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Why don't we remember *being a baby?*

D. Indumathi,

The Institute of Mathematical Sciences, Chennai

Do you remember your first birthday? The time you spoke your first words? Your favourite toy as a 1 year old?! Probably all of you will say, No. Why don't we remember being a baby?

This type of memory is called episodic memory. It is the ability to experience specific events and then recall them later. A serious answer to this seemingly amusing question was recently solved by scientists at the Yale University.

Ideas about why we don't remember

We learn so much during our first years of

life. But scientists thought that we don't hold onto these experiences because the part of the brain responsible for saving memories — the **hippocampus** — is still developing even when we reach adolescence. In other words, scientists thought that we cannot *encode* memories in our earliest years. A new study threw up a very different and interesting result. To find out more, read on.

How do we find out how babies learn?

The study involved 26 babies between 4 months and 2 years old. They were separated

The hippocampus

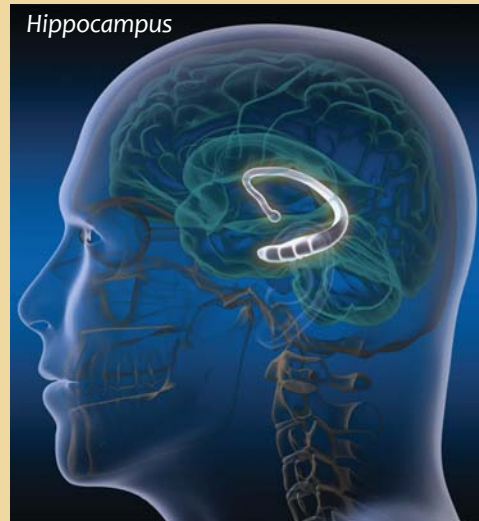
The hippocampus is a vital part of the brain, and is responsible for memory formation and spatial navigation. Located in the medial temporal lobe of the brain, it has a distinctive sea-horse shape. It is the portion of the brain associated with emotions, memory and the autonomic nervous system. It performs several very important functions:

Memory Formation: The hippocampus is essential for transferring short-term memories into long-term storage.

Spatial Navigation: The hippocampus helps create a mental map of our surroundings, allowing us to navigate and find our way around.

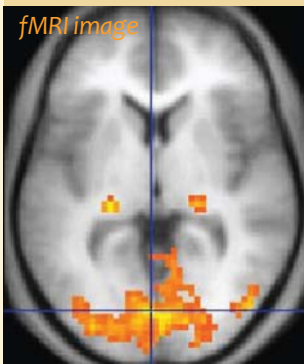
Learning: It is involved in various aspects of learning, including the formation of new associations and the consolidation of learned information.

Emotions: The hippocampus also plays a role in processing emotions and emotional responses.



fMRI Machine

An fMRI or functional-MRI machine is a specialized type of MRI scanner that is used to measure brain activity by detecting changes in blood flow. The picture shows a patient being made ready to be moved into the fMRI machine. It is



a non-invasive technique that doesn't use radiation but instead using high magnetic fields. This makes it a safe and preferred method for studying brain function. fMRI is used to identify which parts of the brain are active during specific tasks or when exposed to certain external stimulus. This technique relies on the fact that blood flow in the cerebrum of the brain, and the activation of neurons, are coupled. When an area of the brain is in use, blood flow to that region also increases.

into two groups: less than 1 year old, and greater than one year old. During the experiment, the babies were placed in an *fMRI machine* and shown a series of unique images for two seconds each. Researchers used the *fMRI machine* to record activity in the hippocampus.

Such young babies have short attention spans, cannot follow instructions, and cannot even talk to the adults! How did the scientists generate the data?

The scientists first showed the babies an image of a new face, object, or scene. Later, after the infants had seen several other images, the researchers showed them a previously seen image next to a new one. If the babies stared at the previously seen image longer than the new one next to it, that can be interpreted as the baby recognizing it as familiar! Incredible, isn't it? Also difficult to implement.

What did they find?

When a baby looked at a new image, the *fMRI* showed activity in the hippocampus regions of their brains. Sometimes there was less activity, sometimes more. The interesting part was this: if there was more hippocampal activity when the baby was shown a certain image, the scientists found that the baby looked at it for a longer time when it was shown again! It was as if it had "recognised" the image. Even more interesting: the part of the hippocampus that showed activity was the region where patterns are learned; the so-called *statistical learning centre*. This was strongest among the older age group of 1-2 year olds. So, what do we know now, from this research? That babies do learn and store episodic memories in the hippocampus.

The question now is: if the babies do store

memories, that is, if we have stored memories as babies, why don't we remember them?! There are a few possibilities. One is that the memories may not be converted into long-term storage and thus simply don't last long. Some recent studies with infants and toddlers show that their "baby memories" might last until preschool age before fading. Another theory is that the memories are still there long after encoding and we just can't access them.

However, it's fair to say that babies are learning from those experiences, and adding to both recognition and emotional information.

Activities that adults or parents involve themselves with can have a deep impact on infants, both through sounds and visual cues. So the scientists encourage adults to keep reading to babies, singing to them, and showing them colour picture books! Even if the baby cannot recall these later, it will help them develop many learning skills.

Sources:

[https://news.yale.edu/2025/03/20/why-dont-we-remember-being-baby-new-study-provides-clues;](https://news.yale.edu/2025/03/20/why-dont-we-remember-being-baby-new-study-provides-clues)

<https://www.psychologicalscience.org/news/you-cant-remember-being-a-baby-for-a-reason-new-study-finds.html>



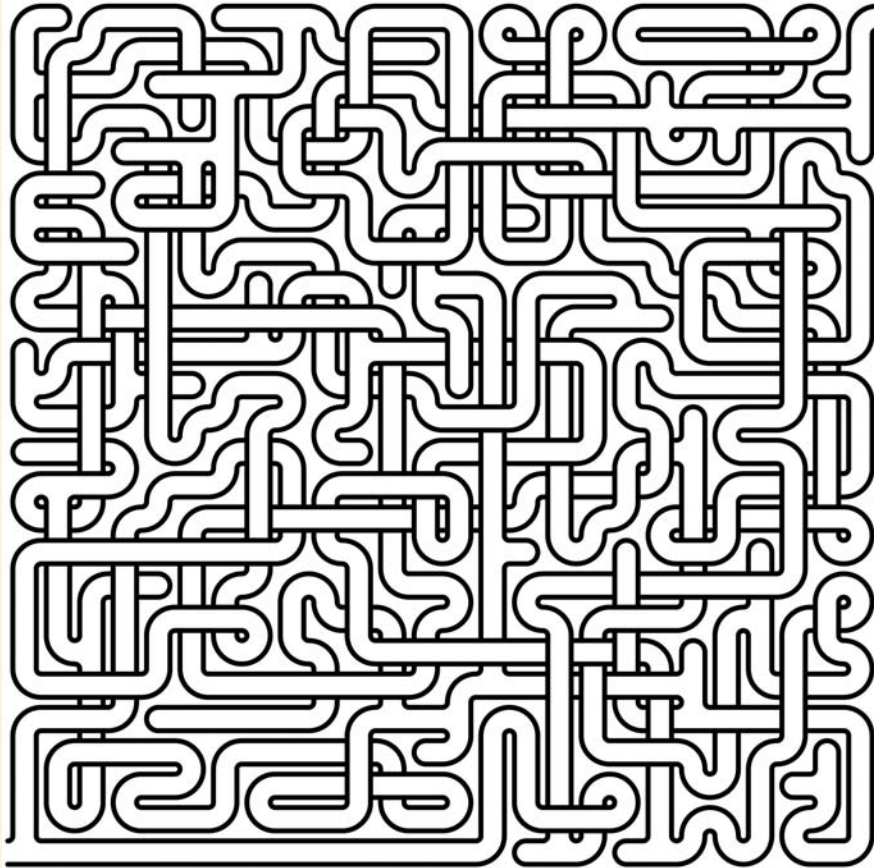
What's in a name?

Sam's Mother has four children. They are called April, May, June, and ... What is the name of the fourth child?

From [Mathsisfun.com](https://www.mathsisfun.com)

Answer on page 5

Help friends meet



*Answer to What's in a name?
puzzle on page 4: Sam!*

Did you get this one?!



RV Sindhu Sadhana



Ballooning Up from the Deep

Zareena, Mookayi and Mari

Zareena, Mookayi, and Mari stood by the railing of the research ship **RV Sindhu Sadhana**. The ocean near Hawaii sparkled under the bright sun. The girls were thrilled to be there. Mooks couldn't contain her excitement. "We're actually at sea! On a ship full of researchers!"

Mari's mother, Usha, a biologist leading the expedition, had arranged for them to join. Even better, **Manu Prakash**, the inventor of the **Foldscope**—a low-cost paper microscope—was on board too! They had first used the Foldscope in a **Tamil Nadu Science Forum** workshop. Their friend **Mo Pandiarajan** had shown them

how to use it. Now, they were surrounded by scientists on a high-tech ship.

Mari pointed to the cabin. "Look, there's Amma—she's leading the biology



Manu Prakash, with Foldscope

Mo Pandiarajan

Mo Pandiarajan works as a teacher at a small primary school in the village of Muthupatti in Tamil Nadu, India. In the early 1990s, the Indian government started a literacy movement. Mo joined the movement and founded the *Eden Science Club*, a group for school-going and drop-out students in Muthupatti that organizes events and lectures to promote scientific exploration for all. When Eden Resource Club received its first Foldscope in 2015, they took an ant as their first sample. From the moment Mo



took a closer look at the microscopic world, he felt like he had unlocked the secrets beyond the naked eye. Today, Mo continues to share the excitement of the microscopic world by providing Foldscope trainings for over 100,000 people and counting. This includes Mo's own son and daughter, who he says "eagerly use their Foldscopes every day!"

team! She's at the microscope!"

Zar gasped. "And that's Manu Prakash! Remember how we used his Foldscope to

study mosquito larvae in the workshop?"

Mooks nodded. "I remember the green algae we saw!"

Just then, Usha walked over, holding a small vial that glowed faintly blue. "Would you like to see something amazing?" she asked. "This is *Pyrocystis noctiluca*—a tiny marine **plankton**. It lives in warm oceans. It glows. It does not swim."

Zar peered at it. "It lights up? Like underwater fireflies?"

Manu Prakash joined them and smiled. "Exactly. It's *bioluminescent*. When waves or fish disturb it, it flashes like a tiny beacon."

Mari squinted at the vial. "Is it really just one cell?"

Usha nodded. "Yes—and it's huge for a single cell. It's usually 250-400 micrometers wide, but it can inflate to six times its size. Big enough to see with your eyes!"

Mooks whistled. "That's almost a millimeter!"

Zar laughed. "That's gigantic for a cell!"

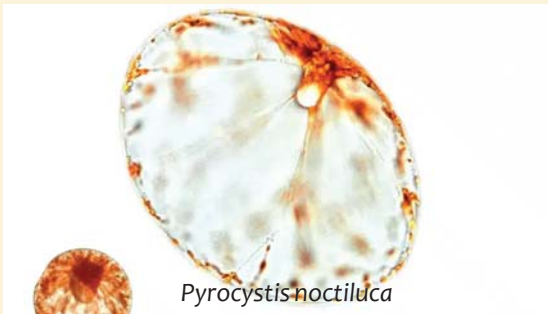
Manu took out a Foldscope. "Under magnification, you'd see something cool. The outside looks smooth, but inside, *plastids* cling to thin threads. Most of the cell is just a giant *vacuole*—like an empty balloon—with the nucleus tucked at the edge."

Mari's eyes lit up. "So the vacuole helps it float?"

