

JANTAR MANTAR

CHILDREN'S SCIENCE OBSERVATORY

English Bi-Monthly

Volume 25 Issue 2 March - April 2025 Rs. 30.00



How plants adapt to their Environment

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Adaptation is the process of change by which an organism becomes better suited to its environment. Either the organism is facing a new environment, or is dealing with changes in its old environment (as in climate change). The organism then needs to adapt in a way that offers it the best chance to survive. Biological adaptations can be passed on to offspring, so that the future generations have a greater chance of reproduction and hence survival of the entire species. India has diverse kinds of environment, but predominantly it has large deserts in the north-west, and rainforests in the south and north-east, including the Western Ghats, and regions of Assam and Arunachal Pradesh. Let us see how plants have adapted to their environment in these regions.

Adaptation in the Desert

Plants adapt to their environment from necessity. For example, plants may adapt by growing lower and closer to the ground to shield themselves from wind and cold. The following adaptation of desert plants help them to conserve food, energy and water and still be able to reproduce effectively.

Many desert plants may have a thick waxy **cuticle** (a protective layer on the surface of



Aloe vera waxy



Prickly Pear-Cactus spine

stem and leaves) to prevent dehydration. For example, both agave and cacti show such adaptation. A *succulent* must be able to absorb large quantities of water in short periods because desert rains are often light and brief, and the soil dries rapidly under an intense sun. These succulent plants store water in fleshy leaves, stems or roots. Apart from cacti, non-cactus plants such as agave, aloe, elephant trees, and many euphorbias are succulents. Most desert plants have thick, fleshy leaves to

store water. Succulent plants like **Agave victoriae-reginae** store water in their leaf blades.

Desert plants usually have a shallow root system to collect small amounts of moisture. Or else they may have extremely deep root systems to tap into underground water.

They have light coloured leaves or small reflective hairs to reflect excessive light, normally grey or silver, to help keep them cool. Such plants show reduced leaf size since *transpiration* (loss of water through the plant, mainly the *stomata*, the pores on the leaves) takes place through leaves. The tiny leaves on

this **pink fairy duster plant** are examples of a reduced leaf surface area, making the plant more water efficient.

Sometimes, there is a complete transformation of the leaves e.g. they are reduced to thorns or spines. These also offer protection against predators. This **Prickly Pear Cactus** not only stores water in its succulent pads (stems), it also protects itself from hungry predators with its spines. Spines also help shade the plant and to capture moisture. The **Camel Thorn tree** is nearly leafless in dry periods, thus reducing water loss. In contrast, it is difficult to tell the stem from the leaves in the **Cardon Cactus tree**! The *cylindrical* shape of columnar cacti like Cardon and the *spherical* shape of globular cacti like the Prickly Pear produce a low surface area-to-volume ratio, thus reducing water loss, as well as minimizing the heating effects of sunlight.

Plants like **Euphorbia** have toxic sap to deter insects. Desert plants flower infrequently and produce large amounts of seed e.g. cacti. Flowers are often light coloured and have no pigment.

Adaptation in the Rainforest

A *rainforest* is a rich and dense forest found in areas with high rainfall, in contrast to a desert climate. The *canopy*, where more species live than anywhere else in the rainforest, is the denser layer of greenery about 6 meters thick formed by the next tallest trees. It acts like a roof over the rest of the rainforest. Plants in rainforests have an extra struggle to survive as they seek the sun through layers of vegetation, with extreme heat and humidity.

In drier, temperate deciduous forests a thick bark helps to limit moisture evaporation from the tree's trunk. Since this is not a con-



Camel Thorn tree



cern in the high humidity of tropical rainforests, most trees have a thin, smooth bark. The smoothness of the bark may also make it difficult for other plants to grow on their surface.

Lianas are climbing woody vines that drape rainforest trees. They have adapted to life in the rainforest by having their roots in the ground and climbing high into the tree canopy to reach available sunlight. That is, their leaves and flowers grow in the canopy where they are exposed to sunlight that enables photosynthesis.

The leaves of forest trees have adapted to cope with exceptionally high rainfall by having “**drip tips**”. It is thought that these drip tips enable rain drops to run off quickly. Plants need to shed water to avoid growth of fungus and bacteria in the warm, wet tropical rainforest.

Cardon Cactus California



Many large trees have **buttresses**. A buttress means a support or reinforcement that strengthens a structure. Many large trees have massive ridges near the base that can rise 30 feet high before blending into the trunk. Buttress roots provide extra stability. Trees like

Euphorbia with toxic sap



Liana vine



Drip Tips of Leaves

Epiphytes are plants that live on the surface of other plants, especially the trunk and branches. They grow on trees to take advantage of the sunlight in the canopy. Most are orchids, bromeliads, ferns, and Philodendron relatives.

Bromeliads are found mostly in the Americas. Some grow in the ground, like pineapple, but most species grow on the branches of trees. Their leaves form a vase or tank that holds water. The tanks support a thriving eco-system of bacteria, mosquito and dragonfly larvae, tadpoles, birds, salamanders and frogs.

fig, silk-cotton (kapok) and jackfruit tree, all have buttress roots — these are large, wide roots on all sides of a shallowly rooted tree. Typically, they are found in nutrient-poor tropical forest soils that may not be very deep, and prevent the tree from falling over.

Stilt roots help give support and are characteristic of tropical palms growing in shallow, wet soils. See the stilt roots of the maize plant in the picture.

Most famous of rainforests are **Mangroves** which are found in many parts of India along both the east and west coasts. Mangroves can be found on tropical deltas and along ocean edges and even river estuaries. These trees have adapted to living in wet, marshy condi-

Environment



Buttress root





Tillandsia Bourgaei on oak Bromeliad



Mangroves in Kannur



Nepenthes Western Ghats

tions. These trees, called mangroves, have wide-spreading stilt roots that support the trees in the tidal mud and trap nutritious organic matter.

A very curious type of plants are the **Nepenthes**. A common example is the Pitcher plant. Here the vines have leaves that form a pitcher (jug), complete with a lid. Sweet or foul-smelling nectar in the pitcher attracts insects, especially ants and flies, that lose their grip on the slick sides and fall into the liquid. Downward-pointing hairs inside the pitcher prevent the insects' escape. The insects are digested by the plants and provide nutrients. Pitcher plants are not epiphytes but climbers rooted in the soil.

Every plant has adapted in various ways to survive best in the environment it has found itself in. Animals also adapt to their environment, but that is another story!

Sources:

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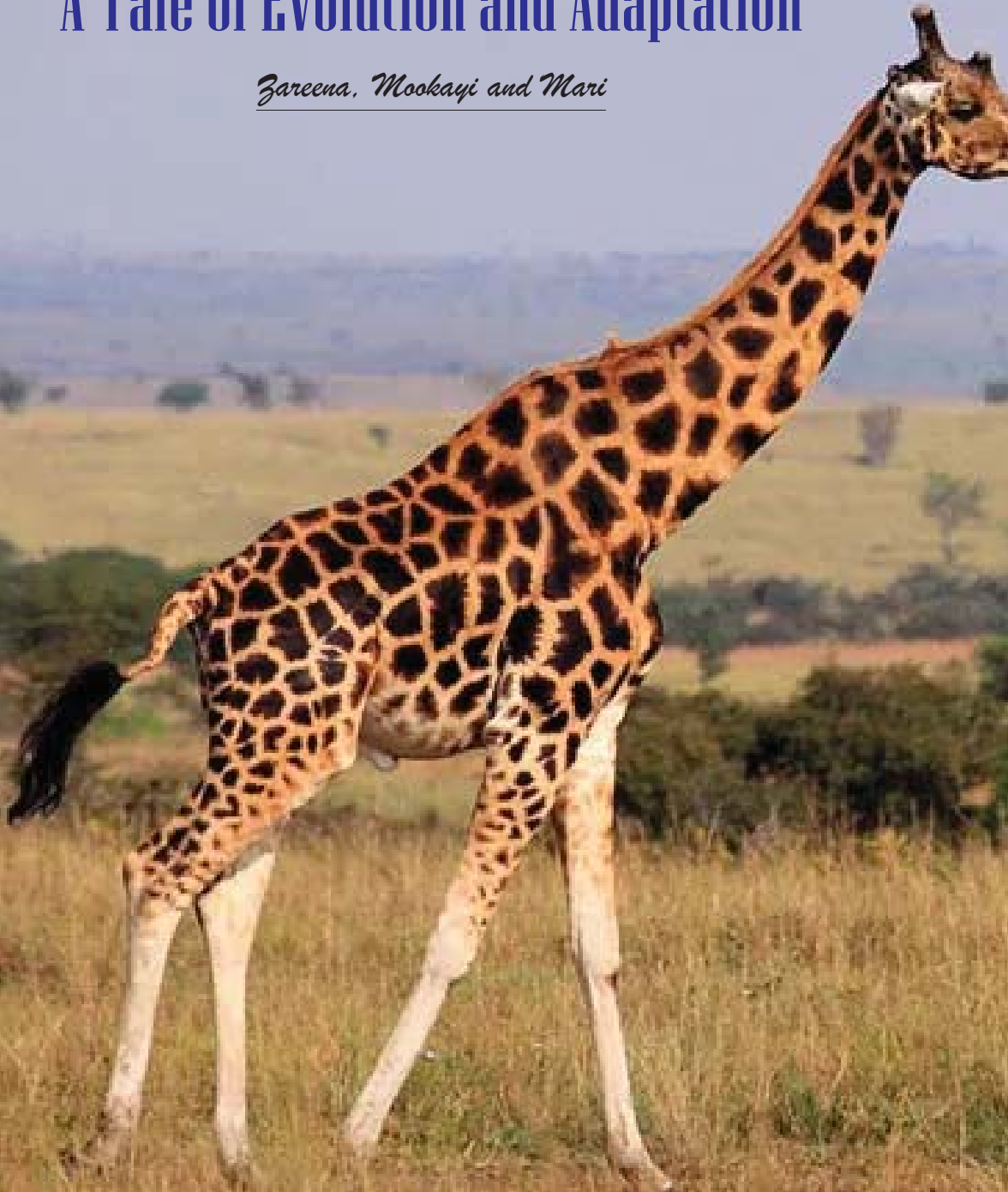
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Images from Wikipedia

