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Brain Teasers

1. You are your way to visit your Grandma, who lives at the end of the valley. It's her birthday, and you want to give her the cakes you've made.

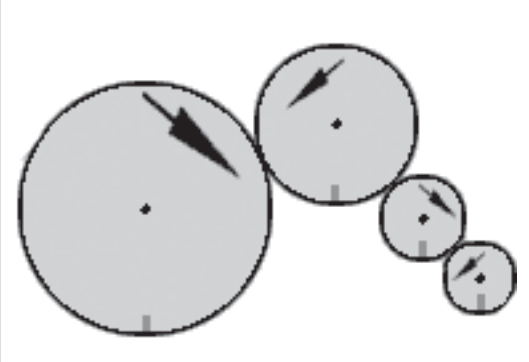
Between your house and her house, you have to cross 7 bridges, and as it goes in the land of make believe, there is a troll under every bridge! Each troll, quite rightly, insists that you pay a troll toll.

Before you can cross their bridge, you have to give them half of the cakes you are carrying, but as they are kind trolls, they each give you back a single cake.

How many cakes do you have to leave home with to make sure that you arrive at Grandma's with exactly 2 cakes?

2. I have a machine which has four sequential cog wheels in constant mesh. The largest cog has 81 teeth and the others have 52, 36 and 20 respectively.

What is the fewest number of revolutions the largest cog must make so that all of the cogs are back in their starting position?



Answers to last issue's Brain Teasers

1. **Logic Puzzles** (stamps): *The Grand Master takes a set of 8 stamps, 4 red and 4 green, and loosely affixes two to the forehead of each of three logicians A, B, and C, so that each logician can see all the other stamps except those two in the Grand Master's pocket and the two on her own forehead. He asks them in turn if they know the colors of their own stamps. Their answers are:*

A: "No."

B: "No."

C: "No."

A: "No."

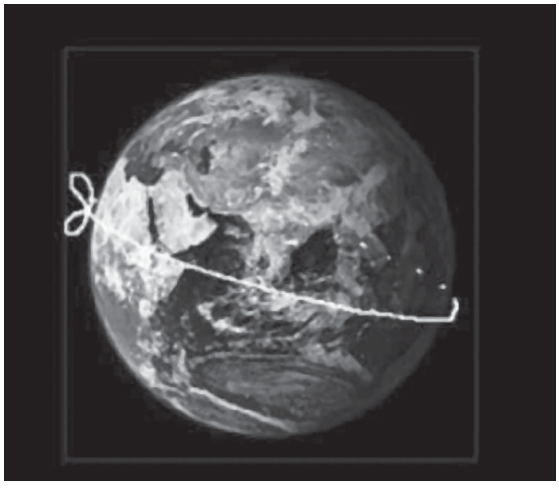
B: "Yes."

That is, after one round of answers, in the second round, B says that she knows the answer. What color stamps does B have?

Ans: The answer, as is usual in such cases, is by a process of elimination. But this time it's a little trickier since it turns out that we cannot solve the whole puzzle; we can only find out the colours of B's stamps. Since B finds the answer, let us argue from her view-point. Also keep in mind that either the two stamps on the people's forehead are of the same colour (red-red RR or green-green GG) or of different colours (green-red GR).

So B will first see what happens if she has RR stamps (or GG stamps, the logic is the same for same-colour stamps). Then she will see what happens if she has RG stamps and then check which one is consistent with the observations above.

Let us start with B assuming that she has RR. In the first round all of them said they could



not tell. What are the possibilities?

Suppose A also has RR. Then C would have seen that both A and B have RR. Since all the reds are used up, in the first round itself C would say that she (C herself) has GG. But she didn't say so. So, B would argue, A would have seen RR on B and would have realised that if she had RR, C should have answered 'yes' on the first round itself. So A would realise that she does not have RR.

So A now thinks that she has GG. But if C has RR (and B has RR, too, since that is the starting assumption), then A would have been able to tell at the very beginning that she is GG. So obviously C cannot have RR. But C cannot have GG either, because then B would have seen that both A and C have GG and so in the first round itself B would have got the answer. Now C would have realised the following:

If she (C) had RR, A would have seen four reds and would have answered that she (A) had GG in the first round. On the other hand, if C also has GG, then B would have seen four greens and she would have answered that she (B) had RR. So C would have realized that, if A has GG and B has RR, and if neither answered on the first turn, then she must have green-red and she would have given the answer in the first round itself. But C didn't! So it means that A cannot be GG. So now we see that at the end of the first round, B has argued that if she herself has RR, A would have realised that she (A) cannot have RR or GG and so must be RG.

This means that at her second turn, A should have given the answer. But A didn't; she still said 'no'. So B realises that this could only be because she herself doesn't have RR, because that is the assumption we started out with.

In a similar way, you can eliminate the possibility that B has GG. This leaves the only possibility for B, that she has GR. So in her second turn, she answers, 'yes'. Note that we still do not know what A and C have.

2. **Wired Equator:** *The circumference of the Earth is approximately 40,000 km. If we made a circle of wire around the globe, that is only 10 meters (0.01 km) longer than the circumference of the globe (40000.01 km), how much gap would there be between the wire and the ground? Would it be big enough for a flea, a mouse, or even a man to creep under it?*

Ans: This is an easy one. All you have to do is to imagine two circles, one longer by 10 m. So the longer one has a larger radius. Using the formula for perimeter in terms of the radius: perimeter $P = 2 \pi r$, we have $r = P/(2\pi)$. We can calculate the radius for P_1 and P_2, the larger and smaller perimeters. The difference between the two radii is the space between the wire and the ground. This is $(P_2-P_1)/(2\pi) = (10\text{ m})/(2\pi)$ = 1.6 m approximately. So a child can easily walk through the gap and a tall person has to duck.

Mysterious Dark Matter

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Our expanding Universe

When we see the night sky, it presents a picture of planets, stars, galaxies, and many other types of astronomical objects not necessarily visible to the naked eye. It is a picture of calm which hides the fact that the Universe is in fact fast expanding. This was first noted by Edwin Hubble in 1929. Hubble observed that the galaxies outside of our own Milky Way galaxy are all moving away from us at a speed that is proportional to the distance from our own galaxy.

The Big Bang

Working backwards it is easy to see that there must have been a time when the Universe was small, indeed a single point at birth. This happened approximately about 14 billion years ago. The fact that the Universe must have been born at a single instant is called the "Big Bang", a word coined by astronomer Fred Hoyle after it was proposed by **Georges Lemaitre** in the 1920s.

The basic principle comes from Einstein's famous equation, $E=mc^2$, which gives the relation between matter with a mass m and its equivalent energy E. The present understanding, based on nearly a century of observations and ideas, says that an extremely concentrated form of energy was transformed into particles of matter immediately after the big bang.

Atoms are formed

According to these theories the Universe after one second was a sea of different kinds of particles such as protons, neutrons, electrons, neutrinos and photons at a temperature of 10 billion degrees. As the Universe started cooling due to expansion, the neutrons combined with protons to form nuclei. Upon further cooling these nuclei combined with electrons to form neutral atoms leading to the formation of matter.

The role of Gravity

Much later, some 150 million years after the birth of the Universe, stars began to form. They started collecting together to form galaxies. Galaxies started to cluster together. It was gravity, at this stage, that was the glue that held these large objects together. When some of these big objects collided they gave rise to little pieces, some of which may have become planet-like objects. This ultimately resulted in the formation of our own solar system and probably many more such systems.

Something is missing

This neat little history of the Universe is actually more complicated than it appears at the outset. The problem was in fact noticed long ago when **Jan Oort** in 1932 observed some unusual effects called anomalies in the

orbital speed of stars in our own galaxy (See box for more explanations). At the same time astronomer **Fritz Zwicky** noticed a similar anomaly in the rotations of galaxies in large galaxy clusters.

After all, the only force that is responsible for the motion of stars in a galaxy, and for the motion of galaxies in a cluster is *gravity*. The effect of gravity can be calculated entirely by knowing the mass distribution in galaxies and clusters since the gravitational force is proportional to the masses of the interacting bodies (and inversely proportional to the square of the distance between them). Surprisingly, their observations showed that it required almost five to six times the mass that is contained in the galaxies and clusters than they were able to account for from the visible matter contained in the stars. Zwicky named this missing matter as *Dark Matter*.