Manu explained, "*P. noctiluca* is denser than seawater and should sink. But early in its life, it swells up, making it lighter so it rises. They make a once-in-a-lifetime trip from about 125 meters deep to about 50 meters, where there's more of the sunlight that they need to photosynthesize. At the

What are plankton?

Plankton are organisms that live in water. They cannot swim but simply drift with the currents (flow of the water). There are plant-like plankton (**phytoplankton**) that perform photosynthesis, using sunlight to produce energy and releasing oxygen. In fact, they are an important part of the food chain in the sea. There are also animal-like plankton (**zooplankton**) that feed on other plankton, including phytoplankton. Both varieties form a critical part of healthy water-based ecosystems. Not only are they the food source for many larger marine animals, they also produce a large part of the Earth's oxygen.

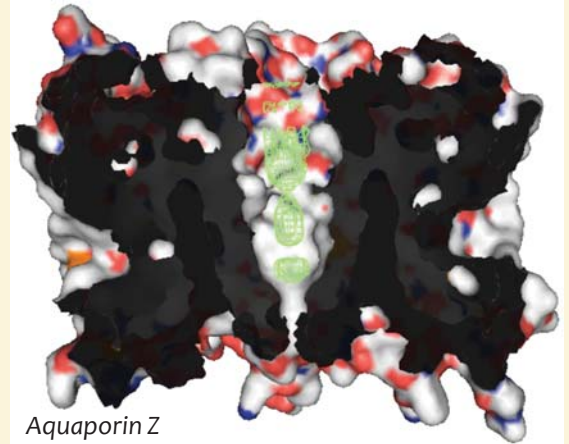


Pyrocystis noctiluca

end of its seven-day life cycle, the cell then starts to divide into two daughter cells as it sinks. When the division is completed, the two newborn cells now inflate by filling up with seawater. And the cycle begins again."

Usha added, "The cell fills its vacuole with low-density water, using special molecules called *aquaporins* to filter out denser salt. Aquaporins are like the plumbing system of a cell. This inflation acts like a slingshot, pushing the cell upward. It's like a helium balloon—but underwater! The large size also protects them from predators and allows for more photosynthesis."

(The picture shows the 3D structure of **aquaporin Z**. You can see the 'hour-glass'-shaped water channel that cuts



Aquaporin Z

through the center of the protein. It's just wide enough to allow water molecules to go through, but does not allow salts inside. So the salt in the seawater remains outside and the vacuole fills with pure water that is less dense than the outside sea water, allowing the organism to float.)

Manu continued, "It can swell six times its size in just 10 minutes. If it doesn't, it sinks too deep, where there's no light—a 'gravitational trap' it can't escape."

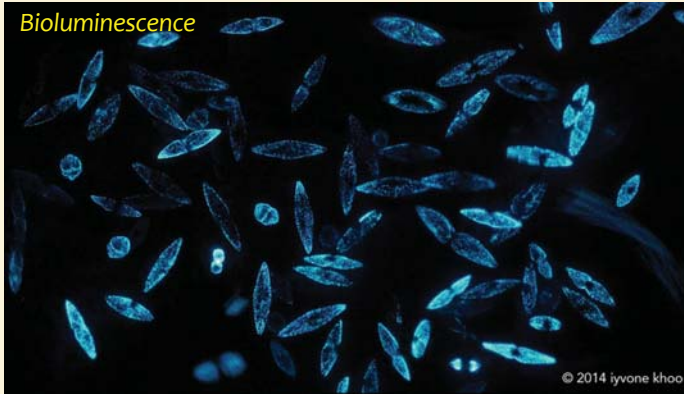
Mooks gasped. "So it's a race against time!"

Zar turned to Usha. "Are there other creatures like this?"

Manu nodded. "Yes! Take **cranchiid squids**—they store **ammonium ions** in their tissues, which are lighter than seawater, so they float easily." (See the article on

Plastids

Plastids are tiny structures inside the cell which serve different functions. The most well-known are chloroplasts, which contain chlorophyll and are responsible for photosynthesis. Chromoplasts are plastids that give the colour to fruit and flowers.



Glass Squids for their fascinating story.)

Zar frowned. "But ammonia is toxic, right?"

Usha agreed. "They've evolved low blood pH to neutralize it. There are also the **Chiroteuthis squids**. It relies on the buoyancy provided by ammonium ions dissolved in their tissues."

Mooks thought for a moment. "So plankton and squids solved the same problem... just differently."

Manu grinned. "That's **convergent evolution**—life finds clever ways to reach the same solution from different starting points!"

As the sun set, the girls looked down. The ocean began to glow.

Zar gasped. "The *Pyrocystis*—it's lighting up the waves!"

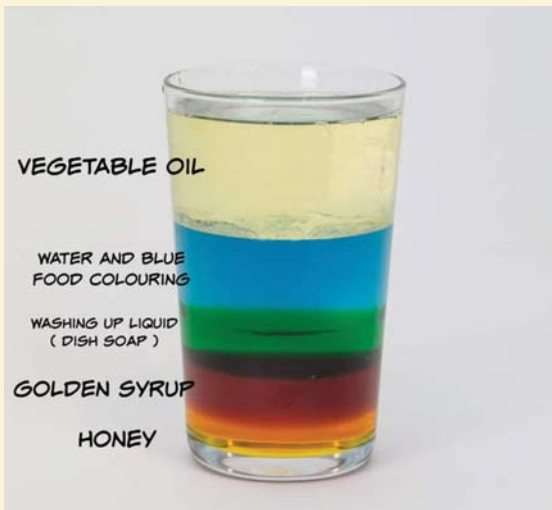
Mari whispered, "Like stars ... all ballooning up."

Together, they called out, "Have a good night, ballooning friends of the deep!"

Mooks clapped her hands. "Let's try an experiment back home! A density jar—layering honey, soap, water, and oil to see how things float."

Zareena added, "And we'll take Foldscoptes to the pond to find plankton!"

References: "Cell biology: Wanderers that balloon towards light" Clotilde Cadart in *Current Biology* 34, R1137–R1157, November 18, 2024; "Inflation-induced motility for long-distance vertical migration" Larson and others in *Current Biology* 34, 5149–5163, November 18, 2024



A density jar experiment

Typically, liquids like honey, dish soap, water, oil, and rubbing alcohol are used. Optionally, add food coloring to each liquid to enhance the visual effect; this creates a visual "rainbow" effect. Carefully pour the liquids into the jar, one at a time, starting with the densest (usually honey) and ending with the least dense (usually rubbing alcohol). Allow the liquids to settle and observe the distinct layers. Then, drop in various objects and see where they float or sink in the layered liquids. They will settle in one of the layers based on their own densities.

Do You Know

1. What is the Ring of Fire?
2. India is a sovereign socialist secular democratic republic. What is the difference between democratic and republic?
3. We are familiar with cyclones. Do we also have tornadoes in India?
4. What is the most abundant element on Earth? In the Universe?

Answers to these questions in the next issue of JM.

Answers to Last Issue's Do You Know?

1. *How much brainpower do our senses take up, and is there one that takes up the most?*

Ans: We don't actually have five senses, which we normally call sight, hearing, taste, touch and smell. In fact, touch is broken down into several components due to how some nerves pick up on some things. So touch/motion/self perception are broken down into lots of things. In any case, brain power could be thought of as

the amount of blood flowing into the brain region to do its job (bringing oxygen and calories) or how much physical space of your brain is dedicated to a particular sense.

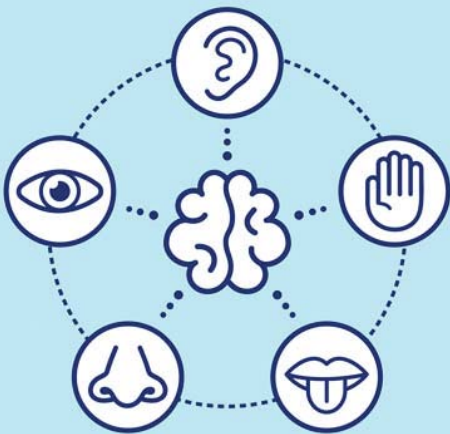
Visual Processing: The occipital lobe, located at the back of the brain, is primarily responsible for visual processing. It receives and interprets signals from the eyes, accounting for a significant portion of the brain's sensory processing capacity.

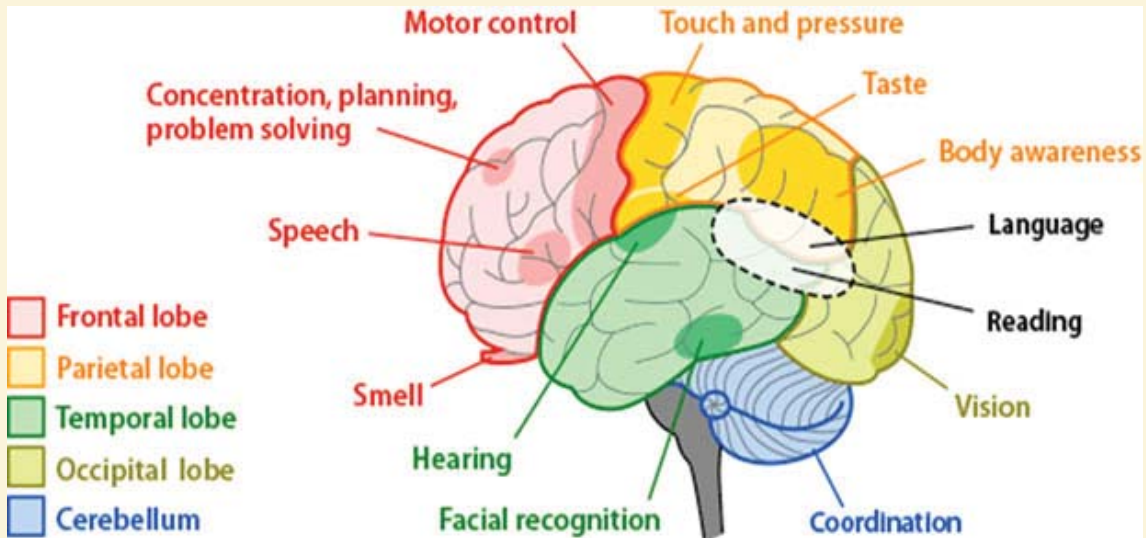
Auditory (Sound) Processing: The temporal lobe, particularly the primary auditory cortex, processes sound. It also plays a role in language comprehension and memory, which can overlap with auditory processing.

Taste and Smell: The gustatory cortex (taste) and olfactory bulb (smell) are involved in processing taste and smell, respectively. These senses are closely linked; for instance, taste is heavily influenced by olfactory signals.

Touch: The parietal lobe contains the somatosensory cortex, which processes tactile information such as pressure, temperature, and pain. (Image from <https://www.tributeseniorliving.com>)

Senses





While it's difficult to assign specific percentages of brain capacity to each sense, studies suggest that a large portion of the brain—up to 30% or more—may be involved in processing sensory information, with **visual processing** often taking the largest share. The exact distribution can vary among individuals and depends on factors such as experience and training.

However, many senses often work together, like smell and taste. For instance, **proprioception** (or kinesthesia), is the body's ability to sense its position and movement in space. It allows you to know where your limbs are without looking and to make adjustments to your posture and movements without conscious thought. This sense relies on *proprioceptors*, specialized sensory receptors located in muscles, tendons, and joints. It could be argued that it takes the "most power" to process proprioception, because this "sense", under normal conditions (like walking down the street and waving to someone) would require bits of other senses: touch, vision, movement, balance, etc.

It is also important to remember that neurons do not have "off" switches. They never goof off; they're always "on", alert, armed and ready for action. So if one sense is using up 10% of your brain power, doesn't mean that the rest of the brain has gone to sleep! It is working 100% of the time, waiting for a signal that needs some action. This also needs energy.

