are boundaries between celestial bodies, and each astronomical object has six elements that determine its orbit in the sky, including orbit velocity, the distance between astronomical objects, object's weight and mass, and the gravity on which the mass is created. The possibility of two objects being identical in terms of these six elements is a long shot; unless one of them loses its gravity, which is rare.

In the Q&A section, Dr. Fikry answered a question about the stars we see in our skies; he explained that they are "navigator stars" as they are very bright and thus, help in navigation. He also told us that astronomers arrange celestial bodies at certain degrees, known as "magnitude". The brighter an object appears, the lower the value of its degree or magnitude; for example, the magnitudes of the Sun is 26, the Moon is 14, and Venus is 4.

"Drag Force," was Dr. Fikry's answer to a question about the correlation between earthquakes and astronomy. He described it as the relationship between planets, where a cosmic effect correlates with a geomagnetic effect inside the Earth; both are among earthquake factors. The last question in this live video was on tides and their relation to the Moon. He told us that the force of attraction between the Earth and the Moon affects the high and low water levels, so the tide is at its highest levels on a full moon night.

On that night, Dr. Omar Fikry observed the Moon using a PSC refracted telescope. The PSC has always been eager to present various fun and enjoyable learning activities; now using remote communication means until the coronavirus crisis ends; praying to God to protect Egypt and its people.



PLANETARIUM SCIENCE CENTER

"Science for All"

Amidst the coronavirus pandemic, and in accordance with the directives of the Egyptian State and its efforts to mitigate the spread of the virus, the Bibliotheca Alexandrina (BA) has been closed to the public as of Friday, 20 March 2020, until further notice. Any updates regarding the re-opening will be posted on the Library's official website www.bibalex.org

As part of the BA's role as a center of excellence in the dissemination of science and scientific culture to the public, the Planetarium Science Center (PSC) has prepared a monthly program tailored to suit all ages, and anyone can follow it from home. Through the Center's official Facebook page, the PSC presents some interesting scientific experiments, interactive activities, Planetarium shows, fun science competitions, in addition to a number of Astronomy Nights and live astronomical observations. Follow us and enjoy our latest programs, so stay tuned!



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BAPSC

The Bibliotheca Alexandrina Planetarium Science Center (PSC) invites its visitors to spend a day of fun learning, where they can enjoy amazing scientific shows that cover a diverse variety of scientific fields and are suitable for a wide range of groups at the **Planetarium Theater**.

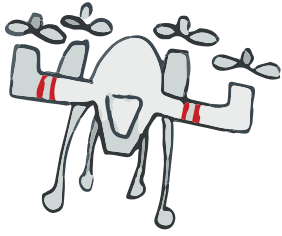
Visitors can also enjoy tours of the **History of Science Museum**, which highlights scientific discoveries throughout three eras: Pharaonic Egypt, Hellenistic Alexandria, and the Golden Age of Islam.

Moreover, visitors can enjoy a collection of interactive exhibits that targets children and adults, workshops, DVD and 3D shows at the **ALEXploratorium** as well as shows at the **12D Theater**.

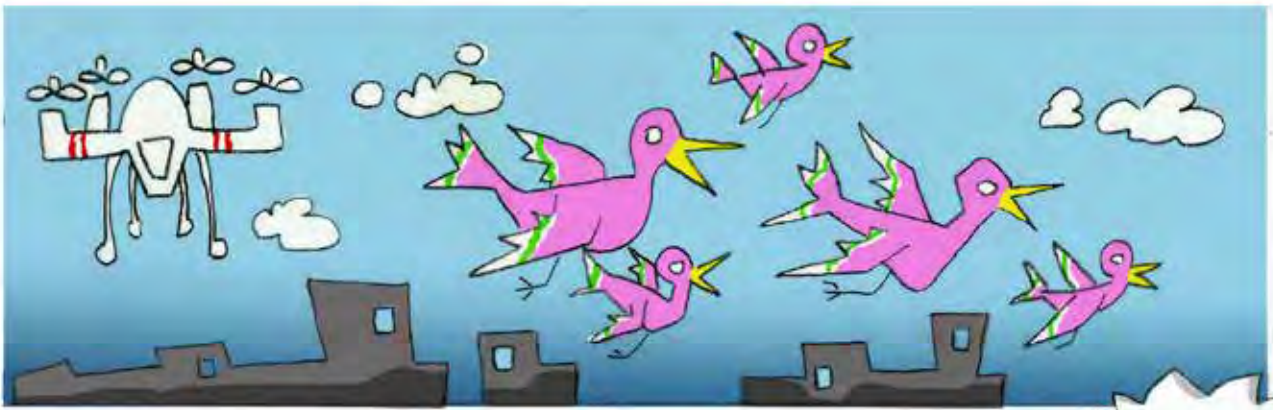




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SPY IN DISGUISE



To know who is the spy, read "Drones: Planes Without Pilots" article, on page 19.
Illustrated by: Mohamed Khamis