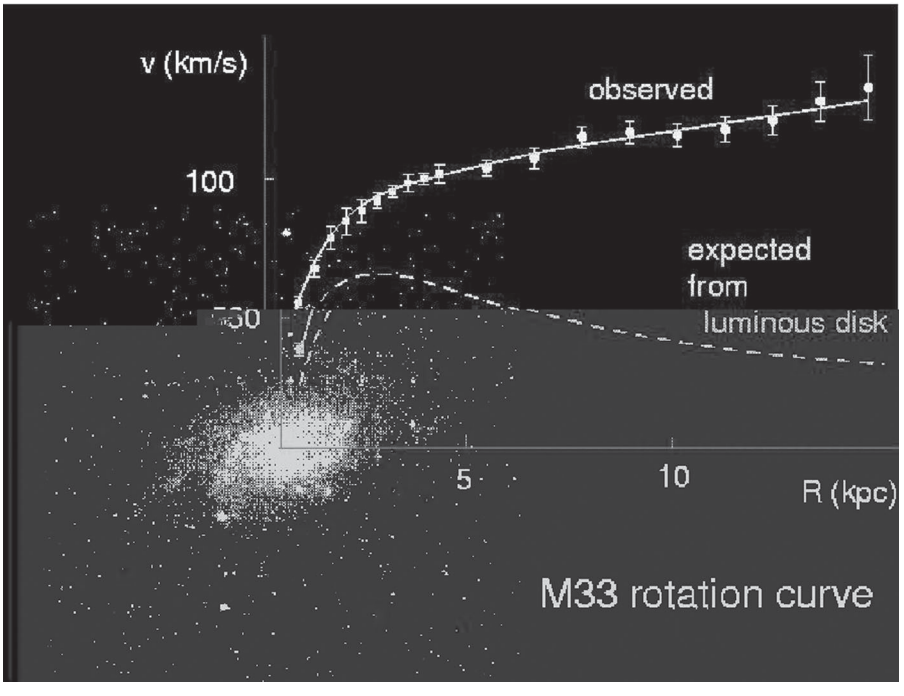
It is this rotational speed observation that caused Jan Oort (in the case of stars) and Zwicky (in the case of galaxies) to conclude that there is a missing mass, five times the visible mass that we see, either visually or otherwise.

In the late sixties and early seventies, **Vera Rubin**, an astronomer at Carnegie Institution in Washington, worked with an accurate spectrograph which could measure the rotational speeds with greater accuracy than ever before. She and her colleagues systematically measured the velocity curve of stars in spiral galaxies.

Vera Rubin discovered that the speed of most stars in spiral galaxies outside the bulge did not decrease as their distance from the centre increased. Instead they orbited roughly at the same speed. What could cause such an effect?

There is Dark Matter

Consider stars near the centre of a galaxy. As you go further away from the centre (but remain within the bulge), there are more and more stars in the inner region, and hence more mass contained inside the radius at which the star is situated. It is this effect that makes the velocities increase as the radius increases. Once you are far away from the centre, there is hardly any change in the mass contained as you go farther away and this is



Dark Matter and star velocities

We can understand their observations through a simple calculation. Like our own Milky Way, there are spiral galaxies in which the stars orbit around a centre where much of the mass is concentrated. The centre of such galaxies is called the galactic bulge and let us call the mass contained in the centre as M.

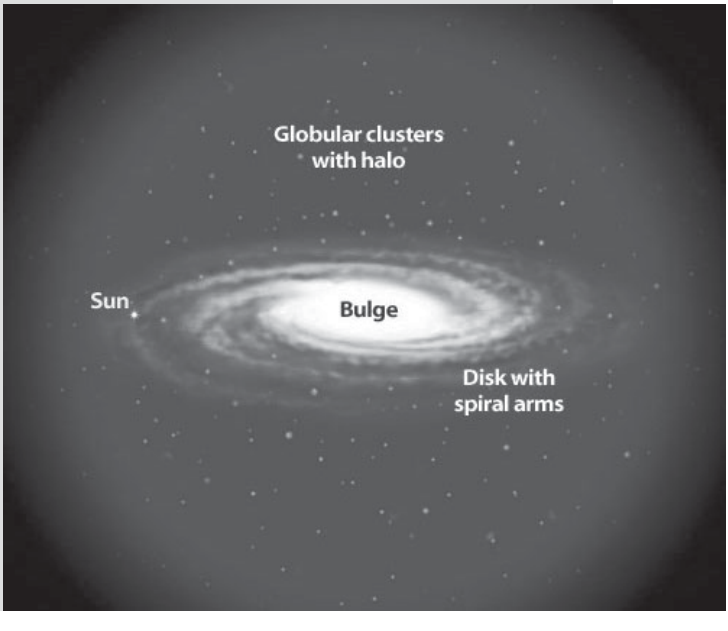
If the mass of the star is m, its distance from the centre is r and its rotational speed is v, then the star is attracted to the entire mass M in the interior of the galaxy (that is, everything inside the radius r) due to gravity. The star is rotating about the central bulge, so the centripetal force that is holding it in orbit is equal to the gravitational force. (Some older readers may recognise that you have to be careful to specify the values of these quantities in the frame in which the star is at rest, but this is not important for now).

The centripetal force is calculated as mv^2/r while the gravitational attraction between the star and the inner part of the galaxy is $G\,Mm/r^2$. Here G is the gravitational constant and is related to the acceleration due to Earth's gravity, $g=9.8\ m/s^2$.

From the structure of the galaxy it is obvious that most of the mass is concentrated in the central bulge. Therefore, the rotational speed $v^2 = GM/r$ or is proportional to 1/r (or decreasing) far away from the bulge. Therefore the speed should decrease inversely as the square root of the distance from the centre.

On the other hand, if the star is inside the bulge, then the volume enclosed inside the radius r is given by $(4/3)\pi r^3$. If we consider the density of stars inside the bulge to be roughly constant, say, ρ, then the mass enclosed = volume X density = $(4/3)\pi r^3 \rho$. In such a situation, $mv^2/r = GM\ (4/3)\pi r^3 \rho/r^2$ or the velocity is proportional to r close to the centre, or the velocity in the central region increases with the distance.

So we see that the rotational speed close to the centre increases linearly up to a point and then decreases for large distances from the centre (outside the bulge).



what makes the velocity decrease at large distances.

Now Vera Rubin discovered that the velocites of distant stars are not decreasing. This means that there is an additional mass that is invisible to us, that is causing this effect. This also means that the mass densities in these galaxies are more or less uniform. You can see some of the measurements in the figure.

The dashed line shows what is expected from the visible matter distribution whereas the observations show that the speeds are increasing and do not show any decreasing tendency. If we work out the mass distribution required to explain the rotational curve as observed by Vera Rubin, it is found that most galaxies contain about six times the mass that can be accounted for by the visible stars. Their distribution extends even beyond the galactic bulge and is almost uniformly distributed. Because we do not know what this matter is, except that it exerts gravitational force like ordinary matter, it was termed *Dark Matter*, in the sense that it does not shine or reflect any light.

Gravitational lensing

There is now independent evidence for dark matter through what is called *gravitational lensing*. Light bends when going through an optical medium like a lens; it also bends around a massive gravitating object. This one of the central results of Einstein's theory of gravitation. A distant bright star may be hidden behind a massive object, but it may become visible because its light can bend around the massive object and

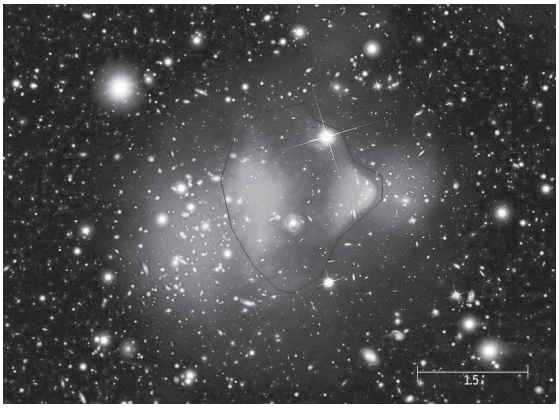
reach us. This is known as gravitational lensing.

If dark matter exerts gravity as shown by the rotational curves, they should also cause gravitational lensing. This is hard to observe in our own galaxy but easier to observe in other astronomical objects through powerful space-based telescopes.

The most spectacular observation of such a lensing is in a system known as **Bullet Cluster**. This cluster is formed by the collision between two galaxy clusters. While in most galaxies dark matter and visible matter are found together, in the Bullet cluster there appears to be a separation of the two. This might have happened during the collision where the stronger collisions between visible matter may have slowed them down so that they are concentrated in the centre near the

point of impact. The dark matter content may have just passed through without slowing down as they do not experience any other force except gravity.

Thus the central part of the Bullet Cluster is almost entirely made up of ordinary matter. But evidence from gravitational lensing suggests that most of the matter resides outside the central region. In the picture, the central region with a dark outline is the visible region as seen by the X-ray observatory called **Chandra**. The outer region shows the total mass distribution of the galaxy and has been reconstructed from gravitational lensing.



Not this, not that

While we are now certain about the existence of dark matter from many independent observations, we do not know what it is. In fact we know more about what it is not.

In principle they could be dead stars which have stopped emitting light or any other form of radiation, known as **white dwarfs**. They could be **brown stars**, stars which failed to ignite in the first place. There are many millions or billions of such stars in the Universe. They could be **neutron stars** which are not rotating or even so-called **black holes**.

While a small portion of dark matter may include all of the above, there are serious problems in accounting for six times the visible mass that is dark. The Big Bang scenario accurately predicts the observed abundance of elements (that is, the proportions of hydrogen, helium, etc., in the Universe) and this accounts only about 4-5 percent of the critical energy density in the Universe. Thus there are not enough dead or brown stars while black holes and neutrons are rare.

What could dark matter be?

It is therefore clear that dark matter may not be the matter that we know and are familiar with. The standard model of particle physics describes the fundamental particles and their interactions. None of these particles however can make up dark matter in its entirety. There are theories which go beyond the standard model of particle physics which do predict new particles and their interactions. However, until they are discovered we will never know if they can be candidates for dark matter particles.