2. *Why do some people get bitten by mosquitoes more than others?*

Ans: Mosquitoes bite some people more frequently than others due to a combination of factors. Clothing choices and even alcohol consumption can alter this.

Body Odour and Sweat: Mosquitoes are attracted to the various chemicals found in human sweat. The smell of a person is influenced by genetics, diet, and skin bacteria. Sweatier persons or those with higher body temperatures tend to attract more mosquitoes.

Carbon Dioxide Exhalation: Mosquitoes detect carbon dioxide from a distance and use it to locate a potential blood meal. Larger individuals and pregnant women,

Mosquito Bite



who naturally exhale more carbon dioxide, may be targeted more frequently.

Skin Bacteria: The composition of bacteria on our skin varies from person to person and can influence attractiveness to mosquitoes.

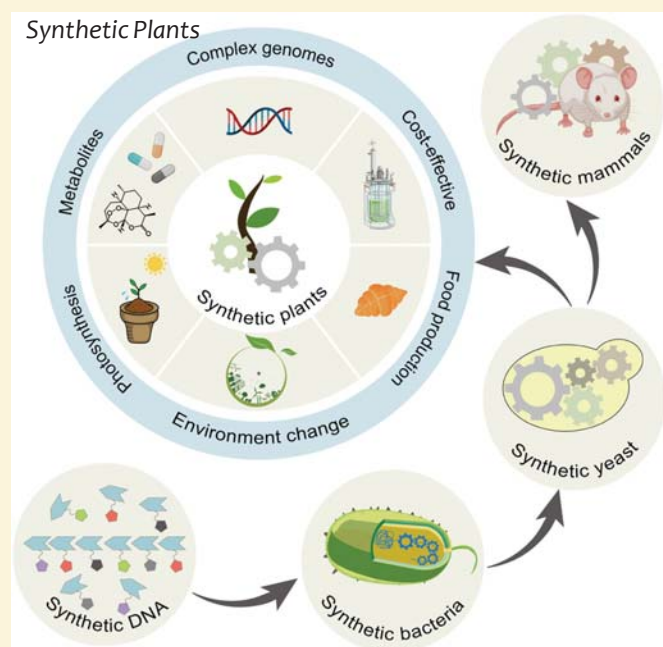
Blood Type: Research suggests mosquitoes are more attracted to people with type O blood. This may be due to specific chemicals released through the skin by people with certain blood types.

Darker clothing can make individuals more noticeable to mosquitoes. Studies suggest that alcohol consumption, particularly beer, may increase mosquito attraction. Even our genes play a role in determining our unique scent and attractiveness to mosquitoes.

3. Can we make a plant entirely “from scratch” using only DNA?

Ans: The short answer is, Not yet. To design and build entire plant genomes, that is, making DNA sequences in the lab, assembling them into functional units like chromosomes, and then introducing them into plant cells, is still quite a challenge.

What has been achieved so far? Scientists can now synthesize DNA from scratch using DNA synthesizers, allowing them to create custom DNA sequences. This means that they can design of new genetic codes and even construct entire genomes. The synthesized DNA sequences are then assembled into larger structures, like **chromosomes**. This means that techniques to build synthetic chromosomes already exist for simpler organisms like yeast and some human cell lines. The process by which these synthetic chromosomes or other genetic elements are introduced into plant cells is called transformation. This is where challenges remain. Various methods are being tested and developed to efficiently perform transformation for plants. This is

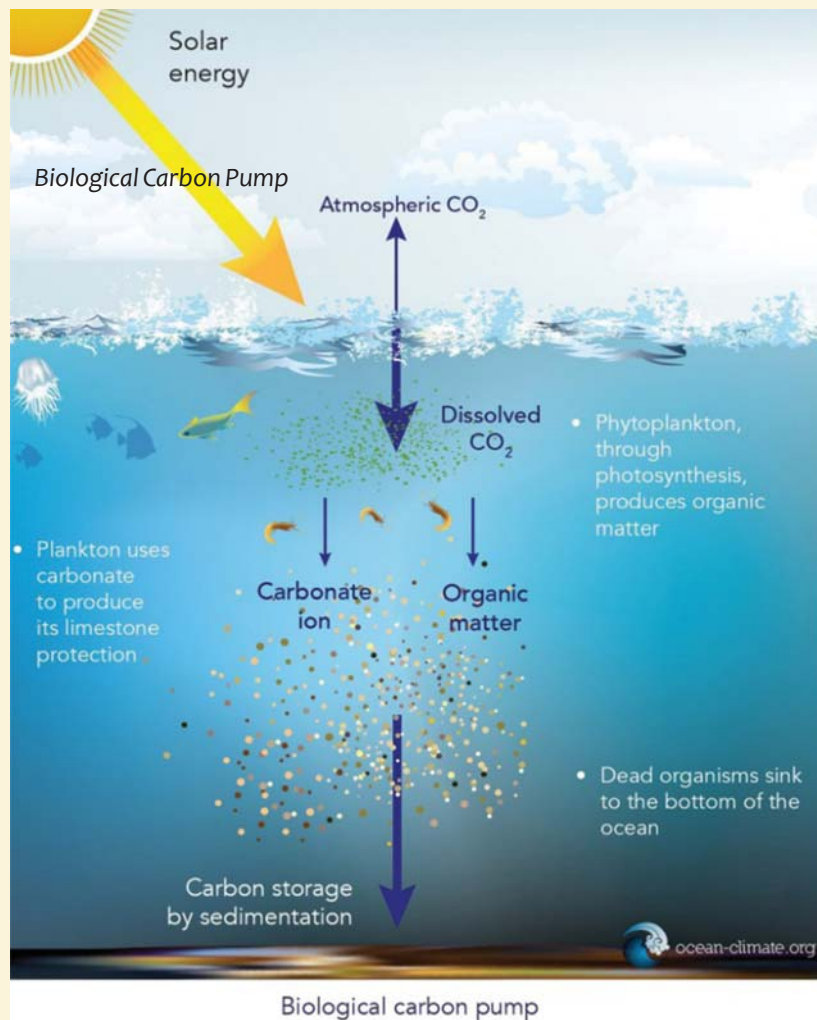


still an active area of research. The ultimate goal is to create a plant that can grow and reproduce from this synthetic genome. This will enable us to create crops with new traits and capabilities. For example, development of crops with increased resilience to climate change, improved nutritional content, are important aspects of this research. It could also lead to a better understanding of plant biology and evolution.

4. Do fish in the deep sea experience seasons?

Ans: Yes, deep-sea fish can experience seasonal changes, though not in the same way as surface-dwelling organisms. The most prominent seasonal changes in the ocean occur at the surface, influenced by sunlight and weather patterns. How does this affect deep sea season? Algal blooms are produced in sunlight. These slowly sink to the sea bed as “marine snow” and become food for the deep-sea ecosystem. This “marine snow” creates seasonal patterns in food availability for deep-sea organisms.

Researchers have documented seasonal migrations of deep-sea fish, suggesting that they respond to these variations in food supply. But as you go deeper, at 3-5 km under water, there will be hardly any



marine snow. This has more influence near continental shelves.

The extent of seasonal influence varies with location. Fish and other marine life in some deep-sea regions (particularly those far from continental shelves or major current systems), may not experience these seasonal changes. So, for example, in the middle of the Atlantic and Pacific oceans, the bottom water is mostly unaffected by seasonal changes in surface waters.

Compiled
from many sources



The Magical Rainbow Adventure

Monica Sueha and Kannan. K

One sunny morning after a rain shower, a curious little boy named Liam and his playful dog, Max, stepped outside. As Liam looked up at the sky, he gasped. There, stretching from one end of the sky to another, was a beautiful rainbow! It shimmered with colours: red, orange, yellow, green, blue, indigo, and violet.

"Wow! Where does the rainbow come from?" Liam wondered aloud.

A soft voice whispered, "Would you like to find out?"

Liam spun around, and he saw a glowing mist near the rainbow's end. Out of the mist stepped a tiny, sparkling fairy named Iris. She had wings as colourful as the rainbow itself.

"I can show you the wonders of the rainbow," Iris said, smiling. "Rainbows are nature's way of painting the sky with light!"

Liam's eyes sparkled. "Really? How does it work?"

Iris waved her wand, and a gentle swirl of light surrounded them. Suddenly, they were floating high in the sky, near the rainbow!

"You see," Iris explained, "a rainbow is made when sunlight meets tiny drops of water in the air. The sunlight enters a raindrop, bends, and splits into different colours. Then it bounces off the inside of the raindrop and bends again as it leaves. This bending and bouncing create the beautiful colours you see!"

Max barked excitedly as they floated closer to the rainbow's glowing colours.

Double rainbow



"But why are the colours always in the same order?" Liam asked.

"Great question!" said Iris. "Each colour bends differently because of its wavelength. Red bends the least, so it's on top. Violet bends the most, so it's at the bottom." (The curious reader can see the Boxes for a more detailed explanation. Each Box contains a little more material for the increasingly curious reader!)

Suddenly, Liam noticed another fainter rainbow above the first one. "Look, Iris! There are two rainbows! How is that possible?"

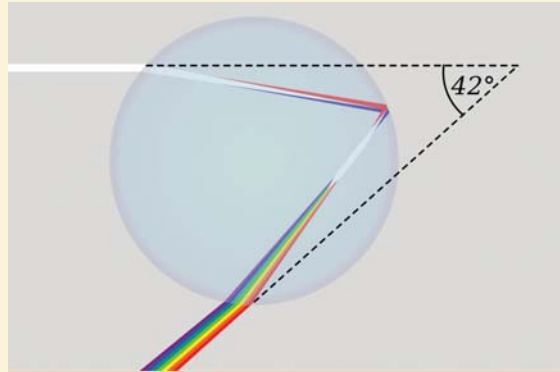
Iris clapped her hands. "Ah, that's a double rainbow! It happens when sunlight bounces twice inside the raindrop before it comes out. The second bounce flips the colours, so the second rainbow has violet on top and red at the bottom. It's fainter because the extra bouncing scatters more light."

Liam's jaw dropped. "That's amazing! Can I take a piece of the rainbow home?"

Iris chuckled. "Rainbows are only for looking. They remind us of hope and wonder. But their magic stays in your heart forever."

With a wave of her wand, Liam and Max found themselves back in their garden. The rainbow and its double were still in the sky, but Iris was gone. Suddenly the earth

Double Rainbow closeup



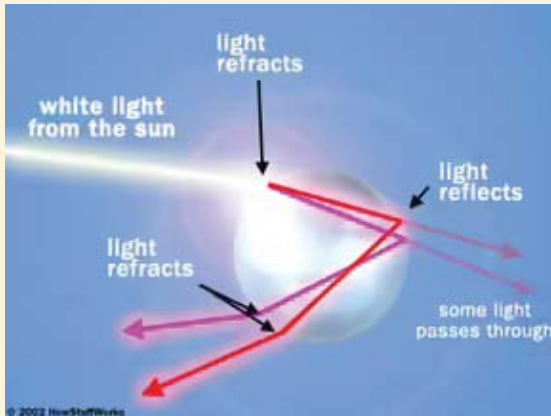
How do rainbows form?

Sunlight is made up of several colours. When sunlight is passed through a prism, for instance, it breaks up into several colours. This is called dispersion. In the rainy season, millions of water drops are to be found in the clouds. These drops disperse sunlight exactly like a prism does and form the rainbows we see.

shook and Max barked loudly. Liam shut his eyes and ears, but the voice he heard did not stop. "Wake up, Max!" it kept saying, over and over. Liam opened his eyes and saw his mother by his bed, shaking him awake. "Time to go to school, Max!" she said, and left.