Giraffes and Their Long Necks A Tale of Evolution and Adaptation

Zareena, Mookayi and Mari



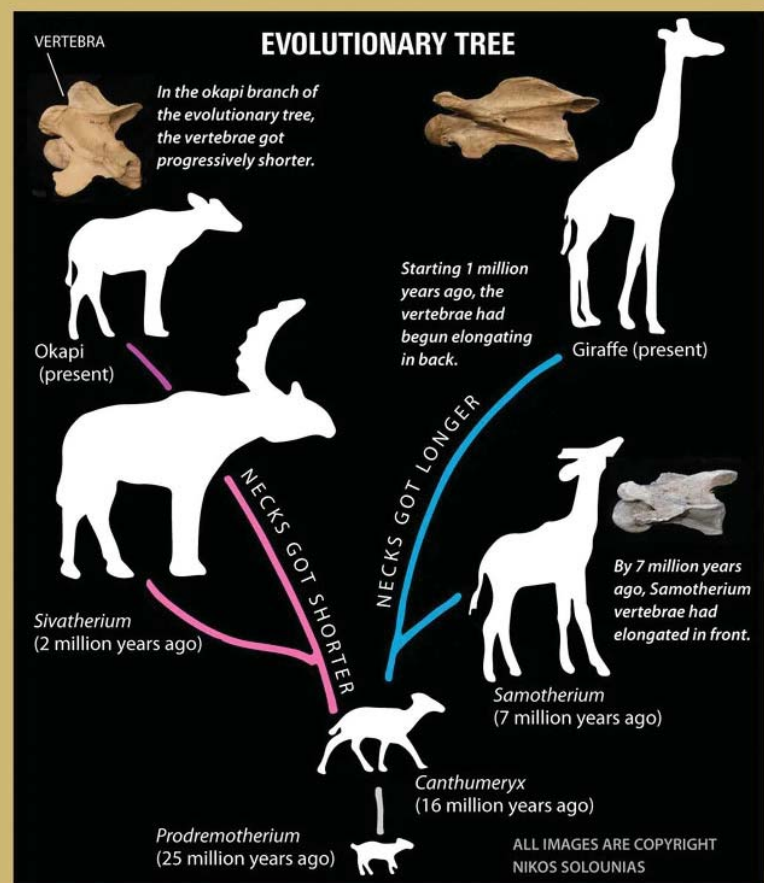
Zareena, Mookayi, and Mari walked down the corridor, their voices full of excitement. The lecture they had just attended on giraffe evolution had left them full of questions. And there was one person whom they knew could explain everything properly—Dr. Usha who was Mari’s mother and a biologist who studies evolution.

On arriving at Usha’s office, they saw her drinking tea. There were piles of research papers around her. She smiled as the three

rushed in. She asked them to sit down and offered them black tea. They happily accepted, and sat down with her.

“Amma,” Mari began eagerly, “we just attended a lecture about why giraffes have such long necks! But we’re so confused. We always heard it was so they could eat leaves on tall trees. Now we heard something different”.

Usha set her cup down and smiled. “Ah, the debate on giraffes! Scientists have been attempting to answer the question of the



SOURCES: NIKOS SOLOUNIAS, SHUTTERSTOCK

KARL TATE / © LiveScience.com



The Giraffe's Body

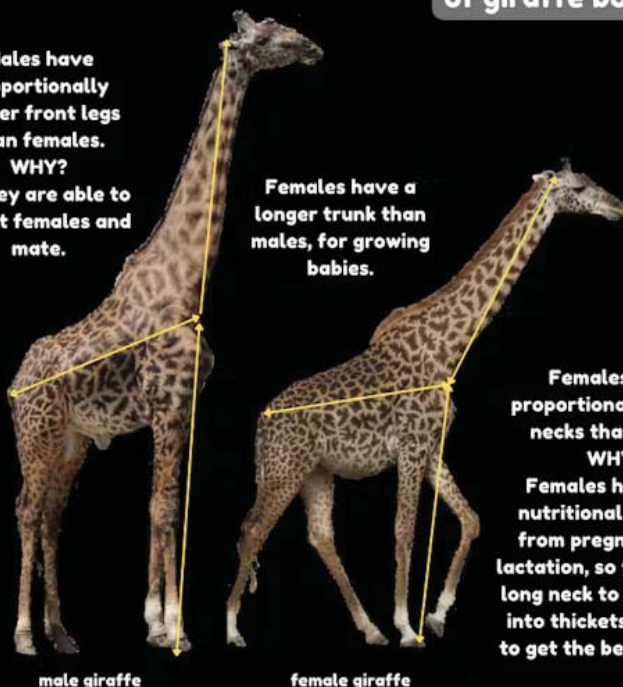
IT'S A LOOOOOOOOONG STORY

Both food and sex shaped the evolution of giraffe bodies

Males have proportionally longer front legs than females. **WHY?** So they are able to mount females and mate.

Females have a longer trunk than males, for growing babies.

Females have proportionally longer necks than males. **WHY?** Females have high nutritional demands from pregnancy and lactation, so they need a long neck to reach deep into thickets and trees to get the best leaves.



giraffe neck for more than a century now. What did your lecturer tell you?"

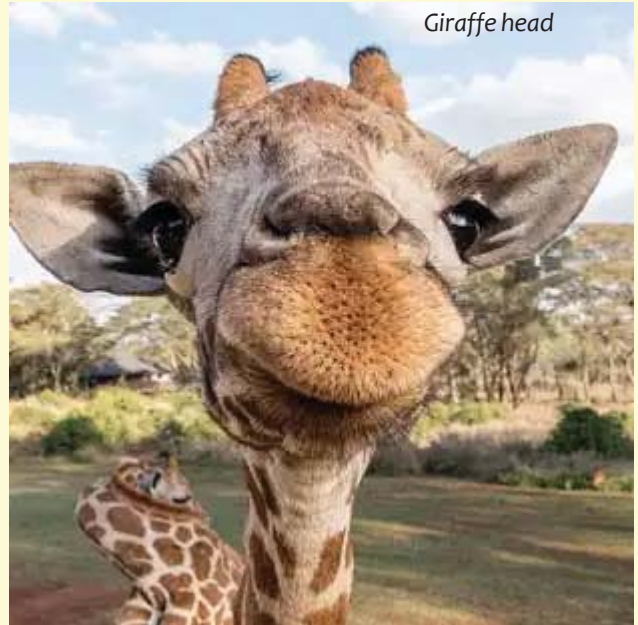
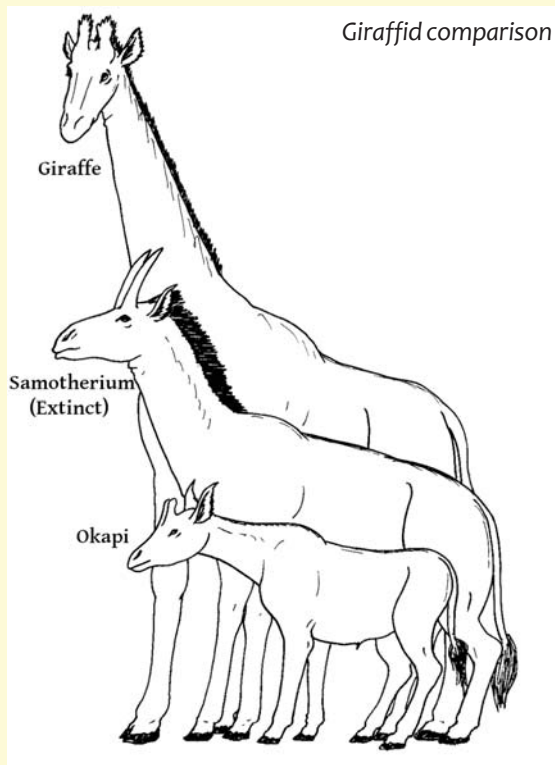
Mooks pondered for a while. "She told us how the general view was that people believed giraffes developed long necks solely to eat leaves on tall trees, as **Charles Darwin** and **Jean-Baptiste Lamarck** had proposed. But later, it was proposed that because male giraffes used their neck

in display and fighting with other males, the neck developed to compete for mates”.