At present there are many space telescopes, like Hubble and Fermi, trying to observe possible signatures of dark matter in space. But there is not enough data to establish the nature of the dark matter. So we know that there is a great deal of dark matter in our Universe but we have no idea what it could be made of.

Dark matter thus remains one of the great mysteries of science, at least for the present.

Memory: how do you remember?

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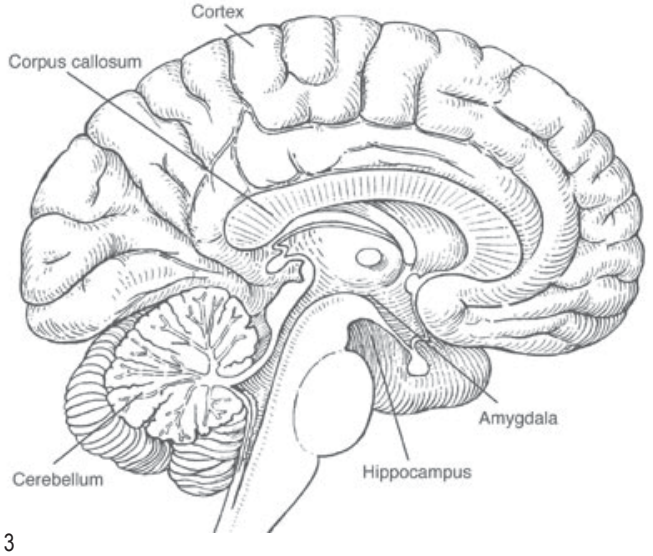
How good is your memory? Can you remember what happened on the same day, last year? Or the one before? Or are you wondering what you had for breakfast this morning? So, do you think your memory is better or worse than your best friend's? Who has the best memory amongst you and your friends?

How much do we remember anyway?

Can you possibly recall your thoughts as a baby?! Is it in fact possible to remember everything that ever happened in your life?

Many psychologists believe that everything we learn is permanently stored in our mind, although we may not be able to recall certain details. So what exactly is the connection between brain and mind? Brain is the physical object, safely enclosed inside our skulls. But where is the mind? From where you you retrieve that particular memory? Is there any way you can search through your brain for a memory just as you would search the shelves of a library for a particular book?

From 1934 onwards, for about two decades, a Canadian neurosurgeon called Wilder Penfield accidentally learned that memories occupy fixed locations in our brains. While searching for the source of the disease called epilepsy, he used electric probes to stimulate the brains of patients. He found that when his probe touched a certain part of the brain called the temporal lobes, it jogged a long forgotten memory. In fact, the memory would be so vividly recalled that the patient was amazed that so many details of the memory were remembered. Also, when he touched the same place another time, the patient would recall the same memory. So Penfield thought that the brain possibly records every incident of note permanently.



Nervous System

The brain and the spinal cord make up the central part of the nervous system. Neurons or nerve cells are the core components of the nervous system. They reach from your brain to your face, ears, eyes, nose, and spinal cord — and from the spinal cord to the rest of your body.

The spinal cord is made of a bundle of nerves running up and down the spine, and is like a superhighway, speeding messages to and from the brain at every second.

Balanced on top of our spines, the brain contains about 100 billion neurons, which are nerve cells that can transmit information using chemical or electrical impulses.

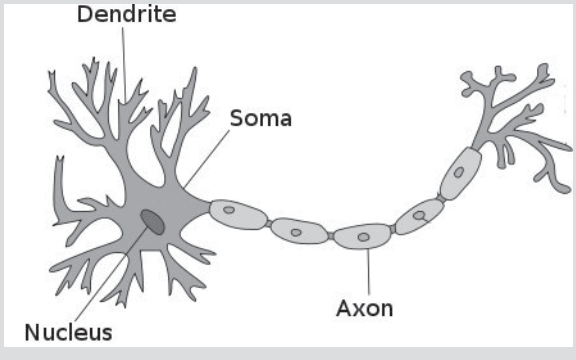
There are specialised neurons.

. Sensory neurons respond to touch, sound, light, etc. As their name suggests, they are sensitive to external stimuli. For instance, if you touch something hot, the sensation is felt by the sensory neurons in your skin, which send signals to the spinal cord and brain.

The brain processes this sensation and the instruction returns from the brain to take your hand off it! How does the instruction return?

. Motor neurons receive signals from the brain and spinal cord and cause the muscle to contract, so that the hand is removed.

. Inter-neurons connect neurons to other neurons within the same region of the brain or spinal cord. Neurons connect to each other to form neural networks.



Each neuron has a special connection with other cells through a structure called a synapse. A typical synapse is a contact between the axon of one neuron and a dendrite or soma of another (see picture).

Nowadays, psychologists think that our memories are not perfect; they fade, they change, and they sometimes disappear altogether; that is, the record of the memory itself physically disappears from the brain. They think that the memories that Penfield evoked in epilepsy patients were more like dreams or hallucinations.

Learning

This is how you sense things (by touch, sound, light, etc): the neurons transmit the sensation and the brain processes the information. It can connect to other neurons or simply to other cells. In fact, a neuron can make about 10,000 synaptic connections with other neurons.

A memory, at the most fundamental level, is a pattern of connections between neurons—such a vast connection between neurons is called the neural network. The connection between two neurons is stronger when both are active at the same time, and so the synapse plays a role in the storage of information and in the formation of memory. When we learn something new, or feel a new sensation, the connections

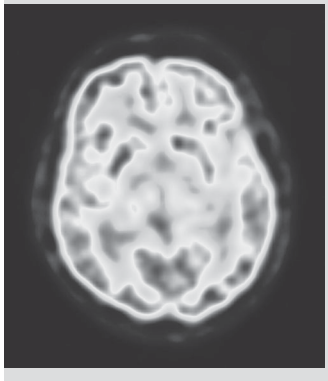
in the network are changed and so this new memory is registered in our brains.

Imaging technology has advanced to the level that we can process brain images with computers and see how the brain is made; we can study neurons to tell us what happens in brain cells. But the area of the cortex, the

Brain

The brain weighs just about one and a half kilos in an adult. Along with the spinal cord and nerves, it controls every activity of our daily life, whether we are asleep or awake.

The brain is an energy-intensive organ. Although it contains only about 2% of the body mass, it uses about 20% of the oxygen that we breathe and about 25% of the glucose burned. The PET scan shown the dark areas where more energetic activity is going on in the brain.

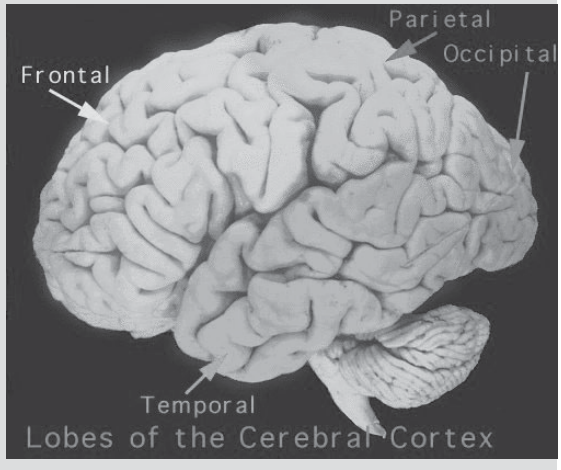


The brain is made up of different parts. (See the cover page for a picture).

The cerebrum or cortex is the largest part of the human brain, associated with higher brain function such as thought and action.

The cerebral cortex is highly wrinkled and that gives the brain its classic wrinkled look. Essentially this makes the brain more efficient, because this increases the surface area of the brain and the amount of neurons within it. A deep furrow divides the cerebrum into two halves, known as the left and right hemispheres. The corpus callosum, a wide, flat bundle of neural fibres beneath the cortex, connects the left and right hemispheres.

Nerve cells make up the gray surface (about 1 cm thick) of the cerebrum. White nerve fibers underneath carry signals between the nerve cells

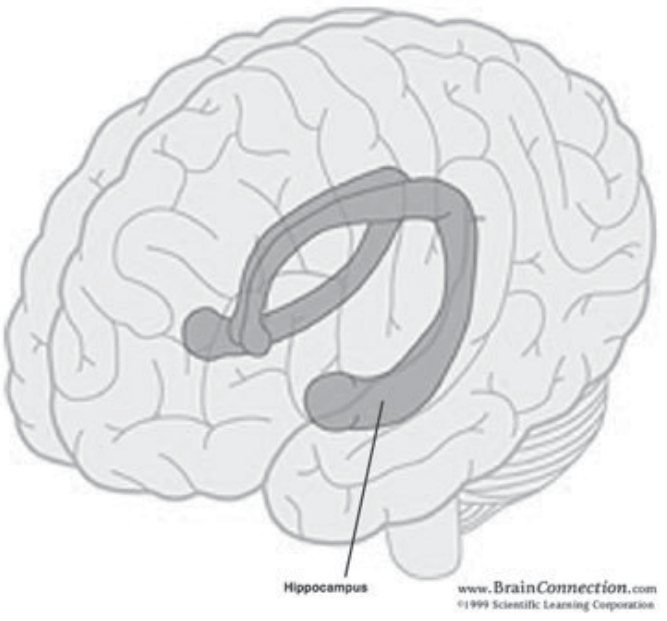


and other parts of the brain and body.