Liam sat up in his bed and thought about his dream. He smiled. They had learned about the rainbow yesterday, in class. It must have made a deep impression on him. He looked out of the window hopefully, but the sky was clear. He smiled at Max and said, "Never mind, Max. We'll soon see a rainbow. Do you know what they are? Rainbows are more than just colours—they're a magical surprise from the rain, the sun, and even science!"

From that day on, every time Liam saw a rainbow, especially a double rainbow, he remembered his magical dream and the fairy who taught him its secrets.



Sunlight and a raindrop: the physics of rainbows

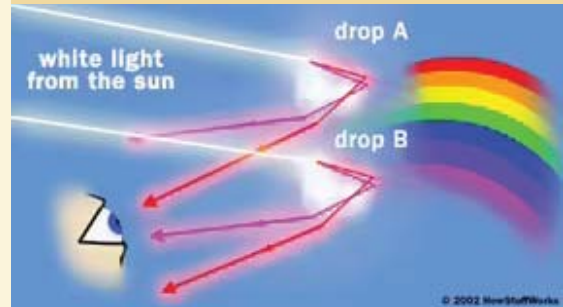
When sunlight encounters a raindrop, part of the light is reflected and the rest enters the raindrop. The light is refracted (bent) at the surface of the raindrop because it is passing from air to water, with a different refractive index. When this light hits the back of the raindrop, some of it is reflected off the back. This is called total internal reflection and happens when the light falls on the back surface of the water drop at sufficiently large angles. (You may have noticed this yourself, in the evenings, when you can see your own reflection in transparent window-glass. Of course, glass always reflects a small amount of light, but when the room is well-lit and the outside is getting dark, this reflection is easier to see.)

When the internally reflected light reaches the surface again, once more some is internally reflected and some is refracted as it exits the drop. This refracted light is what causes the rainbow; the other light serves to light up the clouds.

A small calculation shows that the light is reflected back over the range of 0° to 42° , with the most intense light at $40\text{--}42^\circ$, depending on the colour of the light.

Sunlight and many raindrops: how the rainbow colours are arranged

Look at the sketch of the sunlight going through two drops, A and B. Now, we see only one colour from each raindrop, because the others reflect light at angles that do not fall into our eyes. So, when raindrop A disperses light, let us imagine that only the red light exits at the correct angle to travel to our eyes. The other coloured beams exit at a lower angle, so we don't see them. The sunlight will hit all the surrounding raindrops in the same way, so they will all bounce red light onto our eyes, so we see a



band of red colour from all the raindrops at that angle in the sky.

Raindrop B is much lower in the sky, so we can't see the red light from it. Since it is lower, we will see light that has bent more, that is we will see colours like orange, yellow, green, blue, or violet. Let us imagine that this drop is at a height so that it sends violet light (the other end of the rainbow) into our eyes. All the drops surrounding raindrop B bounce light in the same way. The raindrops in between A and B all bounce different colors of light to us, so we see the full color spectrum from violet at the bottom to red at the top. If you were up above the rain, you would see the rainbow as a full circle, because the light would bounce back from all around you. On the ground, we see the arc of the rainbow that is visible above the horizon.

How a double rainbow is formed

A fainter rainbow is sometimes seen above the usual rainbow. This happens when the light reflects twice inside the raindrop. Because of this double reflection, the light exits the raindrop at a different angle, so we see it higher up. If you look carefully, you'll see that the colors in the second rainbow are in the reverse order of the primary rainbow.

Now, we already said that red light is bent the least, and so if you look at the picture, it will seem as though the rainbow should have red on the inside and violet on the outside. But it is the other way

What is the best time to see a rainbow?

We know that when the Sun is 42 degrees up in the sky, the rainbow will be on the horizon or close to it (see Box 2). If the Sun gets higher, the rainbow will be below the horizon and you won't be able to see it. So the best time to see a rainbow (or even two!) is near sunrise or sunset. So you can't see a rainbow in Tamil Nadu roughly between 09:30 to 14:30 in December and between 08:30 to 15:30 in June.

around! Why is this? To understand this, look at the next box.

Sources: How Stuff Works, Wikipedia

Puzzles to puzzle you *Apples and baskets*

Someone has mixed up the apple baskets. One of the baskets has apples that weigh more than the others. Here is what we know.

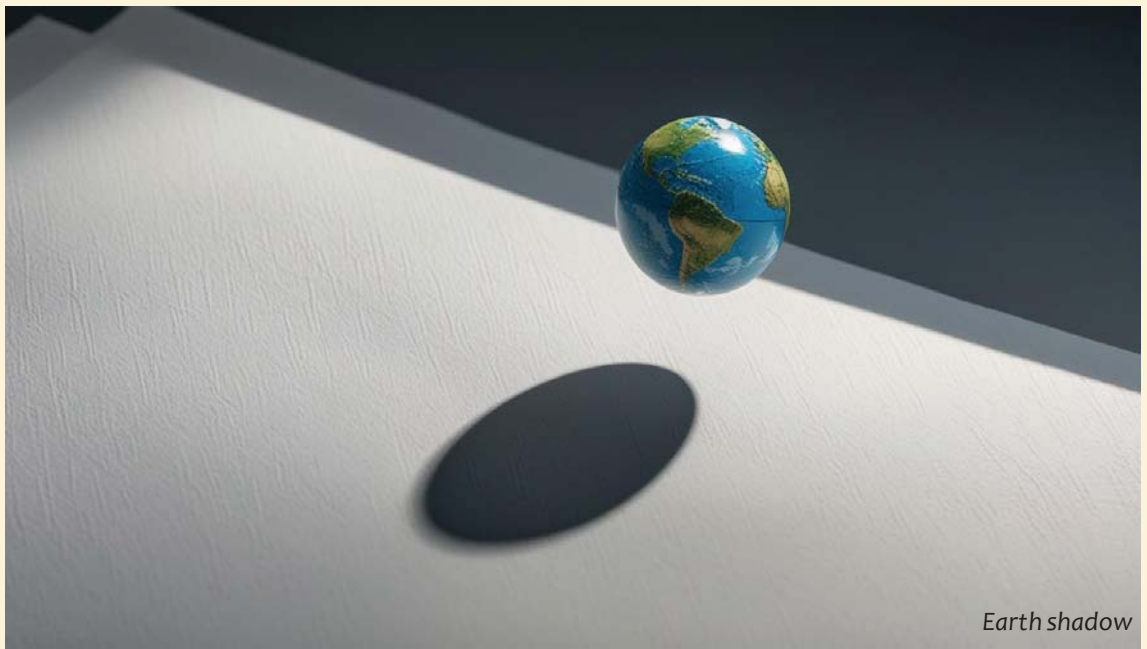
- . There are 10 baskets containing apples.
- . There are various amounts of apples in each basket ranging from 10 to 20.
- . 9 of the baskets have apples weighing 100 g each.
- . 1 of the baskets has apples weighing 120 g each.
- . All the apples look the same.

You have a weighing scale measuring in grams, and an empty basket whose weight we know. It is late and the truck is waiting to take the apples to market. You only have time to make one measurement using the scales. Can you discover which basket has the 5 ounce apples?

From Mathsisfun.com



Answer on page 34



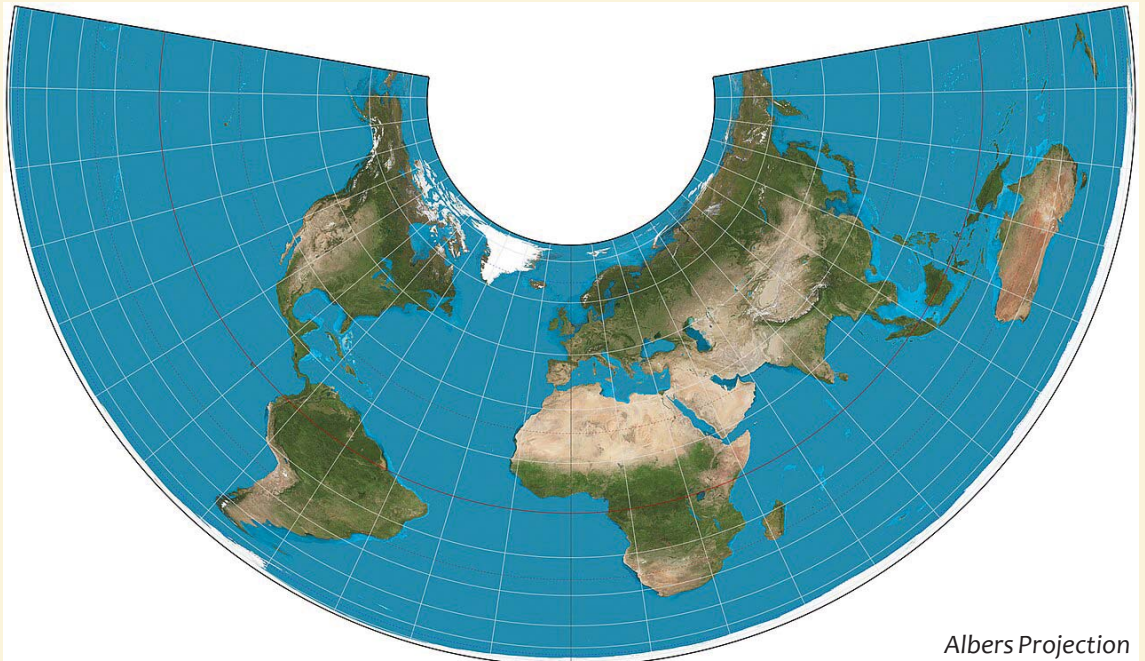
Earth shadow

Map it Out!

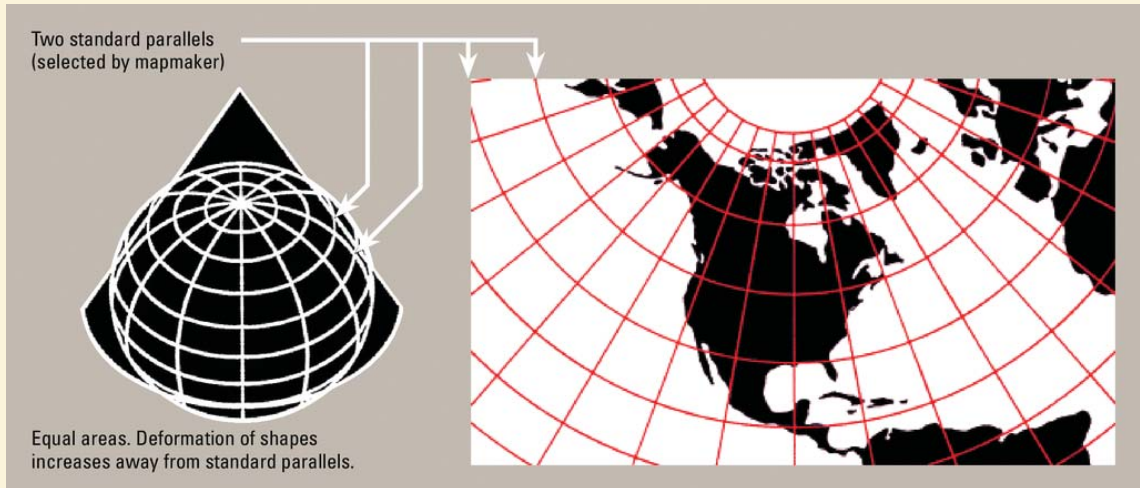
D. Maya and friends.

Chennai

The Earth is a globe, but in every map, we represent it on a flat piece of paper. There are many ways to show a map of the countries of the world. It all depends on what you want to highlight. However, the famous scientist Carl Friedrich Gauss proved that each representation distorts the true facts in some way or the other.