But now, Zar continued, “She said new research indicates female giraffes may actually be behind the long neck story”.

Usha nodded. “That’s correct! The ‘necks-for-sex’ theory was around for many years because male giraffes fought by swinging and hitting with heads. Longer necks helped to win battles and mate. But now evidence suggests that females might have been the reason for the long necks. They tend to have comparatively longer necks than males because of their eating habits”.

Mari gasped, “You mean they evolved longer necks to reach the best food?”



“Yes,” Usha confirmed. “Female giraffes need a lot of energy as they are pregnant or nursing for most of their lives. Those that were able to reach the most nutritious leaves had an advantage in terms of being able to have better *progeny* (offspring). It is now seen as a likely important driver of evolution of their long necks.”

Mooks grinned. “Then the old idea about food being the reason wasn’t totally wrong. It just needed an additional angle!”

“Right!” Usha said. “Lamarck thought the giraffe neck got stretched in each generation. But now we understand it is about **natural selection** which is the ability for success in reproduction and survival of these progenies and the variations that get passed on over generations. Food was an important aspect, but not just any food—especially for females,

it was about getting the best nutrition. This shaped their evolution.”

Zar frowned. “Hold on ... were giraffes always like this? Must not be.”

Mooks asked, “When did their necks start becoming longer than earlier?”

“Good question!” Usha said happily. “The journey of the giraffe’s neck started more than 20 million years ago. *Giraffa camelopardalis* – the modern giraffe – is only the recent stage of this evolution. It turns out that analysis of neck vertebrae from 11 species has shown that giraffes are not the first species in their lineage to have a long neck. They just have the longest one. The 11 included nine extinct species, the modern **giraffe**, and the **okapi**.”

Looking puzzled Mari asked, “But I thought the okapi was like a zebra?”

Usha smiled. “Okapi may look like a cross between a zebra and a deer, however they belong to the giraffe family!”

She continued, “The question of neck length seems to pre-date the giraffe family.

Prodeumotherium, a much earlier species that disappeared some 23 million years ago, was also seen to have neck elongation.”

“What!” exclaimed Mooks. “You mean giraffes were not the first to have long necks?”

Usha replied, “Even before the giraffe’s lineage, the lengthening of the neck began.

For example, the extinct *Giraffa sivalensis* has some of the elongation features that are seen in the modern giraffe. But that also was not the beginning of the journey. Two other extinct creatures from *Samotherian* and *Palaeotragus* have some of these features. The primitive **giraffid** *Canthumeryx* also has the neck lengthening”. (Giraffids are the family to which both giraffes and okapi belong).

Zar was looking amazed. “That implies giraffes were not ‘designed’ with long necks. The process was slow and happened over millions of years.”

Usha nodded. “Yes! And I will tell you another interesting fact. Unlike marine reptiles called *plesiosaurs*, which have 38 to 42 vertebrae, giraffes like most mammals have the standard 7 neck vertebrae. The difference? Their vertebrae became much longer over time. The average length of each vertebra is over 30 centimetres. In comparison, even-toed **ungulates** of similar weight, such as buffalo, have cervical vertebrae that are only about 5 centimetres.”

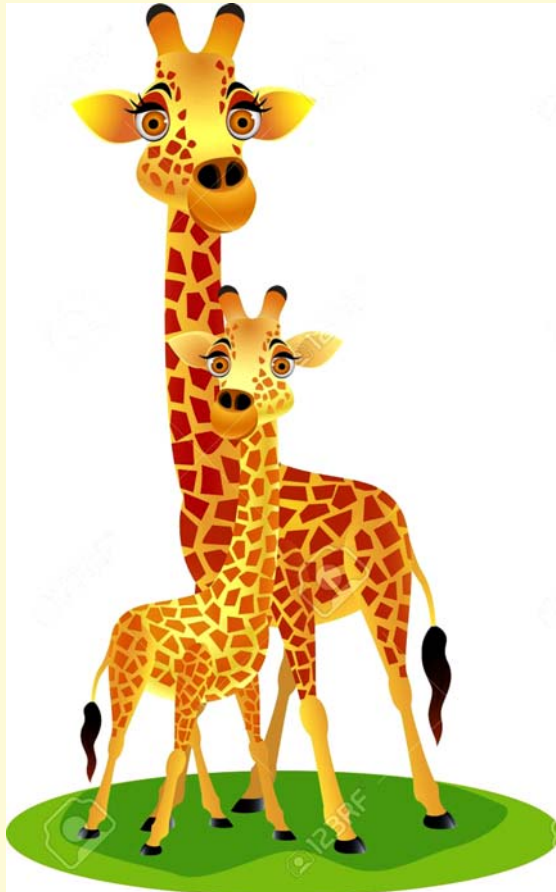
Mooks laughed. “So instead of adding more bones, they stretched the ones they already had?”

“Exactly!” Usha said. “But there was a cost for having these changes. The world’s tallest land mammal is the giraffe. On an average, males can grow up to 5.3 m and weigh 1,200 kg while the smaller females grow only up to 4.3 m and weigh 830 kg on average. The

result is the long legs of the giraffe which contribute to their height and also strain their bodies. In particular, male giraffes suffer from mobility issues as they age. Many die from foreleg problems especially in captivity.”

With a thoughtful look Mari asked, “Do baby giraffes have long necks from birth?”

“No, not really” said Usha. She continued “Baby giraffes, at birth, have proportionally shorter necks. As they mature their necks grow faster than the rest of their body. Surprisingly, at the start, both male and female calves have similar proportions. However, as they grow, their shapes diverge. The females develop longer and slimmer necks. The neck of the males becomes broader and thicker. As the calves can be over 1.8 m (6 feet),



females have to develop proportionally larger trunks to carry the bigger foetus inside.”

Mooks jumped and clapped her hands, “So different pressures resulted in different necks! Longer ones which enabled food access by females, and stouter ones which helped fighting by males!”

“Precisely,” Usha nodded. “Evolution is not a straight line. It is a mix of different pressures. Competition for better food access resulted in longer necks of females while competition for mates resulted in more muscular stouter necks.”

Zar leaned back, amazed. “It’s as if every part of a giraffe’s body tells a story.”

Mooks said looking thoughtful. “I wonder ... how does the heart manages to pump blood to the brain because of its long neck?”

Usha looked at Mooks. “Good question. But we will discuss it another day. I have to get back to my work.” She smiled at the three. “The more we study, think and question, the more we understand how creatures adapt and survive. That is the fun of Science.”

Zar, Mooks, and Mari exchanged excited glances.

Mari said, “Science is just not about answers”.

Mooks added, “It is about asking the right questions, over and over again”.

Zar had the last word. “And we can’t wait to ask and learn more”.

Space Journeys: There and back again

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Those of you who like reading will have heard of *J.R.R. Tolkien's* book called **the Hobbit**. Its full title is "*The Hobbit, or There and Back Again*"! So with apologies to Tolkien for stealing his book title, let us discuss why "coming back" is as important as "going there"! Especially when it comes to space travel.

If you have been following the news, you

may have read of the return of two American space astronauts, **Sunita Williams** and **Barry Wilmore**, on March 18, 2025. Where did they go, and why was their return on the news?

The International Space Station

Where they went, is to the International Space Station (ISS). It is a large space station that orbits the Earth about 400 km above it. It was assembled and is maintained by a collaboration of five space agencies and their contractors: NASA (United States), Roscosmos (Russia), ESA (Europe), JAXA (Japan), and CSA (Canada). It completes about 15.5 orbits of the Earth per day and in fact it is visible to the naked eye from places with clear skies. If you look up, especially at dawn or dusk, the solar panels on the ISS reflect sunlight and it appears as a bright spot moving rapidly in the sky. You can use NASA's "*Spot the Station*" web-site to find out when the ISS will be visible in your hometown.

The ISS is an amazing piece of construction. Just imagine: the crew took parts of the station



Sunita Williams



Barry Wilmore

module by module, and put it together in space! It has been continuously inhabited by astronauts from different countries for nearly 25 years, since November 2, 2000!