The six-layered structure called neocortex occupies the major part of the cortex. It is only found in mammals. It is thought to be a recently evolved structure, and is associated with "higher" information processing by more fully evolved animals such as humans, dolphins, etc.

The cerebellum, or "little brain", also has two hemispheres and has a highly folded surface or cortex. It is associated with coordination of movement, posture, and balance.

The limbic system is inside the cerebrum. It contains the thalamus, hypothalamus, amygdala, and hippocampus. All are associated with different processes, but primarily in emotion and memory. In particular, the amygdala is involved in the processing of feelings, fear and memory. The hippocampus is important for learning and memory: memories live in the neocortex but it is the hippocampus that is believed to be crucial for converting short term memory to more permanent memory, and for recalling spatial relationships in the world about us.



wrinkled outer layer of the brain, is still a mystery to us. We believe that this is the part of the brain that allows us to do maths, to plan for our next exam, and also holds most of our memories.

We have also learned a lot from research on a person called Henry Molaison, who lost most of his medial temporal lobes and hippocampus during surgery. It was found that he could not remember things because he could not convert short-term memory to a long-term one. But he could recall things that happened a long time ago. So the hippocampus clearly plays a role in converting new memories into more long-lasting ones. But the final word is not yet said on this fascinating subject.

How do you find a memory?

There are thousands of connections and patterns. How do you find one connection (that is, one memory) in this mess? Is there an index or are they filed in order?

It turns out, that to find a memory, you need a trigger or a cue. It's like having a library of millions of books with only some books seen on the shelves. A look at one of the books will jog your memory about some other book. Immediately that book will pop up on the shelf! That book will remind you of something else, and this process goes on.

The books on the shelf are your thoughts at any given time. Not having the memory directly on the shelf is expressed as saying "the memory is latent". Using other thoughts to bring to your conscious mind the memory you are trying to remember is making use of the vast network of connections in your brain.

How may times have you forgotten an entire answer in a test? But afterwords, when your friend or mother tells you, "But you knew this answer, it began with ...", the whole memory comes back to you and you mentally kick yourself for having forgotten it! Next time, comfort yourself with the thought that your brain processes memory in such a complex way, it is amazing we can remember even 1/10th of what we do.

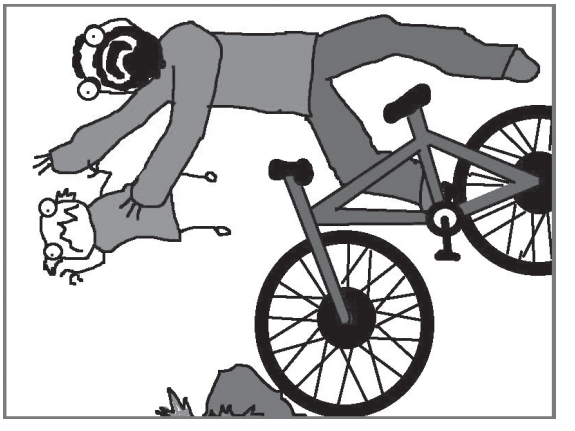
But this important fact: let someone tell you how something starts and you will very likely remember the whole (like a poem), hints to us that we do not remember in isolation: our memories are best when we have to remember things in context, because it is this relationship that jogs the memory.

This is why we feel amazed when some people learn to remember hundreds of unconnected pieces of information, such as the order of a pack of cards or passing car numbers.

Kinds of memory

Procedural or implicit memory is based on implicit learning. What this means is for instance, when you learn to ride a cycle (Picture with thanks from hyperboleandahalf.blogspot.com). Each time you get on a cycle, you don't have to consciously remember to take the cycle off its stand, to hold the handle-bars, to step on the pedal, etc. The memory of how to ride a cycle is unconscious, implicitly known to you, just like the complex art of tying shoe-laces! Such memory, mostly used in learning motor skills, depends on the cerebellum.

Declarative or explicit memory, in contrast, needs to be consciously recalled—for instance,

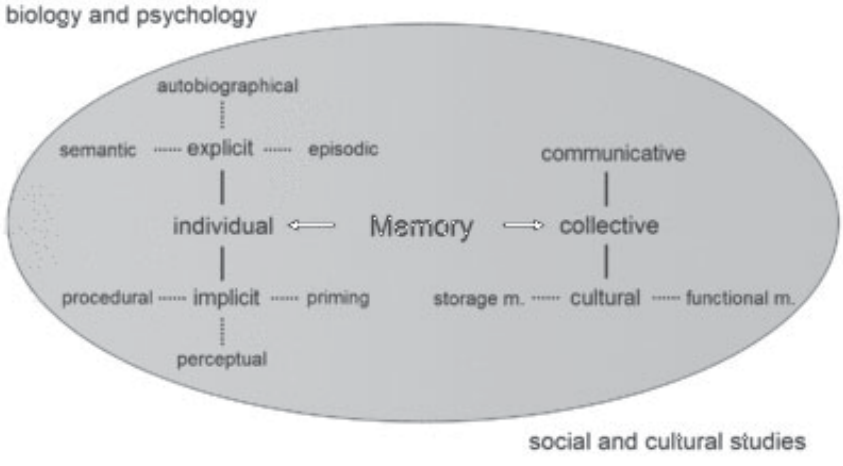


what you ate for lunch yesterday. This includes visual memory, such as the route to your school or the shape of your eyebrows; semantic memory for facts and concepts, such as the names all countries with their capitals, as well as episodic memory, such as details of your last school project. Such perceptual learning takes place in the neocortex.

Even if one part of the brain is damaged the memory involved in the undamaged parts are there. For instance, you may know that dinner is the last meal of the day (semantic memory) but you may not recall what you ate for dinner last night (episodic memory)! Indeed, all our implicit memories are not readily accessible to our conscious brain: and these are what make up who we are and how we think.

How well do we remember what we remember?

Memories are not static objects. They change with time. All of you who struggled to



remember that '3' comes after '2' now easily solve complicated arithmetical problems, taking this fact for granted. On the other hand, many memories fade in time (such as that unforgettable vacation you went on 6 years ago)!

Studies of people suffering from amnesia (who have lost their memory) shows that mostly people clearly remember very old and distant memories. In some sense, the longer the time that we have to "think" about a memory, the more stable and deeply rooted it becomes and so the longer we remember it. But in this process it also happens that we can change the memory itself: it can be changed a little or completely transformed to the extent that we remember the opposite of what really happened. So there are many differences between old and new memories.

Don't disturb me;
I'm strengthening
my memory

One theory is that memories are nomadic (moving about). This means that while they are formed in the hippocampus initially, they are eventually moved to long-term storage in the neocortex. Over time, as they get consolidated they get entrenched in a network of cortical connections. At this point, they have an existence independent of the hippocampus.

It is also thought that sleep plays a key role in the process of consolidating memories; not just so that they remain longer, but also their meaning becomes clearer. For instance, scientists think that dreams are a combination of experiences from real life and are part of the process of firmly storing our experiences as long-term memories. That is why good sleep is important for brain function and memory retention.

Exercise is another area that has many benefits and effects on the brain. Aerobic exercises such as running, cycling and swimming increases the oxygen flow and also the generation of neurons (neurogenesis) in the hippocampus. Earlier it was thought that no new neurons could grow in an adult. It was only

recently shown that neurons regenerate in regions of the hippocampus. Indeed, about one-third of the neurons in the hippocampus are regularly renewed throughout life, (addition of roughly 1,400 new neurons per day), with the rate declining slowly with age.

This has important implications for improving children's academic performance, maintaining mental abilities in old age, and the prevention and potential cure of neurological diseases.

How far back can you remember?

Do you remember being a baby, hearing things, but unable to talk? Unlikely. The neocortex is fully developed only at age 3-4 years. Only then is it possible to have long-term memories. On the other hand this is the stage when the most rapid learning of one's life occurs: learning to walk, talk, understand the world around us. So obviously these are the implicit memories: you don't forget them. It is the conscious memories that are not remembered at this age. This is perhaps because the babies have neither the experience nor the language to help them store their memories (after all, the "book" that you use to jog your memory is also just another memory)!

Why is this so?

Early man, our ancestors, needed to remember very different things from today. He needed to know where to find food, and after a day's hunting or gathering (after knowing which plants were edible), he needed to find the way home. So human memory evolved in a way to make these things easy and efficient. This is one reason our brain is still good at recalling visual information (and why it is said a picture is worth a thousand words)—both pictures and spaces.

Our brain is certainly not as good with words, and worse with numbers simply because it has been handling them for much shorter times. In fact, this entire article was inspired by a book called "Moonwalking with Einstein: The art and science of remembering everything", by Joshua Foer. In this book, the author talks about how people who participate in memory games or perform cards tricks use associations with pictures and locations to help them remember long lists of unrelated words or cards.