Albers Projection

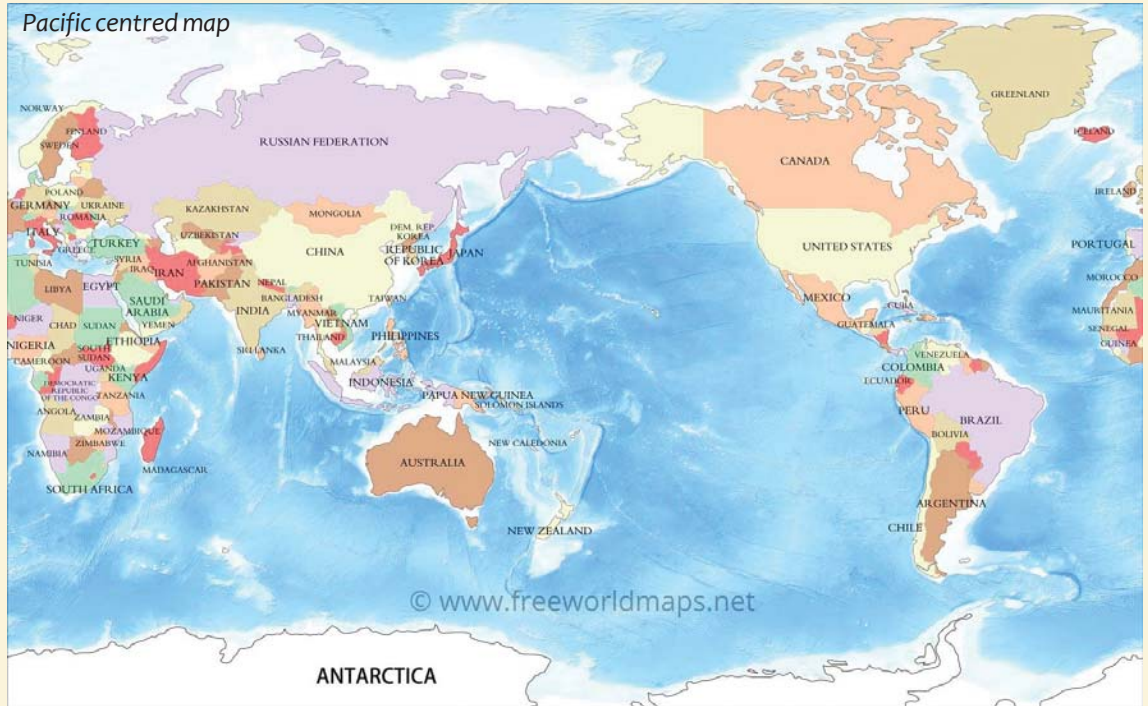


Albers equal area projection

Mercator projection



Pacific centred map



Mollweide projection



Some maps are drawn so that the area of a given region is preserved. That is, the shape is distorted so that the area of (say) India and China are shown correctly in proportion. For instance, two longitudes and two (parallel) latitudes are used to describe

a fixed area, and then rendered on the **Albers equal area projection** map. As the name suggests, the area is preserved (so if a country looks big on this map, it is big) but the scale and direction is not preserved, especially as you go away from the

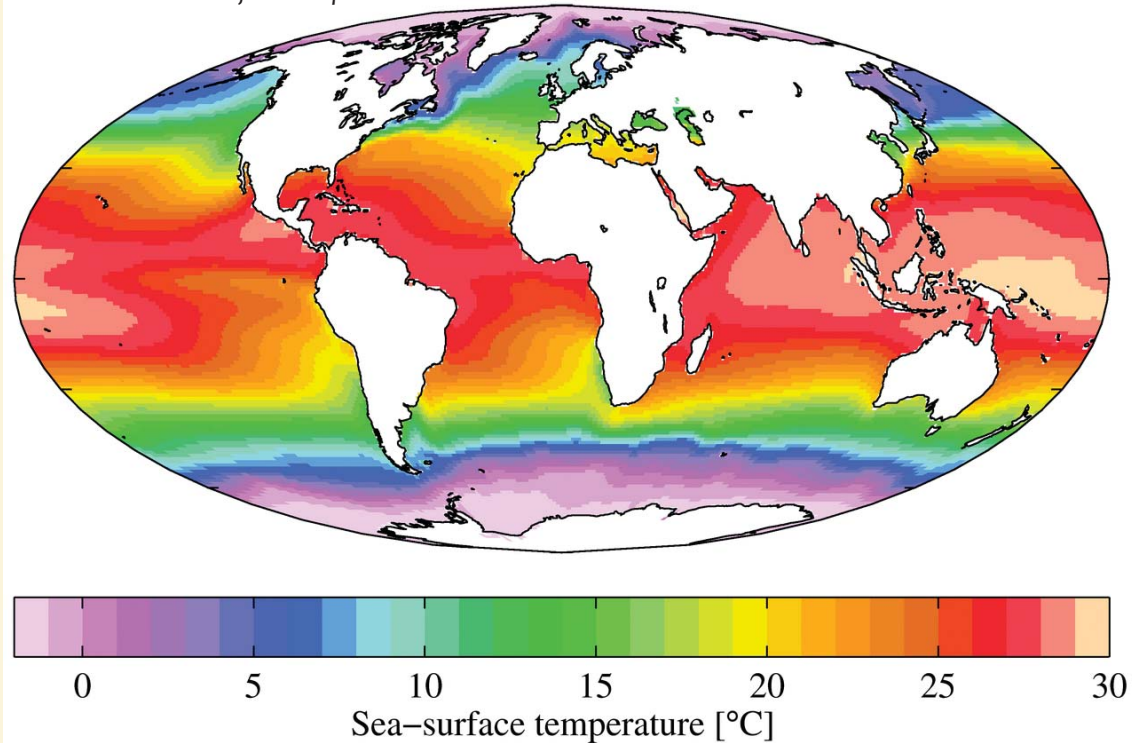


Globe Princeton University

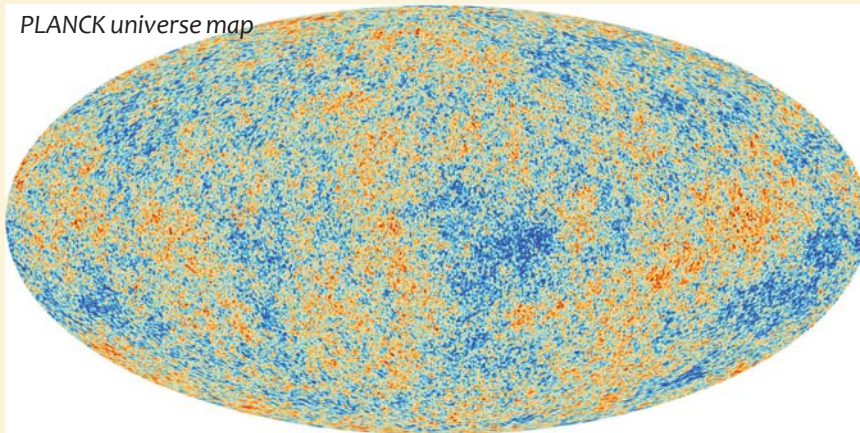
standard parallels. The picture shows the Albers world map using the standard parallels 20° and 50° North. So the region between these two is hardly distorted, while the regions outside these latitudes are badly stretched. See for instance, **Australia** in the southern hemisphere, which is nearly unrecognisable. However, the areas of these countries is correctly represented.

Sometimes, it may be more important to preserve the shape of the region and then it may be shown as having more or less area than the actual value. For instance, in the most common **Mercator projection**, countries near the North Pole are usually shown to be very large. This is because the projection is like that of a cylinder: places near the equator are more or less represented correctly, but **Greenland** near the North Pole and **Antarctica** near the South Pole are stretched from being

Annual mean sea surface temperature



PLANCK universe map



the small end-cap of a sphere to the width of the entire cylinder.

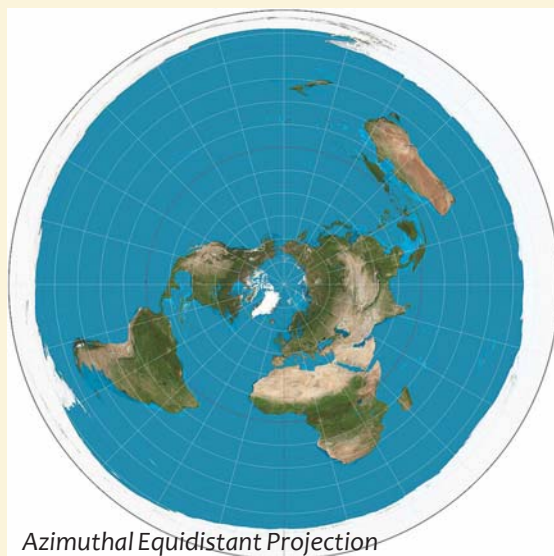
If you want to see how close the eastern end of Russia is to the western end of the United States (Alaska), see the Pacific-centric map! This map is preferred for obvious reasons in countries around the Pacific ocean. They obviously will not prefer a map where their country is squeezed somewhere in the corner of the map. This happens because a globe has to be “cut open” to fit on a flat surface, otherwise you will be able to see only the “front half”.

A more popular version is the **Moll-**

weide projection. It is also an equal area map. You can see that instead of the map being rectangular, it is like a flattened circle. This reduces the enormous distortion near the poles that you see in Mercator projections. You must remember, though, that this is the entire Earth and not just the “front part” of it that you would see on a 3D globe (see the picture, where India is completely hidden). The Mollweide projection is very useful to see global parameters at a glance, for instance, the *mean sea surface temperatures* around the world in 2009.

An exotic use of the Mollweide projection is to represent not countries on the Earth but galaxies on the spherical Universe itself. The **PLANCK** telescope has been observing the Universe for more than 10 years now. Shown in the map are the observations of light coming from different parts of our Universe from very early times. Red and blue spots indicate where the Universe is slightly hotter or cooler than the average value of 2.7 K (or -270°C).

There are many more types of maps in use for different reasons. For instance, can you spot India on this map? Does this map seem familiar to you? Where have you seen it before? For answer, see the back cover.



Azimuthal Equidistant Projection

Science News

Headlines

- Why are humans able to speak & learn complex languages
- New fossil found that walked upright like humans
- Humpback whales are trying to send messages to humans
- Yala Glacier declared dead

Read more about some of these below.

How did humans develop the ability to speak and create languages?

Every species makes sounds, but humans are unique because they can speak in complex languages and learn multiple languages, too. Scientists in the US now propose that one particular protein in the gene **NOVA1** could be responsible for homo sapiens being able to communicate like they do.

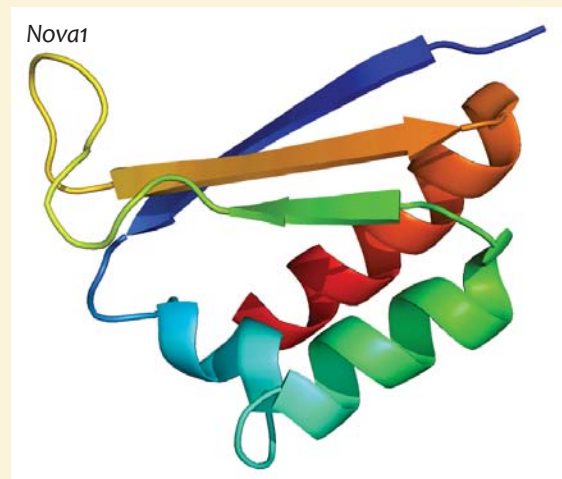
They noticed that the NOVA1 gene is present in all mammals and is useful for neural development. But unlike other mammals and even ancient humans, the NOVA1 gene in modern humans has one different protein variant, called the **I197V**.