Freefall

One of the interesting facts that astronauts working on the ISS encounter is weightlessness. Gravity at the altitude of the ISS is approximately 90% as strong as at Earth's surface, but objects in orbit are in a continuous state of *freefall*, resulting in an apparent state of *weightlessness*. This makes life on the Space Station both fun and challenging.

The ISS provides a platform to conduct scientific research, with power, data, cooling, and crew available to support experiments. Small uncrewed spacecraft can also provide platforms for experiments, especially those involving zero gravity and exposure to space, but space stations offer a long-term environment where studies can be performed potentially for decades, combined with ready access by human

researchers.

As the largest space station ever constructed, it primarily serves as a platform for conducting scientific experiments in microgravity and studying the space environment. The ISS simplifies individual experiments by allowing groups of experiments to share the same launches and crew time. Research is conducted in a wide variety of fields, including astrobiology, astronomy, physical sciences, materials science, space weather, meteorology, and human research including space medicine and the life sciences.

Boeing Starliner

Williams and Wilmore went to the ISS on 5th June 2024, nine months ago. They went on a test flight of the *Boeing Starliner* capsule called **Calypso**. It was in fact the first mission of this capsule, which has a reusable crew capsule along with a service module which is replaced after every launch. Unfortunately, the Starliner had a lot of malfunctions and so returned to Earth,

leaving its crew behind. So a planned 8 day trip stretched into 9 months!

At the Space Station

At the Space Station, the crew do some experiments, maintain the space-craft, and also exercise regularly. This is



Weightless on ISS

Space Station viewed from SpaceX Crew Dragon



because without gravity, the muscles *atrophy* (become weak) in space. Not just muscles, there is also significant bone density loss in space. For every month spent in space, an astronaut's bone density drops by about one percent. The human heart also becomes weaker in space, as it doesn't need to work as hard to pump blood around the body.

You may have seen videos where the astronaut squeezes water drops out of a water bottle which float in air (there is no gravity to make it "fall"). Then they have fun catching and swallowing the water drop. But the same happens with solid food too: you cannot digest food easily as the routine of food sliding from the mouth through the gullet, into the stomach and to the intestine depends on gravity. So astronauts who spend a lot of time in space also experience significant weight loss. So astronauts

Boeing Starliner Calypso docked to ISS



go through a very thorough training to ensure that they are both physically and mentally fit for the rigours of space life.

And back again

They were finally brought back by another spacecraft called **Dragon 2**, which is a series of reusable spacecraft — the specific capsule was called *Freedom* — manufactured by another private company called **SpaceX**. It was launched by a **Falcon 9** rocket also made by SpaceX. Both Boeing and SpaceX work very closely with the *National Aeronautics and Space Administration* (NASA). It is an independent agency of the US government that oversees space research programmes.

Dragon Freedom

You can see the Dragon Freedom on top of the Falcon 9 rocket in the picture. It also has a reusable space capsule and a trunk module. You can see the various parts of the capsule in the picture, as well as the inside view (Pictures from BBC).

The Falcon 9 rocket launched the Crew Dragon spacecraft into space. This then reached the ISS and docked with (connects to) it. That is, the spacecraft first alters its speed to match with the ISS (you cannot connect to something that is at a different speed/direction than you: you will



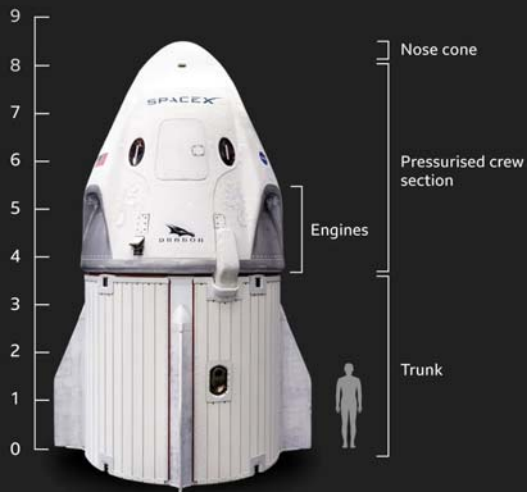
Inside Crew Dragon

Freedom on Falcon



Crew Dragon capsule

metres



OTHER SIDE



Dragon details

Source: SpaceX

BBC

simply hit and damage it). The ISS has five docking stations since it was designed as a place for several astronauts to live and work. Once the two spacecraft are close together, a computer controlled process is begun where first a probe on the capsule engages with a drogue (funnel shaped device) on the ISS. Once the docking is stabilised, an air-tight connection is made between the two so that the astronauts can safely go from the inside of the capsule to the inside of the ISS, or vice versa, without being exposed to harsh outer space.

Splash down

The reverse procedure occurs during departure. The astronauts enter the capsule. The space craft detaches itself from the ISS and speeds back to Earth. The spacecraft has to enter Earth's atmosphere carefully, otherwise it will heat up and burn out like a meteor. This is because the spacecraft is travelling at speeds of about 30,000 km/hour! So reverse thrusters are turned on (opposite of what is used when the rocket takes off) to slow down the capsule. More importantly, the spacecraft must enter at a certain angle to avoid large heating (see figure). Even so the spacecraft can experience temperatures of 4000 degrees! Heat shields in the form of tiles are used to keep the inside of the spacecraft cool and safe for humans. Parachutes then open up (six of them) to slow the capsule sufficiently. The trunk module is abandoned after each flight while the capsule returns to Earth by splashing down in a water body. After many safety checks, people on boats in the water open the hatch and the astronauts come out, one by one. They are home, again.

Sources: Wikipedia information on ISS, Falcon, and Dragon, NASA: www.nasa.gov, BBC: <https://www.bbc.com/news/science-environment-52840482>