In the end, memory is primarily an imaginative process. The seemingly unrelated word-list of porifera, coelenterata, platyhelminthes, nematoda, annelida, arthropoda, echinodermata, will make sense if we can remember eating "pori", listening to a (koel) "coel", with a "plat(e)" in hand, which is actually a(n) "lid", talking to "arth(u)r" who replies through "ech(in)o"s! Once you can master the list with the aid of words which mean something, you can ace that biology test!

In short, we all are what our ancestors and our memories make us!

Sources: Wikipedia and Joshua Foer's book, "Moonwalking with Einstein: The art and science of remembering everything"

Hiss! who is there?

D. Leela and D. Maya,
Chennai

Recently we went to a beautiful exhibition on snakes. We had seen snakes many times before, in the Guindy Snake Park, and this exhibition had only photos, no real snakes. But it was so well done that we were fascinated.

Snakes in India

India is host to a number of snakes, many of them venomous, but the most venomous ones called the Big Four are widely distributed and quite venomous.

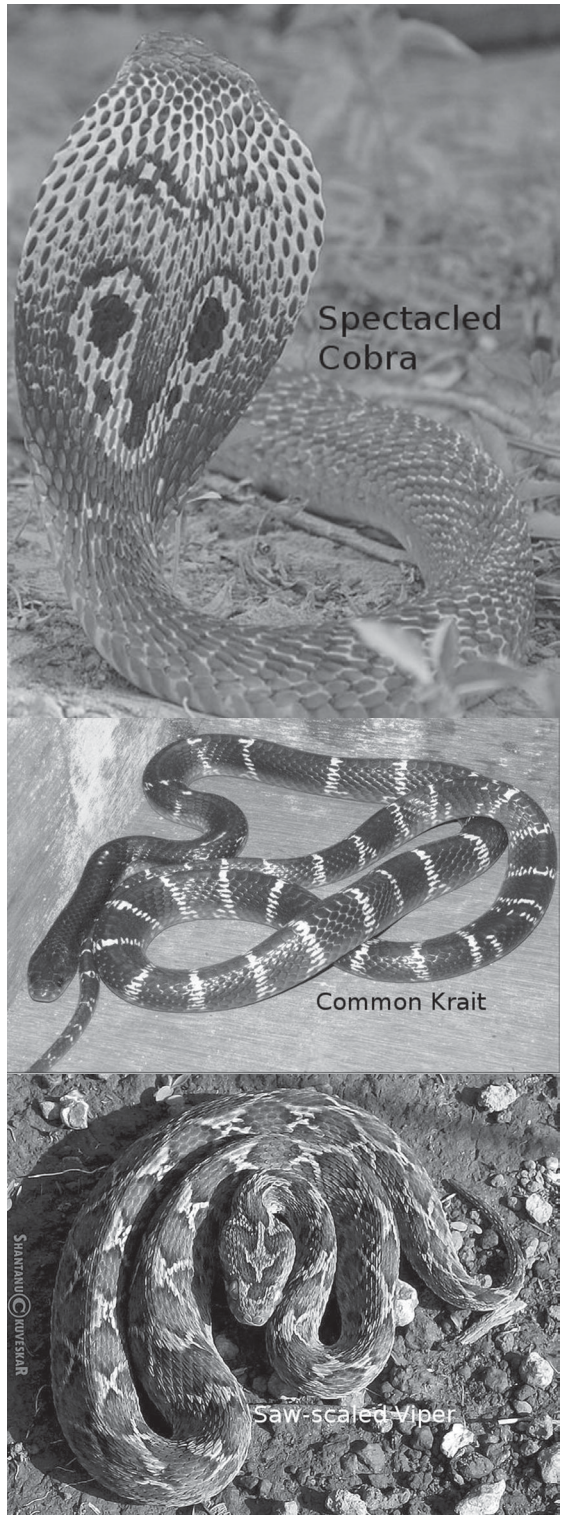
The Common Cobra

These are commonly the snakes in a basket with snake charmers. They are about 1 to 2 m in length, and have a broad head. They can spread a hood behind their head, which gives them their famous, very scary appearance.

Their body color varies based on their geographical location. Generally, cobras in southern India range in color from yellow to brown. Northern India cobras are usually dark brown or black.

Cobras are shy—they'll threaten when provoked, but would prefer to back away. If they attack, they will strike quickly and sometimes repeatedly. Larger cobras may latch on and dig in, releasing maximum venom!

In the event of a cobra bite, seek medical attention immediately: the common cobra is responsible for a large number of human deaths across India.



Common krait

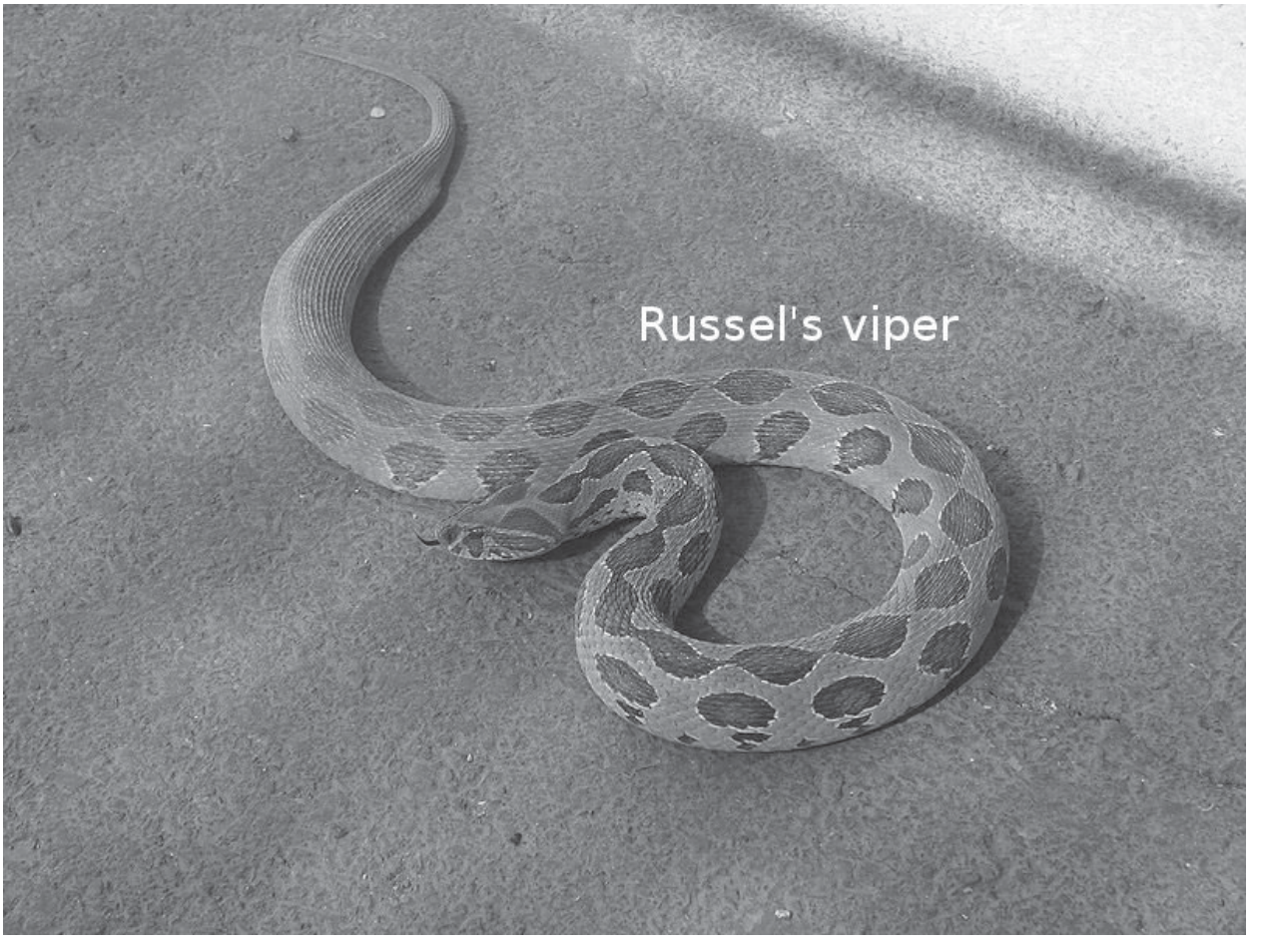
Slightly longer than the cobra, the krait ranges in length from about 1.5 to 3 m. Their head is depressed, slightly broader than the neck, with a rounded snout. Its eyes are small and entirely black.

The krait's body is black, with single or double milky-white bands. Its scales are hexagonal in shape, but those beneath the tail are undivided.

The krait is nocturnal, and during the day can be found in dark, dry places. They're docile and shy during the day, but at night will attack if provoked.

Russel's Viper

The Russel's viper is a stout snake, with a brown body mixed with reds and yellows. The body features three longitudinal rows of eye-like spots of dark brown or black, that start from the head and fade out towards the tail. The spots on either side are smaller and more rounded than the top spots.