NOVA1 (Neuro-Oncological Ventral Antigen 1) is a critically important gene that regulates RNA binding in the developing brain. This gene acts like a conductor in an orchestra, helping coordinate how neurons develop and connect with each other. It's particularly active during early brain development, influencing how nerve cells mature and form networks.

What makes NOVA1 especially interesting is a specific mutation found only in

humans. This mutation, called I197V, involves a single amino acid change that occurred after humans diverged from our ancient cousins like Neanderthals and Denisovans. In genetic terms, this is remarkable—a tiny change that potentially contributed to massive differences in communication abilities.

The research team, led by neuroscientist **Gül Dölen**, used CRISPR gene-editing technology to replace the mouse version of NOVA1 with the human variant. This precise genetic engineering allowed them to create mice with the exact mutation that makes human NOVA1 different from other



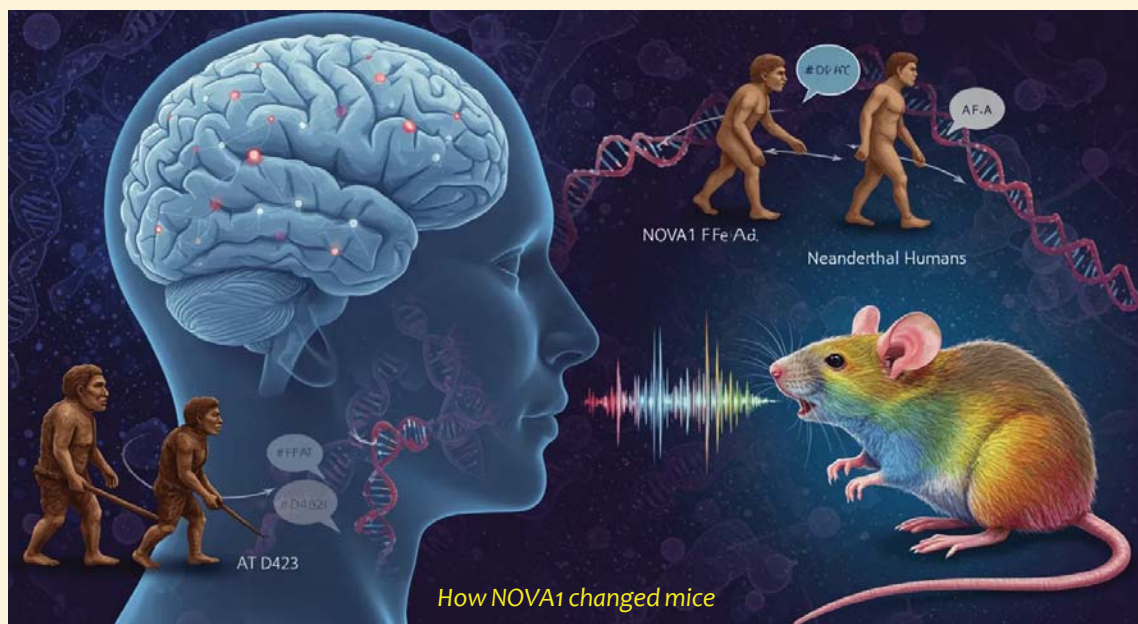
primates.

After successfully creating these “humanized” mice, the researchers began recording and analyzing their vocalizations. Mice naturally communicate through ultrasonic vocalizations (USVs)—squeaks at frequencies too high for humans to hear without special equipment.

The results were striking: Mouse pups with the human NOVA1 variant made calls with higher pitched frequencies. Adult male

The researchers also observed physical changes in the brain structures of the modified mice, particularly in regions associated with vocal learning and production. This provided physical evidence that NOVA1 influences not just vocalization but the actual neural circuits involved in producing sounds.

The discovery that Neanderthals had the ancestral version of NOVA1, not the human-specific variant, provides intriguing



mice produced more complex call structures during courtship behaviors. The vocalization patterns showed greater variety and structural organization.

Interestingly, while the calls were more complex, they weren’t necessarily more effective at attracting attention from other mice. This suggests that the changes were significant but didn’t automatically confer communication advantages in the mouse context—a fascinating parallel to how evolutionary changes often work.

insights about our ancient relatives’ communication abilities. This genetic difference suggests that while Neanderthals likely had some form of communication, it may have been fundamentally different from modern human speech.

This contrasts with another famous “language gene” called **FOXP2**. Both humans and Neanderthals shared the same version of FOXP2, which is linked to speech and language development. The different pattern with NOVA1 suggests a more com-

plex picture of language evolution, where multiple genes contribute to our unique abilities.

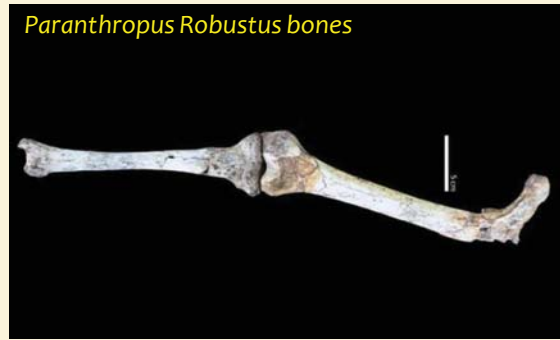
The human I197V mutation in NOVA1 appears to have emerged specifically in the *Homo sapiens* lineage after our divergence from Neanderthals around 500,000-600,000 years ago. This timing coincides with periods of rapid cultural and technological development in our ancestors, suggesting possible connections between language evolution and other human innovations.

The NOVA1 experiment raises important ethical questions about genetic modification and animal research. While the study provides valuable scientific insights, it reminds us of the need for careful consideration of research ethics and animal welfare in scientific advancement.

Beyond the laboratory, this research touches on fundamental questions about human identity. What makes us human? How much of our uniqueness comes from our genes versus our cultural experiences? The NOVA1 study suggests that while genetic factors made language possible, the complex interplay between biology, environment, and culture shaped human communication into what it is today.

New fossil found that walked upright like humans

For decades, scientists have been puzzled by *Paranthropus robustus*, a mysterious hominin (human-like) species from two million years ago. Recently a study has made a new and startling find at **Swartkrans Cave** in South Africa. The fossil remains of a small *Paranthropus robustus*, including a hip, thigh, and shin bone, have revealed that this ancient species wasn't just



another ape-like creature. They actually walked upright, just like humans!

Such species are called bipedal walkers. Despite their tiny size, just barely over 3 feet tall, yet they were walking upright – a crucial milestone in the evolution of humankind.

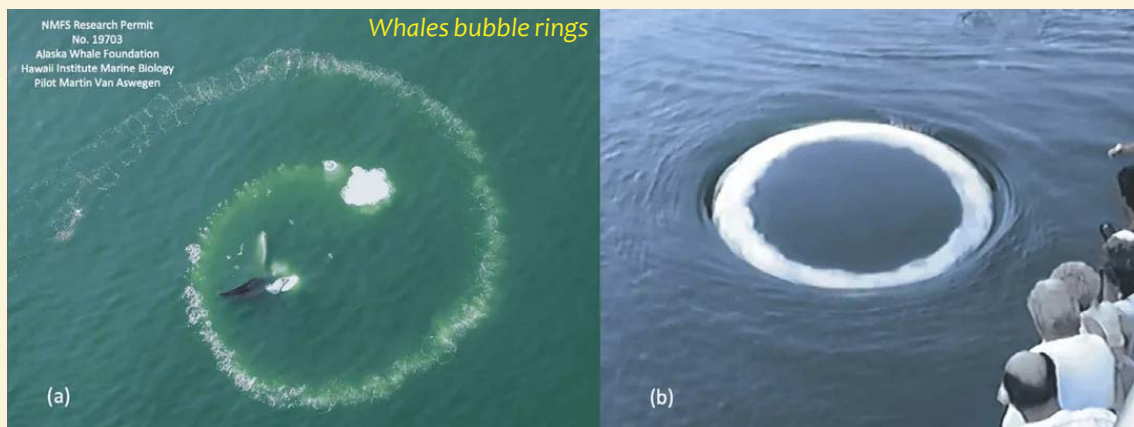
The individual fossil found is believed to be a young female, measuring about 1 metre tall and weighing only 27 kg – smaller than other early hominins like *Australopithecus afarensis* and *Homo floresiensis*, both of which are larger in comparison.

What's even more interesting is the danger these ancient species faced. The fossils show signs of damage from predators like leopards, leaving tooth marks and chewed bones. But it wasn't helpless – scientists found indications that these little hominins used tools.

Researchers are now diving deeper into their behaviour, social structure, and tool use, trying to piece together a story that's more complex than we ever imagined.

Humpback whales are trying to send messages to humans

Humpback whales have been documented for the first time creating large bubble rings in water during friendly inter-



actions with humans, suggesting they could be trying to communicate with us.

These whales are known to use bubbles to hunt prey and when competing to escort females. They don't just produce these rings but also manipulate them in a variety of ways, actively controlling their size and depth. The bubble rings are described by researchers as spinning, air-infused vortices that look like "giant smoke rings" about a metre in diameter.

The whales often exhibit inquisitive, friendly behaviour towards boats and human swimmers. "We've now located a dozen whales from populations around the world, the majority of which have voluntarily approached boats and swimmers blowing bubble rings during these episodes of curious behaviour," said **Jodi Frediani**, an author of the study,

In the study, researchers analysed 12 humpback whale bubble ring production incidents, totalling 39 rings made by 11 individuals. They categorised the whales into known age classes: yearling; 4-6 years old subadult; and adult.

In many of these instances, during ring release, the whales were motionless or slowly idling forward "with blowholes held

upright and the body mostly in the horizontal position". "None of the other ten episodes were associated with feeding behaviour nor were prey organisms noted within rings," the researchers noted. In a majority of the observed incidents the ring blowing whale was alone, suggesting that the intended recipient wasn't another whale.

"More research is needed to systematically study bubble ring production and ascertain under what conditions bubble rings are consistently produced," they said.

Yala Glacier declared dead

Climate change is impacting our seas, our rivers, and our mountains. In particular, because of global warming, glaciers (which are sheets of ice) on the Himalayan ranges are melting and dying into puddles of water.

On May 12, 2025, the rapidly retreating Yala Glacier in Nepal's **Langtang Valley** was officially declared to be dying, and a memorial plaque put in place at a height of 5000 m. The ceremony brought together scientists, monks, villagers, and government officials, in a rare combination of science and prayer. While Buddhist monks prayed over it, glaciologists (scientists who



study glaciers) made speeches to the listening audience. At the site are photographs marking the retreat of the glacier from 1974 to the present. It is expected to vanish by 2040. It is especially shocking since this was glacier long used to train Nepal's glaciologists due to its accessibility.

Its memorial plaques are carved into local Nepali granite and bear inscriptions in English, Nepali and the Tibetan language. The text includes a reading of current atmospheric carbon dioxide levels and the words:

"We know what is happening and what needs to be done. Only you know if we did it,"

by the Iceland poet and environmentalist **Andri Snaer Magnason**.

This is the third global glacier to bear Magnason's climate message, following memorials for Iceland's **OK Glacier** in 2019 and Mexico's **Ayoloco Glacier** in 2021.

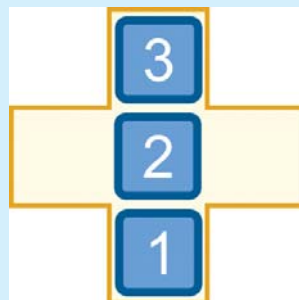
Sources: <https://torontostarts.com>, [Indian Defence Review.com](https://www.indiandefence.com), [Yahoo News](https://www.yahoo.com), [Down to Earth Magazine](https://www.downtoearthmagazine.com)

Change the order

*Puzzles
to
puzzle
you!*

The diagram shows a cross-shaped box containing three numbered blocks reading 3, 2, 1, downwards. The puzzle is to slide the blocks around the box until the numbers read 1, 2, 3 as you go down. How do you do it? And how many moves does it take?