Each country is scored out of 10 based on self-reported measures of well-being

← LEAST

1

2

3

4

THE MOST & LEAST HAPPY COUNTRIES

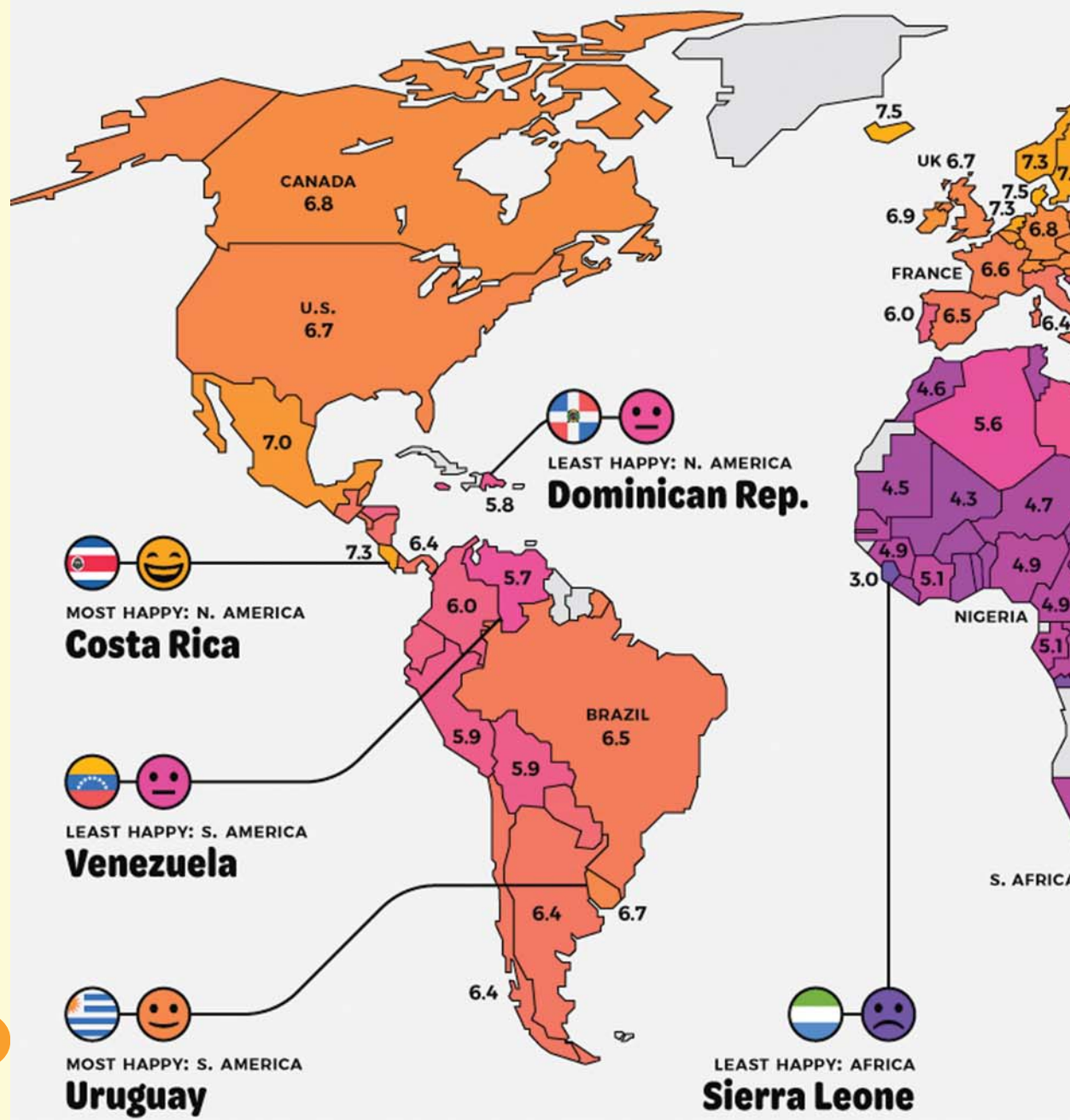


Source: World Happiness Report 2025



MOST HAPPY: EUROPE

Finland

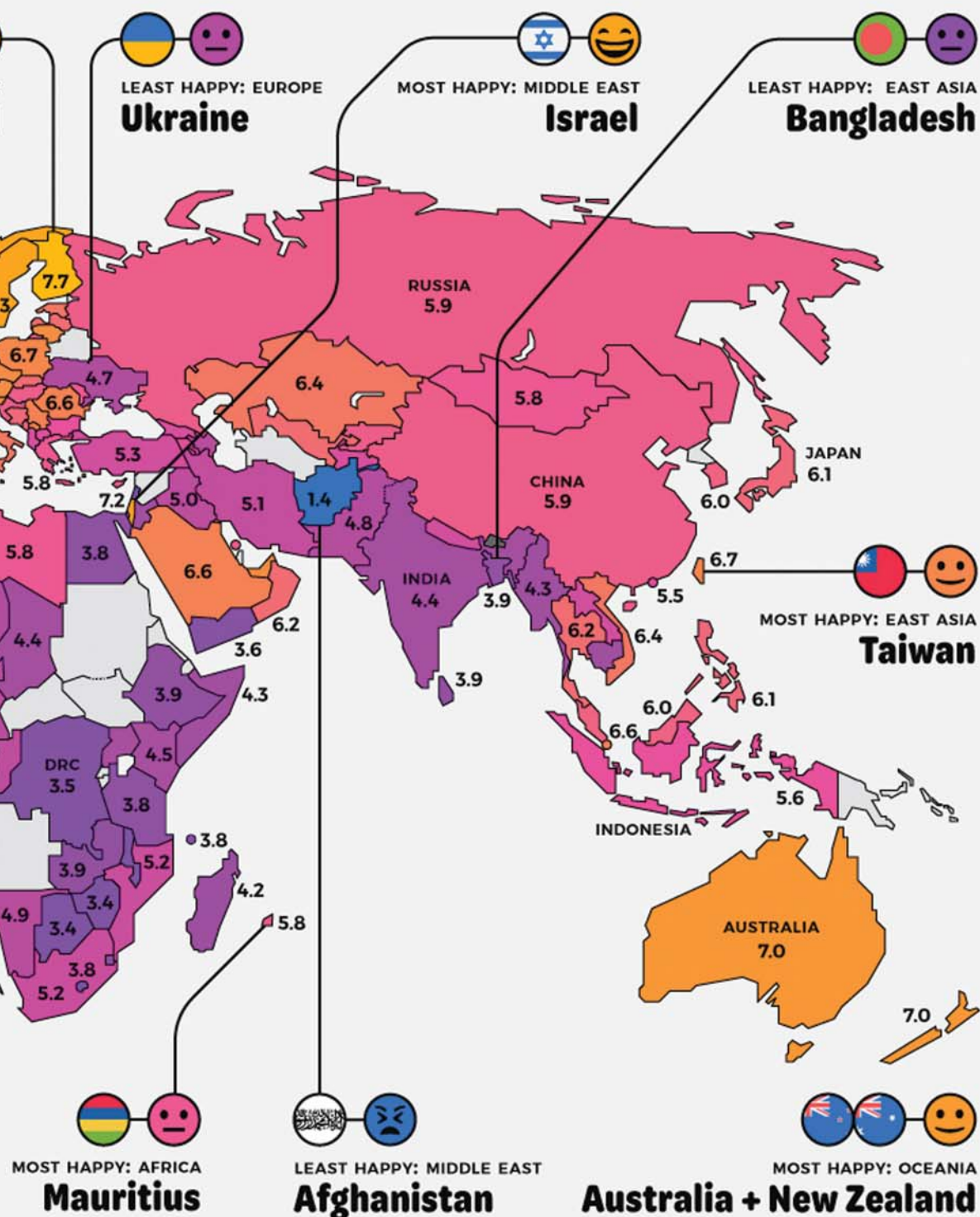




and happiness. See the World Happiness Report 2025 for the full methodology.

5 6 7 8 → MOST

COUNTRIES IN THE WORLD



My Talk With Birds -2

C R Ramana Kailash.

Tirunelveli

This is the second part of a two-part article on bird watching by a young bird watcher. The first part appeared in the previous issue.

Birds are one of the richest and most spectacular creations in Nature. They are descended from the prehistoric feathered dinosaurs of the late Jurassic period. Today they are spread across the world: from the frigid poles to dry Saharan deserts, from tropical rainforests at the Equator to the watery oceans of the Pacific. These creatures are able to adapt and thrive in the harshest conditions on Earth.

Birds have evolved and diverged in different sizes and colours. Birds like New Zealand Moa and Elephant birds are more than ten feet while a few birds like Bee Hummingbirds are as small as a coin. The rich diversity in these animals is peculiar to this spectacular class, Aves.

Birding is a hobby or profession of observing birds in their habitats. This hobby helps us to connect with the natural world and interact with it. Birding is a recreational activity or a citizen science. Unlike other nature-based hobbies, birding can be followed by amateurs too. This hobby engulfed me when I was 9; since then I learned to observe and celebrate these wonderful creatures.

Birds can be classified by their family, hab-

its, characteristics or their habitats. Identifying and classifying birds according to their habitats are much easier than other methods, especially for children. Birds can be divided broadly into two, *Aquatic* and *Terrestrial*. In the first part of this article, I talked about aquatic birds. In this article, I will describe terrestrial and aerial birds.

Terrestrial birds

Terrestrial birds are birds which live on terrestrial habitats; these birds are widespread and evolved according to habitats. Terrestrial birds or ground birds are species which spend most of their lives on the ground. Partridges, Bustards, Grouses and other flightless birds are

Greater Coucal



Quail chicks with dad

a few ground birds. India doesn't have flightless birds but Coursers and other ground birds are found in grasslands and plains of India.

Aerial birds

Birds which fly can be called as Aerial birds; true aerial birds are birds which can fight, mate and even sleep in the air. Few aerial birds have evolved to survive in urban environments and live successfully. A few birds can be easily seen in our neighborhoods but distinguishing them is relatively tougher.

i. Dry land birds:

Birds in dry and scrublands can be seen on the electric poles alongside highways. A few

Black-winged Kite



Barn Swallow

What is a habitat

A habitat is the environment where an organism lives, finds food, and reproduces. It provides all the conditions an organism needs to survive.

Types of habitats

Aquatic: Habitats in water, such as oceans, rivers, lakes, and ponds

Terrestrial: Land-based habitats, such as forests, deserts, grasslands, and mountains

Aerial: Habitats in the air, such as those of birds

Examples of habitats

Forest: A habitat that provides food, water, shelter, and mates for many living things, including fish, birds, and mammals

Rainforest: A habitat with high amounts of rainfall and dense evergreen tree cover

Mountain: A habitat that is home to many different plants and animals, such as mountain goats

Ocean: The largest habitat in the world, home to a wide variety of sea life, including fish, whales, sharks, and birds

Arctic: A habitat within the Arctic Circle, near the North Pole, that includes the Arctic Ocean and parts of countries such as Russia, Canada, and Iceland

There are many factors that shape habitats such as climate, landscape, food availability, and the presence of other species.

Raptors thrive in these stretches of dry lands. Other birds including Coucals, Indian Rollers, cuckoos common quails and Larks live in scrublands.

Greater Coucals are one of the impressive birds in scrublands. Their hooting sound can be easily recognized. They are heavier and mostly foraging (obtain food by searching) and they seldom fly long distances. Even though these birds are relatives of the Cuckoo, they are non-brood parasites. Another beautiful bird from the Cuckoo family is the *Jacobin Cuckoo*; they have a prominent crest and white patches over their wings and tail edges. They rarely appear and I had seen them only twice, but these are one of my favorite birds.