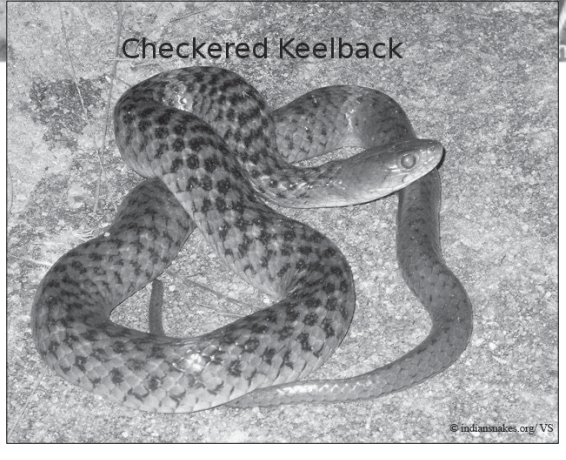
The head is triangular, pointed at the snout, and much broader at the neck, and features two triangular-shaped spots. Its eyes have vertical pupils, and its tongue is purplish black.

Common Kukri

Russel's viper is venomous enough that you should seek treatment immediately. If you provoke one (and not just step on it accidentally), it will warn with a high-pitched whistle like a pressure cooker.

Saw-scaled viper

These are the second most common vipers in India, after Russel's viper, and are much smaller, just 40 to 80 cm long. Their body ranges from dark brown to red, gray, or a mix of those colors. Light colored spots of light yellow or very light brown, with dark-colored lines woven through.



The saw-scaled viper is very aggressive when provoked, and makes a saw-like sound by rubbing its side dorsal scales together. Don't stick around if you hear that sound: the saw-scaled viper is one of the fastest-striking species

in the world!

If bitten, get treatment. It may dry-bite on occasion, but only a medical expert can say for sure.

The King Cobra

Sometimes this is included along with the other four to get the Big Five. An extremely aggressive snake, 3 to 5 m long, it has distinct light cross bands mainly on the forebody. It is uniformly coloured olive, brown, or green. The underside is a lighter shade of the body colour and the back has yellow bands. It is much more rare than the common or spectacled cobra, but it is much more menacing because of its great size.

Non-venomous snakes of India

Common ones are the checkered keelback, common cat snake, bronze-back tree snake, common kukri, common sand boa, common wolf snake, rock python, and rat snake. The last is often mistaken for a cobra.

Venomous or Non-venomous?

The thing that comes to most people's minds (children and adults alike) when they first see or hear the word snake is: is it venomous? (Poisons are eaten, venoms are injected so snakes are called venomous, not poisonous).

Most of the world's snakes are non-venomous. This means they do not produce a toxin that is clinically significant to people. Many non-venomous snakes kill their prey by constriction, literally squeezing the life out of them.

However, most snakes will hear you approach (from the ground vibrations) and simply go away. Unless provoked or accidentally stepped on, they will not be agressive or bite, whether venomous or not.

There are some basic features that distinguish venomous and non-venomous snakes.

Most venomous snakes have a sharp, pointed or triangular head, elliptical pupils, and upper jaws with fangs. They also have belly plates that expand all the way across their bodies to their blunt or rounded tails. Non-venomous snakes have curved heads, rounded pupils, sharp teeth and no fangs. Their belly plates are in two parts to their sharp, pointed tails.

Having read all this, we decided that it is difficult to come close enough to a snake and look at its head or pupils! Either we hope that the scientists are right and that snakes rarely attack, or we hope that there is snake anti-

How to tell venomous snakes?

1 Look at the head. Most venomous snakes usually have triangular shaped heads.

2 Check out the colors. Some venomous snakes such as the coral snake have bright colors to tell you that it's dangerous.

3 Watch for warning signs. All snakes have some kind of warnings. A saw-scaled viper will make a saw-like sound while a Russel's viper will whistle like a pressure cooker. Other snakes will hiss and snap at you.

4 Look at the eyes. Some venomous snakes have vertical eye slits, however, not all venomous snakes have vertical eye slits, and not all non-venomous snakes have round pupils.

5 Check the tail. The bottom of the tail (behind the anus) of venomous snakes looks the same as the rest of the belly. If the snake has a cross pattern (like a diamond shape) it is non-venomous.

venom available nearby!

Snake Facts

Snakes have been around for more than 100 million years, from the Cretaceous period and have overlapped with the now extinct dinosaurs.

Spotting a snake is unnerving for many people.

An amazing fact we learned is that in some sense snakes have permanently closed eye-lids. The skin of a snake is covered with scales. If you have seen a moulted snake skin (when the snake grows a new skin and sheds its old one, almost completely intact), you will see the scales and feel the dry, smooth texture.

These scales have specialised forms. In the eye region, the eyelids of a snake are made of transparent "spectacle" scales called brille, which are permanently closed. So the snakes do have eyelids that are permanently closed but see-through! That is why if you stare at them, they stare right back at you! Without blinking!

Snakes also have specialised scales in their belly region for gripping surfaces when they move. This is how some snakes can easily climb trees.

Snakes don't have ears, but they can spot you approaching by the ground vibrations generated by your movement.

Snakes don't have great vision; they rely on their sense of smell to track their prey. Their forked tongue is used to collect air-borne particles and these particles are examined in the mouth to see if it has come from some animal that is suitable to eat. The fork in the tongue ensures that the snake is able to tell in what direction the smell is coming from so that it can find its prey (or even its predator).

Some snakes like pythons have infrared-sensitive receptors in deep grooves on the snout (near the nostrils). This allows them to detect warm-blooded animals from the heat they radiate.

Snakes are helpful to humans in many ways and perform important roles in the natural environment. For one thing, they help control rodents and other pests, some of which could transmit diseases to humans.

The exhibition also had many details on snakes in various cultures and how historically snakes played an important role in many ancient civilisations.

Sources: Mobile Snake Exhibition, Natural History Museum, Beijing, and the Internet for information on Indian snakes, and images

Do You Know?

1. Is cancer contagious?

2. Can a mother's diet affect her baby's genes?

3. Why is space dark?

4. What makes things sticky?

5. Why does Uranus glow?

6. If I were an astronaut in space and suddenly open my space suit while floating outside my vehicle, would I explode first due to the lack of air pressure, or freeze first because of the lack of heat?

Answers to last issue's Do You Know?

1. Can ageing be controlled?

Ans: About twenty years ago, the answer would have been a clear 'No'. Now it is less clear, as scientists find out more and more about the inner workings of cells at the molecular and genetic levels.

For a long time ageing has been attributed to "oxidative stress": over the course of time, our bodies accumulate molecular damage as a by-product of breathing oxygen and eventually, damaged cells stop working. But recent experiments have shown that this theory may not be correct. For instance, a tiny mouselike creature known as the naked mole rat manages to live up to 30 years (about 10 times longer than a similarly sized mouse) despite accumulating a much greater level of oxidative damage in its tissues than other rodents.

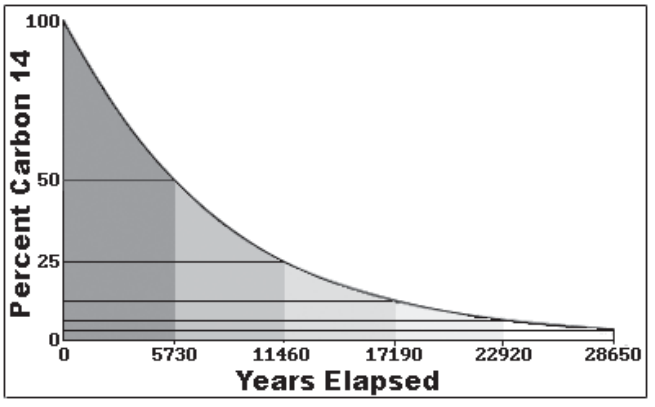
Apart from molecular damage, there is also genetic damage. These are changes in the genes themselves as well as in the switches that regulate how the genes are expressed.

Figuring out why and how these happen seems to be very difficult. For instance, why do organisms with remarkable genetic similarity have sometimes great differences in life span? We know that many of the processes that go on in the human body also go on in yeast and mice. Yet, yeast live only a few days, a mouse lives about three years, and people live for decades. We really do not know what evolution has done to take basically the same genes and produce different life spans.

We also don't know whether it will ever be possible to substantially extend human life span. But scientists do think we will learn how to extend human health span, or the number of years that older people can live in relatively good health.

2. We talk of "ancient" artefacts. How do we know how old they really are?

Ans: Historians and archaeologists talk about ancient artefacts or structures that are so many thousands of years old. How do they date these objects? Did these ancient civilisations have some sort of time and date recording system in



place then as well?

The answer is that some times archaeologists make use of the dates recorded by the civilisations, but most of the time, it is by carbon dating. When you have a king proclaiming that his ancestor ruled for 400 years for example, (it does happen) you'll want to check this out with other evidence.

Archaeologists use a number of tools to put dates on things they find and they tend to fall into two categories — absolute and relative. With relative dating, things that have been found by digging in the ground (called dig finds) are placed in order and that can be done using layers of Earth or mineral deposits in which remains are found; the deeper you go, the older the layer will be. Another relative dating technique uses typology. Humans tend to go through fashions in the many things they make; whether it's pottery, road building, house construction or metal forging, we can usually identify what period the objects we find belong to. But this is only because we already have a back catalogue with which to compare them.