From [Mathsisfun.com](https://www.mathsisfun.com)



Answer on page 35



Nature Diary

Glass Squid

(Family Cranchiidae)

Maximum Size: 2 m

Found at depths: Surface–2,000m
(some species may migrate closer to the surface at night)

Habitat: Midwater, primarily in the twilight (mesopelagic) zone, with juveniles in the surface (epipelagic) zone

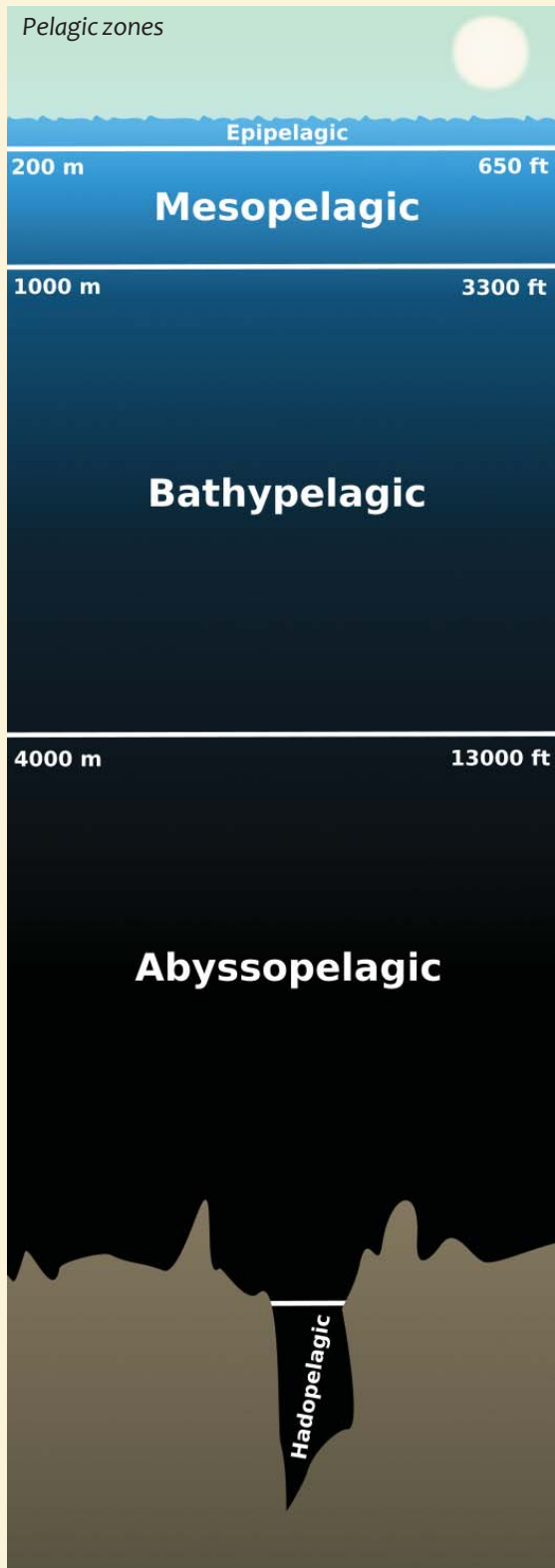
Diet: Crustaceans, fishes, and cephalopods

Range: Worldwide

Glass squids (family Cranchiidae) live in the boundless waters of the twilight, or mesopelagic, zone in the sea. This is the part of the sea that is 200-1000 meters deep. It is characterised by faint sunlight, with temperatures that change rapidly with depth. This region has a unique ecosystem of **bioluminescent** creatures, of which glass squids are one.

With no protective shell and nowhere to shelter, they need to get creative. Transparency is one way to thrive in a home with few places to hide. An “invisibility cloak” keeps these squids safe in the twilight zone.

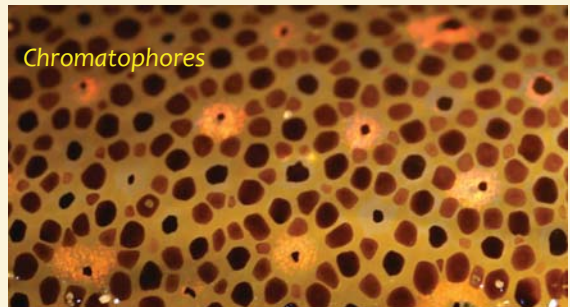
Like other **cephalopods** (a class of marine animals, including molluscs), glass squids are covered in tiny pigment sacs called **chromatophores**. They often keep their chromatophores closed so their skin is basically see-through. This invisibility cloak



hides them from both predators and prey.

Glass squids have a large internal cavity they fill with **ammonium**, a chemical that is lighter than seawater. Building a more buoyant body means the squid does not have to swim as hard to stay afloat. They manoeuvre slowly through the midwater with their fins, constantly on the lookout for danger or a delicious meal.

Special light organs called *photophores* mask the shadow of their opaque body parts, like their eyeballs. These organs glow at the same intensity as the dim sunlight



from above to hide the squid's silhouette from predators hunting from below.

When the glass squid's cover is blown, they expand their chromatophores to darken their appearance. Some may fill their body cavity with ink instead, presumably to blend into the darkness. And when danger still looms, a glass squid may squirt ink into the water and jet away. A ghostly shroud of ink creates a distraction so the squid can escape.

More than 60 species of glass squids live in deep twilight waters around the world. Some are little more than 10 centimeters long, but others are giants. In fact, the largest of all squids—the colossal squid (*Mesonychoteuthis hamiltoni*), nearly 10 meters long and weighing up to 495 kilograms—belongs to the family **Cranchiidae**. We typically see smaller glass squids about 30 centimeters long, likely because the larger ones are faster swimmers that can easily elude our slow-moving submersibles.

But the future of these fascinating midwater animals is in danger. The deep seafloor holds

buried treasure: nodules of precious minerals critical to modern technologies. Mining these metals will release plumes of wastewater that will cloud the ocean's twilight zone.

Most deep-sea habitats have very low concentrations of naturally suspended sediment, even near the seafloor. Glass squids and other midwater animals have extremely large eyes and keen eyesight. Many communicate with living light, or bioluminescence. Investigating how deep-sea animals sense their surroundings will help us predict how much harder mining will make their day-to-day lives. We urgently need to identify the impacts deep-sea mining will have across all ocean habitats, from the midwater to the seafloor.

Source: <https://www.mbari.org/animal/glass-squid>, Monterey Bay Aquarium Research Institute

About: MBARI is a non-profit oceanographic research centre advancing marine science and engineering to understand our changing ocean.

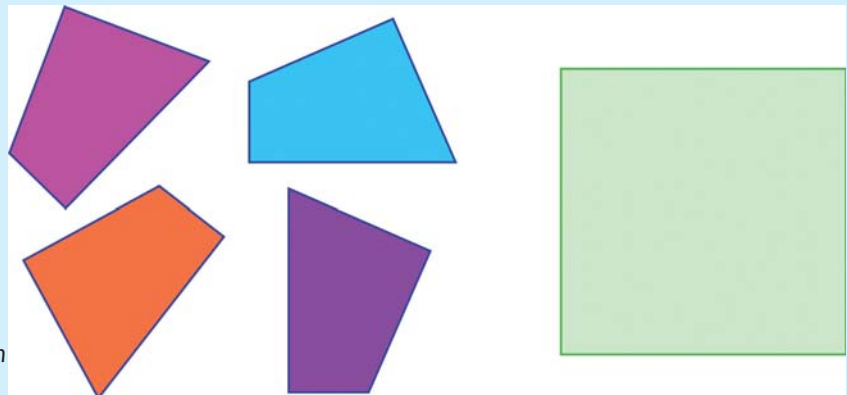
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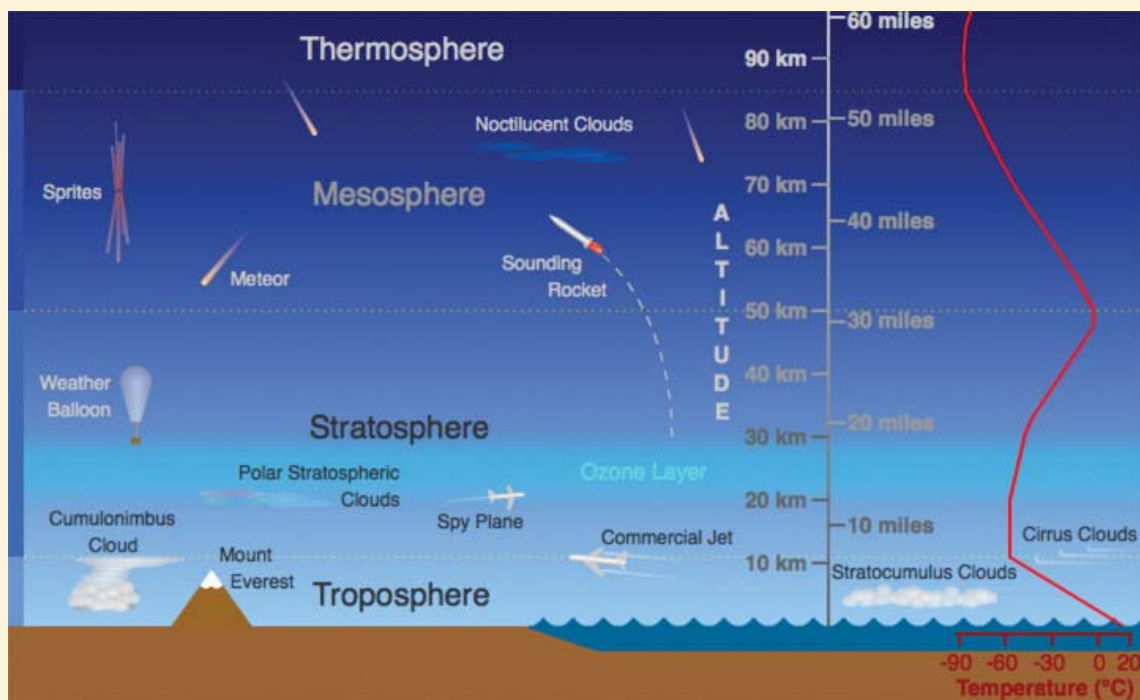
Puzzles to puzzle you!

Make the square

Can you fit the pieces to form a square? Maybe you can cut out the pieces first and try.