The *Black-Winged Kite* is a bird of prey found in the drier parts of Tamilnadu. I have seen them hovering on the same spot for a long time; then they dive in to catch their prey. These birds are truly athletic as well as beautiful; I like the black stripe around their eyes. I have also seen the *Shaheen Falcon* diving down in lightning speed: they are one of the fastest birds in the world and are widely used in Falconry.

Common Quails are another of my favorite birds. They are cute little birds; I like their speedy run. They can be seen crossing roads suddenly. Once, I saw a large Quail followed by 5 chicks running behind in a straight line. Palm swifts and *Swallows* are true Aerial birds; they can be seen standing on any surface, their legs are very tiny and can't be seen with naked eyes when they fly.

ii. Forest birds:

Most of the birds in forests are smaller and equally shy. Western Ghats is one of the richest bird habitat in the Indian subcontinent. The



Indian Parakeet



Malabar Grey Hornbill male



Malabar Grey Hornbill female



Black Hooded Oriole

Ghats teem with life of many endemic birds (they are present all the year round); most of them are spectacular and vividly coloured. Even smaller birds like Cinereous Tits and Pied Bushchats are colorful and cute.

The *Paradise Flycatcher* is the most beautiful birds I have ever seen. The males have a beautiful long tail. Some of them have a black and rufous (reddish brown) plumage, while others have white plumage. I wonder how these birds fly with such a long tail to carry on its back. The tail moves beautifully like a wave as it flies.

But the birds which I yearned for were Hornbills; these magnificent birds live in the forests of the Western Ghats. Malabar Pied Hornbills and Malabar Gray Hornbills are two endemic Hornbills in Western Ghats; I was lucky to see this species at Topslip in Annamalai Tiger Reserve. I woke up at 5'o clock, to trek in Topslip. Melodious sounds of the Malabar whistling Thrush echoed around the valley.

The most memorable moment was seeing a flock of *Malabar gray Hornbills*. I jumped out of excitement. Hornbills play an important role in maintaining forest cover and they are the major seed dispersers in the forests; they are called as 'farmers of the forest'. I had seen an extravagant Malabar pied Hornbill unexpectedly during a ride in 'blue mountains' train. It was larger than an eagle. The bird slowly glided over the valleys.

Thattekad Bird Sanctuary

In the beginning of this year, we went to Thattekad bird sanctuary, one of the richest bird areas in India. **Dr. Salim Ali** (who was known as the Birdman of India) described this forest as being as diverse as the Eastern Himalayas. As we trekked into the teak for-

ests, we saw a *Black Hooded Oriole*, a brilliant yellow colored, black headed bird. Unfortunately I was unable to see the Ceylon frogmouths but we spotted an equally rarer, *Black Baza*. The raptor had a large crest, banded ribbed under parts, rose and white overlapping patches in wings. This migratory bird of prey travels from cold Mongolia to Thattekkad. We also saw lesser whistling Ducks, Chestnut Bee-eaters and white cheeked Barbets.

iii. Urban birds:

Rather than going outside and searching for birds, birding in our backyard is useful for amateurs. Birds in urban jungles face lots of threats. Only opportunistic birds can survive in these dangerous, ever-changing worlds. A few impressive birds in my locality are Shikras, Flameback Woodpeckers, Spotted Doves, brown-headed Barbets, Rufous Tree-pie and Bee-eaters.

Bird counts including Global Backyard Count are conducted for recording birds in our locality. *Shikras* are the top predators in my backyard. A pair of *Shikras* lives in our home. Though smaller, these birds are known for their incredible agility and strength. I have seen a *Shikra* crawling with a bulky hill Mynah. Crows, Babblers and Drongos chase away and fight with these raptors.

Flameback Woodpeckers are birds which are hardworking and powerful. Hearing the sound of a woodpecker hitting the tree is common.

Blue-tailed Bee-eaters are found in jungles and dry areas but adapted to live in urban areas too. They are acrobatic and catch insects midair. Black Kites are successful raptors in urban areas; hundreds of Kites live in Indian megacities. It's true that few birds are successfully adapted to live in urban areas.



Black Baza

Flameback woodpecker





Shikra



Blue-tailed Bee-Eaters with Dragonfly

Let's talk with birds and conserve them

Birds play an important role in our eco-system:

- . birds like Vultures and Kites scavenge carcasses, reducing disease outbreak.
- . Frugivores including Hornbills help in dispersal of seeds, expanding forest cover.

. A few birds like Owls and insectivorous birds feed on rodents and insects controlling pests, thus becoming friends of farmers.

But most of the birds around the world are threatened: Dodos, Elephant birds, Haast's eagle and Moa are a few extinct legendary birds. Other birds including Great Indian Bustard, Jerdon's Coursers and Himalayan Quails are on the brink of extinction. They have lost their historical ranges and live in small natural refuges. Illegal pet trade had played a major role in exterminating many species. Even today, birds are sold as pets and for wildlife medicines in black markets.

Many birds are regionally extinct in India; few are not recorded after the end of the millennium. Urgent protection is needed for conserving these birds; their roles can't be substituted. Banning illegal wildlife trade and habitat restoration is needed to protect these animals. Community awareness had risen and participation of people in bird census, campaigns makes us conclude that there is a possibility of getting a bright future for birds. Let's love birds, talk with them and conserve them.

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Do You Know?

1. There are many household things made of plastic in our homes that are non-recyclable. How can we best dispose of them? Do we bury them, burn them, what is best to do?
2. It is summer and the air is full of flies. Where do they go in winter?
3. How do creams go through the skin?
4. If you have been observant, you would have noticed that boat and plane propellers are in different places. Why?

Answers in the next issue of JM.

Answers to Last Issue's Do You Know?

1. Can plastics really enter our body tissues through what we eat? How do we decrease the amount of plastics in our bodies?

Ans: Yes, microplastics, defined as plastic pieces less than 5 mm in size, have been detected in various human tissues and organs, including blood, lungs, liver, kidneys, placenta,

and even the brain, suggesting widespread exposure. A study found microplastics in the blood vessels on either side of the neck of heart disease patients, according to the Environmental Working Group. Researchers have also found microplastics in human brains. Microplastics have been detected in breast milk, placentas, and other human tissues and organs.



Microplastics

Microplastics can enter the body through various routes, including:

Food and Drink: Microplastics have been detected in seafood, tap water, bottled water, and other common beverages.

Air: Microplastics can be airborne and inhaled, potentially reaching deep into the lungs.

Cosmetics and Personal Care Products: Some products contain microplastics, which can be absorbed through the skin.

While the long-term health effects of microplastics are still being studied, some potential concerns include:

Oxidative Damage: Microplastics can cause oxidative stress, which can damage cells and tissues.

Inflammation: Microplastics can trigger inflammation in the body.

Changes in Gene Activity: Microplastics can potentially alter gene expression.

Disruption of Hormones: Some chemicals in microplastics, like **BPA** and **phthalates**, can disrupt the endocrine system. You may have noticed many plastics being labelled as “BPA-free”.

Lung and Liver Effects: Microplastics can accumulate in the lungs and liver, potentially causing damage.

Impact on Gut Microbiome: Microplastics can alter the composition and function of the gut microbiome.

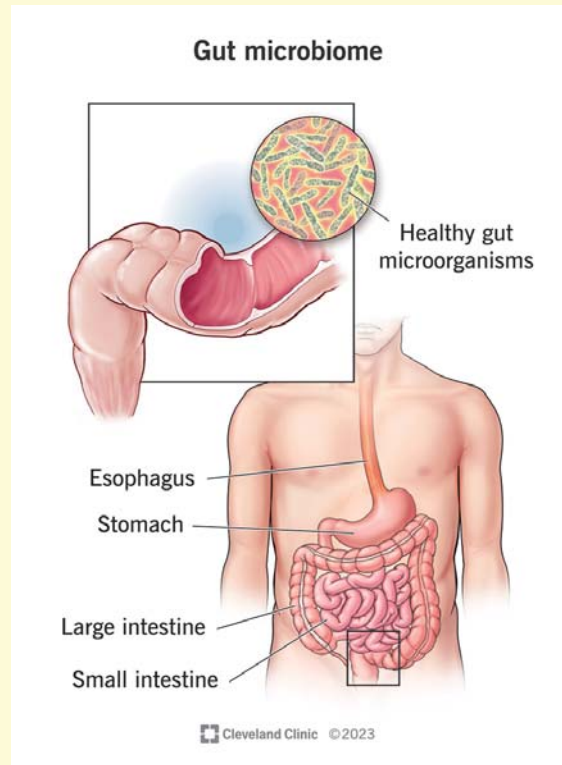
Scientists are actively researching the potential health impacts of microplastics and how to reduce exposure.