For instance, the Mayan civilisations did have a calendar of their own and sometimes they were kind enough to leave dates from carvings and encryptions about their rulers. They didn't however leave dates for the minutiae of daily life. And that's when we need absolute dating.

Carbon dating is probably the best known chemical technique although there are others. When organisms such as people, animals, crops and trees are alive, they're continuously exchanging carbon with their environment. There are two main types of carbon out there. The one we're interested in is carbon-14 because it's unstable. Carbon-14 has two excess neutrons compared to regular or Carbon-12. Most importantly, the ratio of C-14 to C-12 in the atmosphere is constant, and via photosynthesis, all living beings also have this ratio in them.

When an organism dies, that carbon-14 starts to decay at a measurable rate, that is, it gets converted over time to ordinary nitrogen through a process called radioactivity. All you need to do to work out when that organism died is to see how much carbon 14 is left in proportion to the other forms of carbon.

There are also other clever archaeological tricks like optical dating which examines when buried minerals were last exposed to daylight.

3. We are told to brush our teeth every day. Do other animal species care for their teeth too?

Ans: In all the TV documentaries we watch, the animals, particularly felines and canines, seem to have perfectly clean gnashers. Are we humans missing something? Or is it our complex diet that necessitates toothpaste? Many people think wild animals by and large don't get tooth decay because they do not eat soft food. But this is not entirely right. Look at wild otters. They eat soft fish and slippery eels, but have no teeth trouble.

The difference is probably related to the

amount of carbohydrate in the diet — pet's diets, wild animals' diets, and our diets as well. The sugars and starches provide a ready food source of bacteria in the mouth. They have strange names like proteobacteria, firmicutes and fusobacteria. If there's sugar in the mouth, then they can grow more and more, and give dental decay. Of course, all these fits with what dentists tell us about our teeth, doesn't it? Sugary drinks and sweets increase our risk of dental decay. So maybe, we should be like the wild animals and try and cut down on our sugar and carbohydrate intake.

Do wild animals go to dentists? Some do! Some crocodiles, for instance. After eating its full, the crocodile goes off for a little snooze, relax and open its jaw. At this point a plover bird comes and is allowed to act as the crocodile's personal dental hygienist, vacuuming up the scraps that are left in crocodile snappers. The plover bird is well fed and the croc keeps its winning smile!

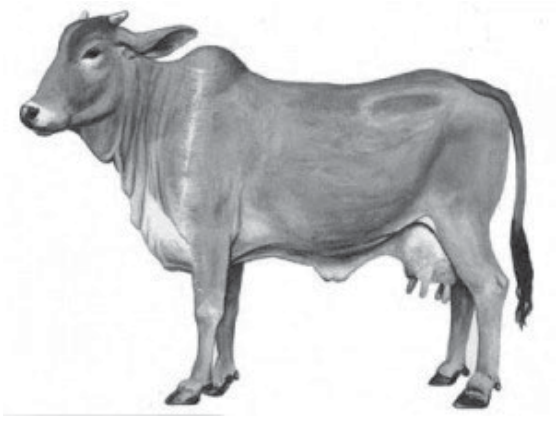
4. Can I "melt" a potato into a liquid?

Ans: No, you cannot. Why don't potatoes melt? This is actually quite tricky to answer, but it depends on the complexity of what we're trying to melt. The things that generally will melt are very simple substances, and most melt reversibly: if you cool them down, they might form solids again. Everyone knows that mercury is already a liquid (at room temperature). If you cool it down, you'll get a solid again. You can keep doing that forever, it will just reverse between solid, liquid and solid as you warm it and cool it.

But if you get more complicated things, there are other possibilities. Things can start to change, start to break down. Molecules can actually decompose and this is what's going to happen with potatoes.

So, if you think about sugar, this is a more complicated structure. It is made up of 3 different types of atoms — we have got carbon, hydrogen, and oxygen. If we warm this up, well, we can get liquid sugar. We can melt the sugar, and this is where the molecules are all moving around, still in their sugar forms. But if you heat that up too much, again, different parts of the sugar molecules might start to interact with each other and form new chemical compounds. You can boil off water and you're going to be left with this sort of black gooey mess which is carbon.

Now, when you come to a potato, it's even more complicated. You haven't got one type of substance there. You have a complete array of all sorts of complexity. There is water, there are starches, sugar, fats. All of these start interacting with each other. We do not have only a liquid mess of all of those. They start interacting at much lower temperatures, recombining, giving out water vapour and decomposing what's left into this sort of black gooey carbon mess, and that's what you end up with — your burned potato.



5. How did we get to using cows for our needs like milk, etc?

Ans: Scientists have analysed pots found in what is now the Sahara Desert in Libya; thousands of years ago it was green countryside. By studying chemical residues found in these containers, they've discovered the first direct evidence that people in Africa were using cattle for milk more than 7000 years ago.

The scientists found lipids (molecules like fats and waxes) in ceramics indicating that those people were using milk products and also animal fat products and processing them in their pots. Probably the ancients were making butter, cheese and yoghurt (curd) in these pots.

It's quite remarkable: around about 10,000 years ago when people settled down living a farming lifestyle (as opposed to being hunter gatherers) nobody could tolerate milk. Once cattle were domesticated, people in the ancient world started processing these milk products and using them. Within about a thousand years a gene evolves which allowed people to tolerate milk so we've become lactose tolerant.

During the lipid analysis, 50% of the pots showed evidence that milk was processed in them. So it was the secondary products like the milk, the cheese, the butter, the yoghurts that were much more important to ancient people rather than the actual flesh of the animal.

6. Is it true that we use only 10% of our brains? What happens to the rest then?

Ans: Your brain is ticking over all of the time. When you actually engage in a specific task, a small part of the brain that's concerned with doing that task becomes more active, starts signalling more vigorously to process the information that's needed to solve that problem or to stop you falling over or whatever. And that is because it's a small fraction that gets switched into action to do something specific. That's why people could not measure a big change in energy consumption when the brain engaged actively in some specific mental work.

So, one might wonder, "Well, could I in fact have more of these parts of the brain switched on and do incredible multitasking?" The answer is, no. When these small regions of the brain become more active to do a specific piece of mental work, their signalling rates go up by a factor of about 10. If you were to increase the activity of every neuron in the brain ten-fold, then your brain would be using more energy per second per gram of brain than an Olympic sprinter who is making a world record attempt.

The architecture of the brain is such that it's not a general purpose computer that uses a small set of circuits to do everything. It's a specialised computer which has a specific set of circuits for every task and because of that, when it's able to deal with everything, only a small fraction of the brain circuits will be engaged in that at any one time.

Science News

Headlines

- Kangaroos flex biceps too!
- The new parasite: Mikrocytos mackini.
- Light stopped for a full minute!
- Mice made to remember what didn't happen at all
- Bacteria posting on Twitter

For more details, read on

Kangaroos flex biceps too!

Isn't it common to see boys flexing their biceps, showing off how strong they are (especially to girls)? We humans aren't the only ones, it now turns out that male kangaroos do this too!

In a recent study of 13 grey kangaroo males and 15 females, the body mass of each animal was calculated by femur (thigh bone) circumference, measuring the bone at the narrowest point. Forelimb muscle mass in males was found to be heavier than the equivalent muscles in females, suggesting different applications for the same limb between the sexes.

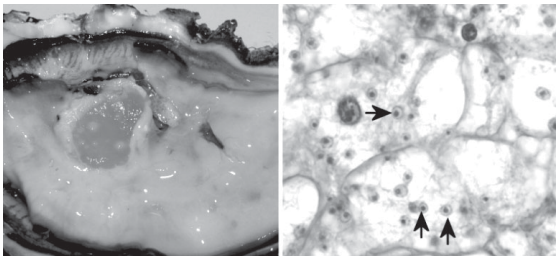
Male kangaroos apparently use their muscles in wrestling matches with love rivals. Scientists found a select group of muscles which are particularly used in grasping the other males and drawing them towards them, which were exaggerated in the larger males. The larger the males get, the more those individual muscles are worked up, so they are disproportionally larger than the rest of the body.

Males are not simply getting bigger but their forelimbs are getting disproportionally bigger not only in bone length and diameter but also in muscle mass. Scientists relate this to male-male competition for right to win females.

There is some controversy about these conclusions but isn't it fun? Would you like to arm-wrestle a kangaroo?

50-year search for killer ends

In 1960, a strange disease was reported. Called the Denman Island disease, it infects mainly Pacific oysters, and leads to unsightly green lesions and death. Which parasite



causes this disease? A puzzle of longstanding, this mystery has at last been solved, and the culprit has been apprehended: it is a parasite called Mikrocytos mackini.

M. mackini has eluded capture for more than 50 years because it lives inside the oyster's cells and has proved impossible to grow and study in a lab. A recent issue of Current Biology reports how scientists isolated the parasites from infected oysters and analyzed their genes.

M. mackini is part of an enigmatic group of amoebae called Rhizaria that was only itself discovered a few years ago. These parasites have an extremely reduced metabolism. They can't survive in oxygen and its mitochondria — or cellular powerhouse — can't produce energy, so they probably steal most things from the oyster host in order to survive.