From Mathsisfun.com





Atmospheric Composition of Planets

Dr. A. Arun Viveke,

St. Joseph's College, Tiruchirappalli

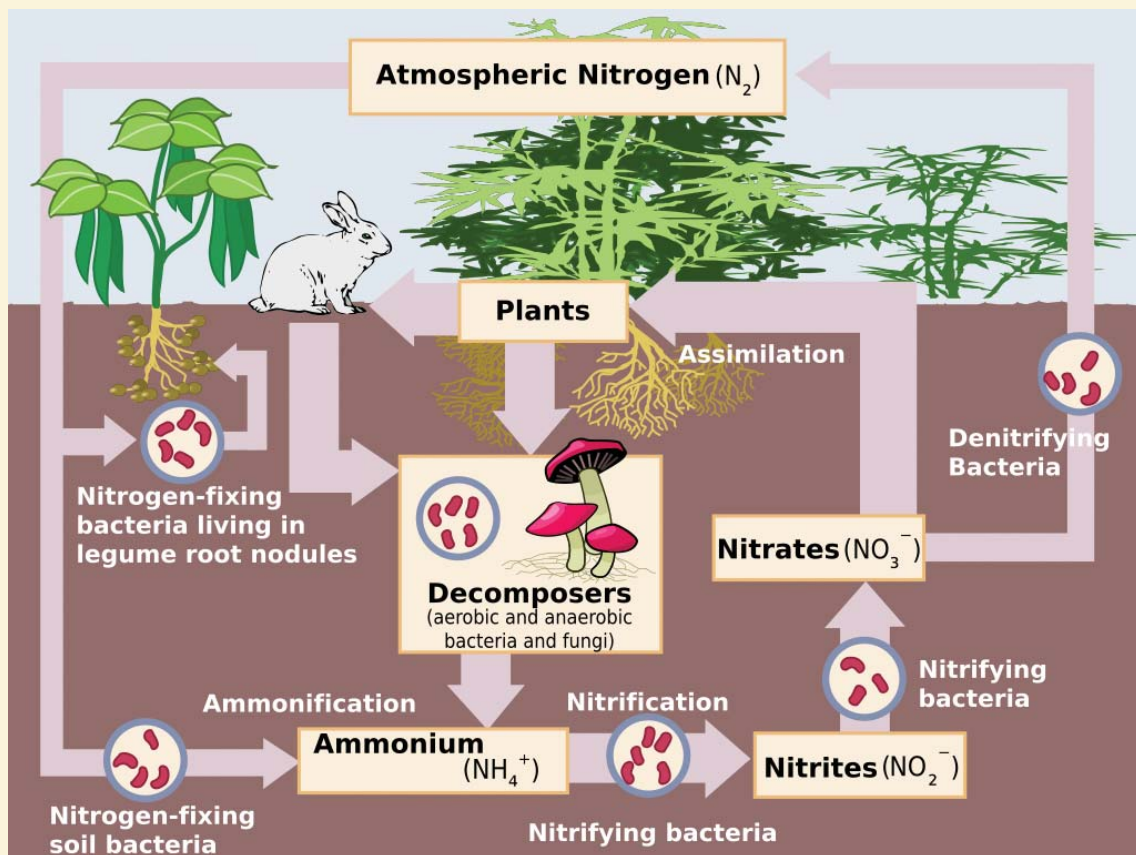
A common question faced by any student in high school is the atmospheric composition of the Earth.

What is Earth's atmosphere made of?

When this question is posed to students, the instant answer is usually: 78% nitrogen, 21% oxygen, 0.9% argon, and 0.1% other gases. Is this wrong? It's not so much about right or

wrong; it misrepresents the *nature* of science which is *evolutionary*. What does this mean?

Decades of research by geologists and atmospheric chemists has told us that the Earth was formed 4.5 billion years ago. Earth's atmosphere has undergone many changes from the time of the formation of Earth.



How was our Solar System formed?

This happened many billions of years ago. The popular science writer **Sam Kean** imagined the formation of Earth in the book *Caesar's Last Breath* as

“Around 4.5 billion years ago, a supernova detonated in our neck of the cosmos and sent a shock wave into space. This shock wave plowed into a sea of mostly hydrogen gas that happened to be nearby and stirred something inside it to life, causing the sea to grow choppy and swirl in a vortex about its center. Gravity eventually sucked together 99.9 percent of that gas to form a new star, our sun. The majority of the remaining gas got pushed to the edges of this incipient solar system, where it formed gas giant planets like Jupiter and Saturn”.

In the beginning ...

The early Earth's atmosphere had lighter gases like hydrogen and helium. At that time, Earth was not a solid mass yet. Gravity played a central role in attracting heavier atoms around the light hydrogen core. The constant attraction of heavier gases led to the formation of the solid mass that is more like what we see today. This happened on a large geological time scale of billions of years. Earth's surface remained hostile with gusting gases at temperatures of 8,000 degrees! So the earliest composition of Earth's atmosphere had just two gases (hydrogen and helium).

The cooling process led to the formation of heavier elements and molecules. During the formation of this second atmosphere, Earth

was filled with carbon dioxide, water vapour, hydrogen sulphide and oxides of sulphur.

Earth's second atmosphere played a crucial role in depositing *carbonates* in the Earth's crust. This happened because dissolved carbon dioxide in water vapour reacted with other metals to form carbonates such as calcium carbonate.

Volcanoes and Nitrogen

The present atmosphere has a large quantity of nitrogen, but why is nitrogen alone present in such a large quantity? This is an important question to be answered, is it not? Other elements like sulphur and oxygen are more reactive, so they formed minerals and different compounds (most ores in the Earth are oxides). Since nitrogen is an inert gas, it remained as nitrogen. But where did this nitrogen come from?

Earth was not alone in its orbit. There was another planet named **Theia** sharing the same orbit. The collision of Theia and Earth made Earth's crust even more hostile than ever before with prolonged volcanic activity. Nitrogen began to accumulate from volcanic activity that existed for four billion years.

Nitrogen plays a crucial role in supporting many life forms especially plants, thanks to some bacteria which can metabolize nitrogen and

convert it into nitrates in the soil in the process called **nitrogen fixation**.

Remember that proteins contain nitrogen in their amino acids (apart from hydrogen, oxygen and carbon).

Atmospheric composition of other planets

Have you ever asked the question, why the first four planets alone contain solid surfaces while rest of them from Jupiter onwards are gas giants? The role of gravity played an important role in shaping the solar system. Sun is the largest and heaviest in the solar system and its gravity attracted heavier elements, forming solid surfaces for first four planets. The remaining planets have lighter elements such as hydrogen and helium as the major constituents. The tables (by Andy Bruning and NASA) present a clear picture of atmospheric composition of various planets.

OXIDE MINERALS

Hematite
 Fe_2O_3



Magnetite
 Fe_3O_4



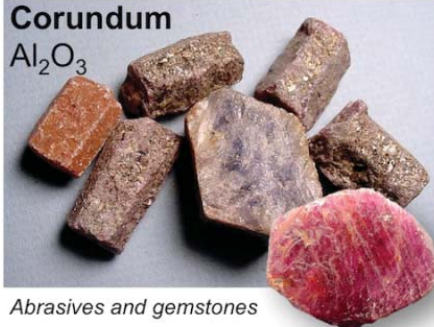
Limonite
 $2\text{Fe}_2\text{O}_3 \cdot 3\text{H}_2\text{O}$



Iron ore minerals

Photos by R. Weller/ Cochise College

Corundum
 Al_2O_3



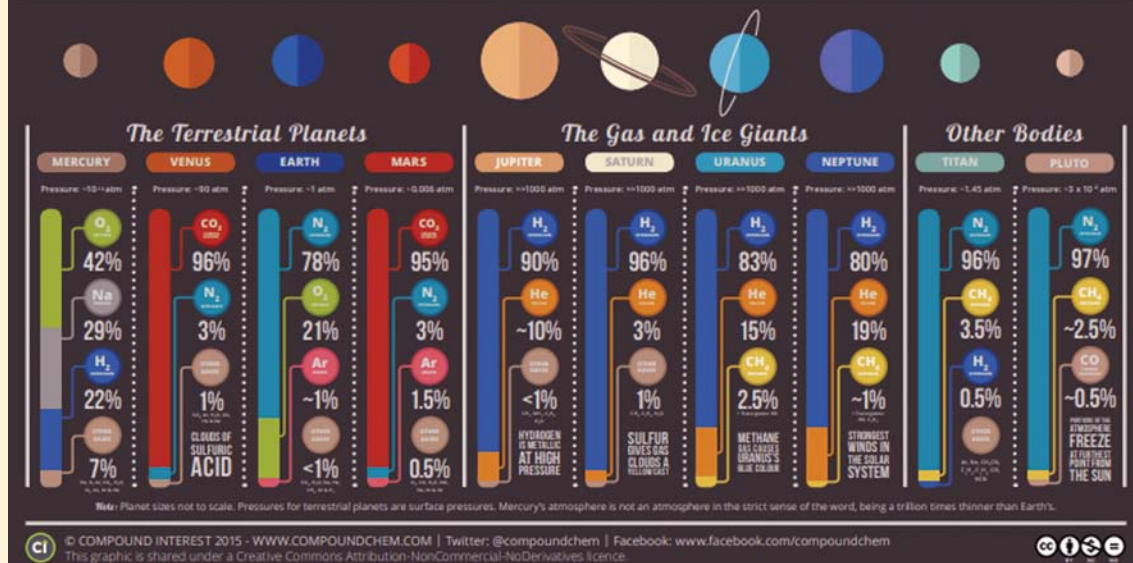
Abrasives and gemstones



Bauxite
 $\text{Al}_2\text{O}_3 \cdot 2\text{H}_2\text{O}$
Aluminum ore



THE ATMOSPHERES OF THE SOLAR SYSTEM



Concluding remarks

Beware! students of Science! While providing one absolute answer to a question, there could be more than one correct answer—just as we saw for questions like the atmospheric composition of planets on a geological timescale. In fact, many misconceptions arise from providing absolute answers to questions. Often,

people give absolute answers when they do not have an adequate understanding of the problem.

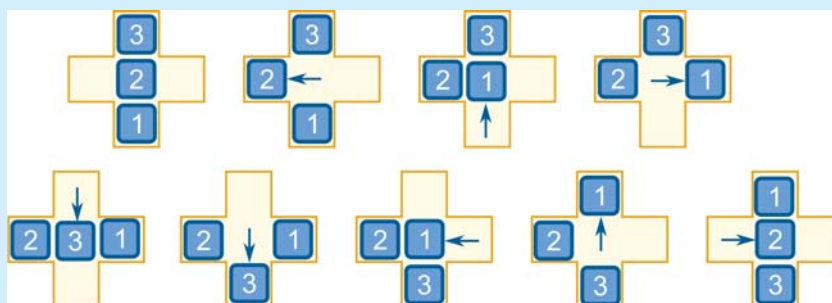
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<https://www.compoundchem.com/2014/07/25/planetatmospheres/>;
https://www.nasa.gov/wp-content/uploads/2015/01/yoss_act_4.pdf;
 Images from Wikipedia

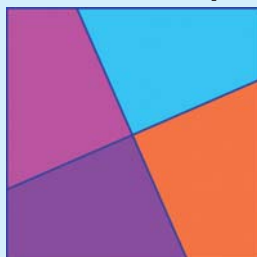
Answer to Apples and baskets Puzzle on page 17: The key point is to realise that in only one weighing, we must include apples from all baskets. How to tell which apples came from which basket? Line up the baskets in a row and number them 1 to 10. Take one apple from Basket 1, two apples from Basket 2, etc, all the way to ten apples from Basket 10. So we have $(1+2+\dots+10=55)$ apples in all. Weigh them all together in the empty basket. Now, if they all weighed the same, they would weigh $(55 \times 100 = 5500)$ g (leaving out the weight of the basket). But some apples are heavier. Now, we have to reason it out. Suppose Basket 1 contained the heavier apples. Then one apple would be heavier by 20 g and we would get a weight of 5520 g. If the second basket contained the heavier apples, we would get an extra weight of $2 \times 20 = 40$ g, or a total weight of 5540 g. If you think this through, you can tell the following: find the weight of all the 55 apples you have chosen. Subtract 5500 from this weight. Divide the remainder by 20, and that will give you the number of the Basket which contains the heavier apples. As an example, if we get a weight of 5600 g, then $(5600 - 5500) / 20 = 100 / 20 = 5$. This means five apples are heavier than normal and these were taken from Basket 5, which has the heavier apples.

From MathsIsFun.com

Page 27 Ans: See the picture. It takes 8 moves.



Page 30 Ans: See picture.



Back cover:

Sudhanshu Shukla (second from left) on Axiom-4 spacecraft, the first Indian to go to the International Space Station.

Front cover:

Enjoying the Rain

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S. Subramani

TNSF, Chennai 600 086

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Rajeswari

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Flag of United Nations

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