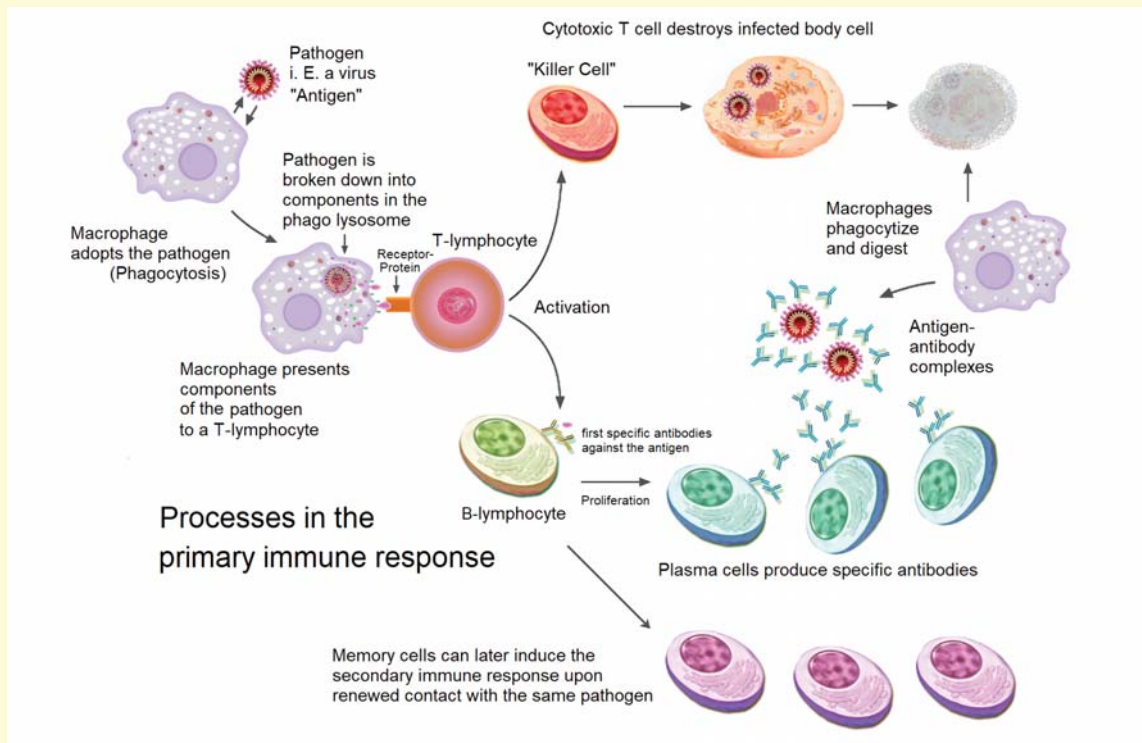
2. How can our body distinguish good and bad bacteria?

Ans: Our bodies distinguish “good” and “bad” bacteria primarily through the immune system, which learns to recognize and tolerate beneficial gut bacteria while targeting harmful pathogens. The gut, containing a large portion of the body’s immune cells, plays a crucial role in this process.

Beneficial microbes in your gut help to train your immune system to tell them apart from the unhelpful, pathogenic types. Your gut is your largest immune system organ, containing up to 80% of your body’s immune cells. These cells help to clear out the many pathogens that pass through it every day.

Helpful gut microbes also compete directly with unhelpful types for real estate and nutrients, preventing them from taking up too much territory. Some of the chronic bacterial infections that can affect your gastro-intesti-





nal tract, including *C. difficile* and *H. pylori*, are directly related to having a diminished gut microbiome.

Short-chain fatty acids, the byproducts of helpful gut bacteria, have important benefits for your immune system. They help maintain your gut barrier, keeping the bacteria and bacterial toxins inside from escaping into your bloodstream. They also have anti-inflammatory properties for your gut. Inflammation is a function of your immune system, but it can malfunction, becoming hyper-reactive. Chronic inflammation is a feature of autoimmune disease and may have a role in many other diseases, including cancer. Short-chain fatty acids appear to suppress these types of inflammatory reactions.

The immune system learns to recognize gut bacteria early in life and establishes surveil-

lance to keep them in check. Specialized immune cells capture pieces of bacteria and carry them to other parts of the body, like the thymus, to further refine the immune system's understanding of these microbes.

Located in the chest, above the heart, the **thymus** is a gland responsible for "educating" immune T cells. Delivery of the cargo prompts the thymus to produce T cells that are targeted to the microbiota. Then, the T cells exit the thymus to surveil lymph nodes, the gut and other sites in order to keep the bacteria under control.

The immune system recognizes substances called antigens on the surface of microbes or in the chemicals they produce, which mark the microbe or toxin as foreign. Antibodies then mark these antigens for destruction, helping the body fight off harmful bacteria or toxins.

3. *Fingerprints are used in crime detection. Can the wrong person be sent to jail if their identical twin committed the crime?*

Ans: The U.S. National Forensic Science Technology Center states that “no two people have ever been found to have the same fingerprints — including identical twins.” Why so?

There are two types of twins: fraternal and identical. The differences ultimately lie in their genetic makeup, or DNA. Fraternal twins develop from two separate eggs and two different sperm. So they share only 50 percent of the DNA as a result.

Identical twins, on the other hand, form within the same egg that splits into two, which results in the two individuals having similar, though not exactly the same

DNA. However, a study of 381 identical twins and 2 sets of identical triplets found that only 38 had identical genes. This is about 10%, not small. What are the chances that they share the same fingerprints?

They share many physical similarities as a result of shared DNA, including hair color, eye color, and skin tone. In fact, it's said that one in four identical twins mirror each other. Environmental factors can still create slight differences in identical twins' physical appearances, though, which is how other people can essentially tell them apart. Some underlying differ-

ences can include weight and height.

Fingerprints aren't included in these genetic similarities. That's because the formation of fingerprints is dependent on both genetic and environmental factors in the womb. A person's fingerprints are formed in the womb based on a combination of genes and environmental factors. Fingerprint patterns are set between 13 and 19 weeks of fetal development. Fingerprints are partially determined by



Fingerprints

DNA. This explains why a pair of identical twins might appear to have similar fingerprints at first.

Environmental factors from inside the womb also contribute to fetal fingerprint development, ensuring that identical twins' fingerprints aren't the same. These factors may include: access to nutrition inside the womb, umbilical cord length, overall blood flow, blood pressure, position inside the womb, and the overall rate of finger growth.

As a result, identical twins may have simi-



Cell phone tower



larities in the ridges, whorls, and loops in their fingerprints. But upon closer examination, you'll notice differences in some of the smaller details, including spaces between ridges and divisions between branch markings.

4. What is Hippopotomonstrosesquippedaliophobia? Do you suffer from it?

Ans: Hippopotomonstrosesquippedaliophobia is the ironically named fear of long words, also known as sesquipedalophobia. Phobia is an extreme or irrational aversion to something, and “sesquipedal” is a Latin term meaning “long word”. So together it means an aversion to long words.

This may be especially seen as a social phobia (think of when you are reading a passage in class and cannot pronounce the long word).

5. Sometimes, you get poor quality signal on your cell phone. Why does that happen?

Ans: Poor cell phone signal quality can stem from several factors, including distance from cell towers, obstructions, building materials,

network congestion, and weather conditions. The further you are from a cell tower, the weaker the signal becomes, leading to dropped calls and slow data speeds. This is because cell towers have a limited range, and signals weaken as they travel further.

Physical barriers like buildings, trees, hills, and even thick walls can block or weaken cell phone signals. Metal objects and certain building materials can also interfere with signal transmission. Even the type of phone case you use can sometimes affect signal reception.

When many users in a specific area are trying to use the same cell tower simultaneously, the network can become congested, leading to slower data speeds and reduced call quality. This is common in urban areas or during

peak usage times.

Adverse weather, such as heavy rain, storms, or fog, can disrupt cell phone signals. These conditions can cause signal fluctuations or even temporary outages.

Sometimes, a problem with your phone's antenna or other components can cause poor signal reception. It's possible that your carrier's coverage doesn't extend well into your area, or that they are experiencing a temporary outage.

Devices, like microwaves or cordless phones, can sometimes also interfere with cell phone signals.

Sources:
Many different online sources

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Publisher

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TNSF, Chennai 600 086

Typeset at

Fineline

Design, Illustrations and Layout

Basheer
Rajeswari

Printed at

Sri Murugan Printers,
7/1, Boobegam 3rd St, Anna salai,
Chepauk, Chennai - 600 002.

Single copy Rs. 30/- Annual subscription Rs. 200/- Life Subscription Rs. 2000/-

Bank Details: Jantar Mantar, Indian Overseas Bank, Dr. RK Salai Branch, Chennai - 600004

AC No: 029101000031081 IFSC Code: IOBA0000291



Fun with Geometry:

The Möbius Strip

Rahman Ur Izam,

Chennai

In mathematics, a *Möbius strip*, *Möbius band*, or *Möbius loop* is called a non-orientable surface. What does this mean? Read on to find out.

Activity 1.



Cut out a thin strip of newspaper and join the ends with a staple or cello tape. Now, with a pen or pencil, start at one end of the joint, and draw a line along

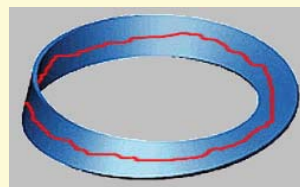
the length of the paper. Keep going till you come back to the starting point.

Observation: You will see that one side of the paper strip has a line going through it, and the other side is clean. This means (obviously) that there are two sides of the paper strip, which we could have actually found by just looking at it! So what is special? We will find out in Activity 2.

Activity 2.

Cut out another strip of newspaper. Now,

twist it once before you join the ends. That is, turn over the edge you have in one hand, and join it to the other.

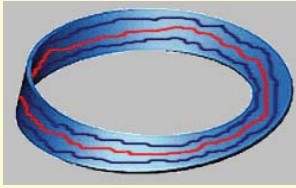


This is called a half-twist. It should look like the twisted strip shown in the figure. Do the same “experiment” as before. Starting at one end, draw a line along the paper and keep going till you reach the starting point.

Observation: What do you see? You will find that there is no side of the paper strip which is not marked by your pen. If you think this through, you will realise that this object that you have just made has only one side! It is called a Möbius strip.

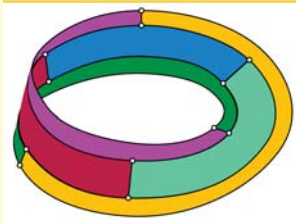
So, now, what do we mean by “non-orientable”? It is a surface, where we cannot distinguish clockwise from anti-clockwise turns. This is because it has only one boundary curve, which is the equivalent of the single pencil line along the strip, covering “both” sides.

Activity 3.



You can check this by starting at the join, colouring one edge using a felt pen, and continuing till you reach back to the starting point. You will find that there are no un-coloured edges left, since there is only one boundary.

Do you know?



Heinrich Franz Friedrich Tietze showed in 1910 that the Möbius strip can be subdivided into six regions

that all touch each other – three along the boundary of the strip and three along its center line. There is a famous “4-colour” theorem in mathematics which says that objects on any flat surface (like a map) only need a maximum of four colours for uniquely colouring it. For example, you can colour a map of Indian states using four colours so that no two adjacent states (with common boundaries) are touching each other. It appears that you will need 6 colours to achieve this with a Möbius strip.

Applications

There are many applications of Möbius strips. One of the most important ones was the realisation that if you have a mechanical belt in the shape of a Möbius strip, it will last twice as long as an ordinary belt where only one side is always exposed to the effects of friction. So, for instance, dual-track roller

coasters whose carriages alternate between the two tracks, use Möbius strip belts. Möbius strips also appear in molecules and devices with novel electrical and electromechanical properties.



Interestingly, the Universal recycling symbol (see picture, the outline version with green fill), originally designed in 1970, is a Möbius loop. So is the older Google drive logo. However, what fascinates mathematicians are the very curious properties of the Möbius strip.

Properties of the Möbius Strip

Now that you know how to make a Möbius strip, let's have some more fun with them.

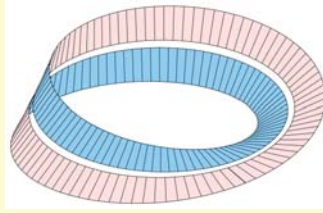
Activity 4.

Cut a Möbius strip along the centre-line with a pair of scissors. Don't you expect to get two Möbius strips? What do you get? A *single* strip, which has 4 half-twists in it! Again, do the experiment of drawing a line along the length of this cut strip. What do you get? Is it also a Möbius strip with only one side?

Activity 5.

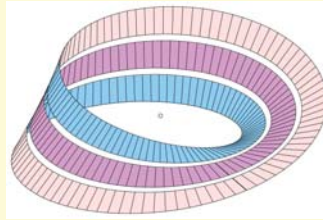
Cut this double twisted strip again along the centre-line. This time you will get two strips, but they will be interlinked and you will not be able to separate them without

cutting the paper! Each strip is double-twisted (check). Is each strip a Möbius strip? Find out!



Activity 6.

Instead of cutting a Möbius strip long the centre-line, cut it one-third of the way from the edge. Again, keep going until you reach back to the original point. What do you get? You will now get two strips! Again,



these are interlinked and cannot be separated without cutting the paper. Amazing, what just cutting it off-centre will do! Are these both Möbius strips? Do the Möbius strip test of drawing a line along the strip. You will find that one of the strips is indeed a Möbius strip while the other has two half-twists.

Activity 7.

Instead of cutting the strip one-third of the way from the edge, try different widths: cut it at $\frac{1}{4}$, $\frac{1}{5}$, etc., and see what you get. Do write in to **JM** with your answers and insights, or even pictures!

Sources:

Images from Wikipedia

Puzzles to Puzzle You

Apples or Oranges?

You work at a fruit factory.

There are 3 crates in front of you. One crate contains only apples. One crate contains only oranges. The other crate contains both apples and oranges.

Each crate is labeled. One reads "apples", one reads "oranges", and one reads "apples and oranges".

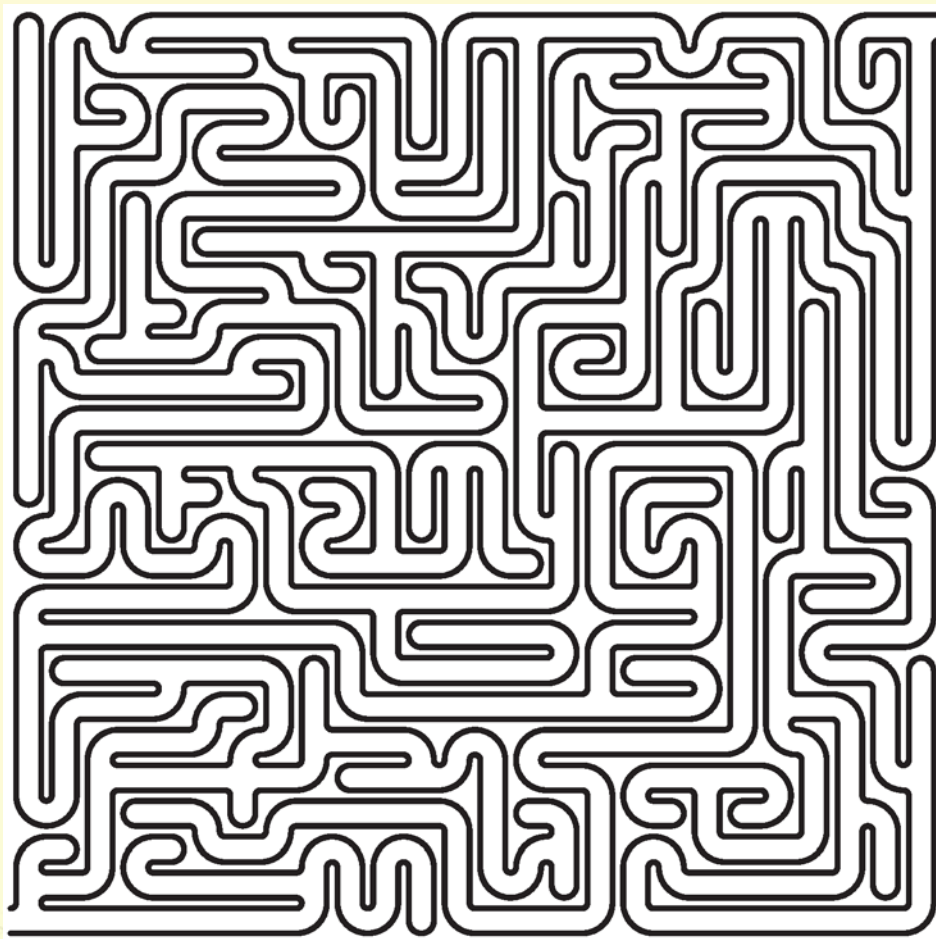
But the labeling machine has gone crazy and is now labeling all boxes incorrectly.



Take a piece of fruit from the "apples and oranges" crate. If it's an apple then you know that the "apples" crate since ALL THE CRATES ARE LABELED INCORRECTLY. This means the crate marked "apples" must be "oranges" and the crate marked "oranges" must be "apples and oranges".

Ans:

Help
the friends
meet !





Published by S.Subramani Published at 245, Avvai Shanmugam Salai, Gopalapuram,
Chennai-600 086 Printed by P.S.Kumaresan, Printed at SRI MURUGAN PRINTERS,
No.7/1, BooBegum 3rd Street, Chepauk, Anna Salai, Chennai-600 002.
Owned by Tamil Nadu Science Forum, Editor: Dr. D. Indumathi