While not considered a health threat to humans, the Denman Island disease makes oysters very unappealing. In fact, in many parts of the world, oysters are eaten raw and relished as a delicacy. There is good news for them now.

. Light stopped for a full minute!

What is the fastest thing in the universe? Light. It travels at the speed of just under 300 million metres per second in vacuum. A recent issue of Physical Review Letters reports on an experiment that managed to stop light for a full minute — time in which light would travel about 18 million kilometres in that time - that's more than 20 round trips to the moon.

In 1999 physicists managed to slow it down to just 17 metres per second. Earlier this year, researchers kept it still for 16 seconds using cold atoms. Now they have reached a minute.

Scientists fired a control laser at an opaque crystal, sending its atoms into a quantum superposition of two states. This made it transparent to a narrow range of frequencies. They then halted a second beam that entered the crystal by switching off the first laser and hence the transparency.

The storage time depends on the crystal's superposition. A magnetic field extends it but complicates the control laser configuration. The team used an algorithm to "breed"

combinations of magnet and laser, leading them to one that trapped light for a minute.

It is all very technical and difficult to understand, but let us simply marvel at this achievement for now.

. Mice made to remember what didn't happen at all

We all keep forgetting things, and know that memory is an act of the brain. By manipulating neurons in the brain, can we made to "remember" something that never happened? That is, we will then believe that something happened though it never did. Sounds bizarre, doesn't it? Even a little scary.

But it is possible, and has been demonstrated in mice, according to a recent issue of the journal Science. Researchers have been able to consistently create a "false memory", making a mouse fearful of a place it

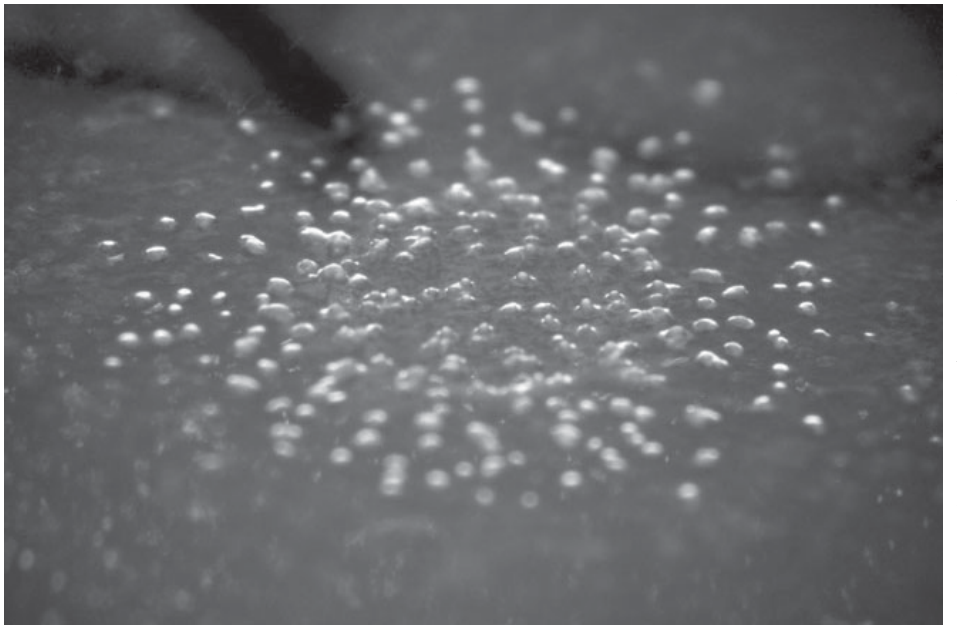
has no reason to fear. The memory was implanted by shining blue light into the mouse's brain, which triggered a carefully chosen group of neurons.

The researchers used optogenetics, a technique that allows precise control of brain circuits. The control is achieved by expressing proteins that act as switches in particular types of brain cell. These switches are channels that, when struck by a particular colour of light, allow charged particles into or out of the neurons, which will either activate or silence them.

They installed an optogenetic trigger in neurons that were especially busy while a mouse got to know a new environment (call it Place A). The next day, in a different environment, they gave the mouse small electric shocks while triggering the memory of Place A using light. After that, even though it never had a negative experience in Place A itself, the mouse froze when it was returned there.

In another experiment, mice were given the same memory-shock treatment and then offered a choice between Place A and somewhere else. The mice avoided Place A. A group of mice that had the same virus inserted into a different part of the hippocampus was unaffected and was just as happy in Place A as anywhere else.

Hapless laboratory animals have been enduring this type of behavioural testing for nearly a century. It is no surprise that we can train a mouse to dislike a room. But to do so while the mouse is in another room entirely, by triggering a memory with light? Science like this was impossible a decade ago, but is very useful in understanding the progress of diseases such as Pakinson's, autism, and depression.



muck that lines water pipes is a biofilm. So is the slippery slime on river rocks. In contrast to the simple petri dish, wild bacteria exist in complex, 3-D, multi-species communities.

Unlike human nerves, bacterial communication doesn't require that two cells be in near-direct physical contact. Many species of bacteria release chemicals freely into their environment in order to communicate with their neighbours. But this technique is the bacterial equivalent of a general posting top secret military information on Twitter. Other bacteria within range can eavesdrop and develop chemical countermeasures. To make their communications a little more private, some bacteria evolved the ability to package their chemical cargo inside blobs of cell membrane. Depending on the function of the chemical contents, these packages can act as either mines or messages in a bottle.

. Bacteria posting on Twitter

Imagine an elaborate communication network, that acts like a smart super-organism with defence and attack capabilities. Are thinking of the military? No, this one is under our feet, a web made of bacteria.

A team of scientists have used cutting-edge 3-D microscopy to identify a new mechanism for bacterial networking. They observed elaborate webs of a common soil bacterium, Myxococcus xanthus, connected by thread-like membranes. This system of cellular pipelines suggests that some bacteria have evolved complex ways to deliver molecular cargo out of sight from snooping neighbors.

Scoop up a handful of dirt, and you're likely holding Myxococcus. This common bacterium is a model organism for studying biofilms, physical networks of bacteria made from webs of cells and sticky secretions. The

The new observations provide the strongest evidence yet that Myxococcus, and perhaps other species, are attached by chains of shared membranes. These flexible links and tubes could allow bacterial cells to move as a web, communicating and hunting like a superorganism.

Such structures in bacteria are very real. What they are used for remains to be explored. Whether we can exploit them for drugs is the big question.

activity page

Boggle'd

Boggle is a word game designed by Allan Turoff and trademarked by Parker Brothers and Hasbro. Here we play a smaller version of the traditional game.

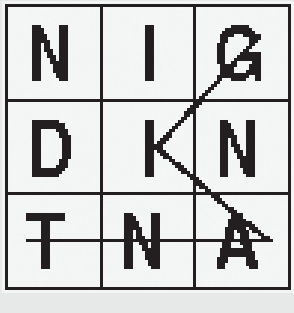
How to play

Search for words that can be constructed from the letters of sequentially adjacent squares, where "adjacent" squares are those horizontally, vertically or diagonally neighboring. Words must be at least three letters long, may include singular and plural (or other derived forms) separately, but may not use the same letter square more than once per word.

An example "GIANT" is already done for you.

The original game has a time limit of 3 minutes and uses 4 X 4 squares. Here, your time limit is the next JM issue! Do write in your word list to the JM address given in the magazine and we'll print the ones with the most number of words. Don't forget to write in your name and address.

N	I	G
D	I	N
T	N	A



Sudoku

Rules

. Use the numbers from 1 to 6.

. Every row must have all the numbers from 1 to 6

. Every column must have all the numbers from 1 to 6

. Every sub-rectangle must have all the numbers from 1 to 6

. The central shaded square (in the medium puzzle) must have the numbers 1 to 4

(A sub-rectangle is the 2 x 3 rectangle; the 6 x 6 square is broken up into 6 such sub-rectangles.)

Use the numbers already filled in as hints to complete the grid. Each Sudoku puzzle has a unique solution.

Send in your answers to us at the JM address given elsewhere in the magazine. Don't forget to write in your full name and address.

EASY

1					
		4	5		2
			3		
	4	3		2	
5				3	
					6

MEDIUM

				3	
		2			
1					4
	5				
6					
	3		5		

Crossword

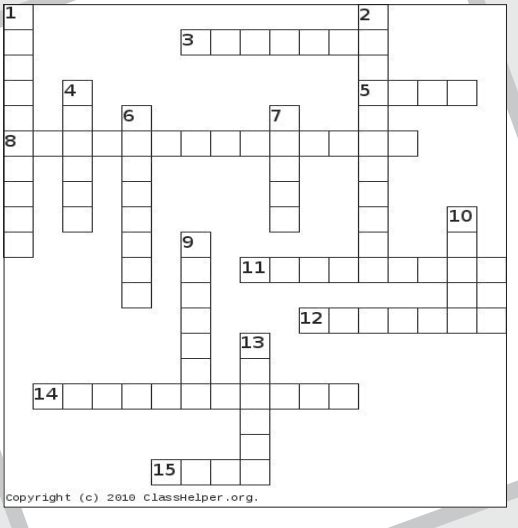
In this Year of Statistics, here is a puzzle for you from www.abcteach.com

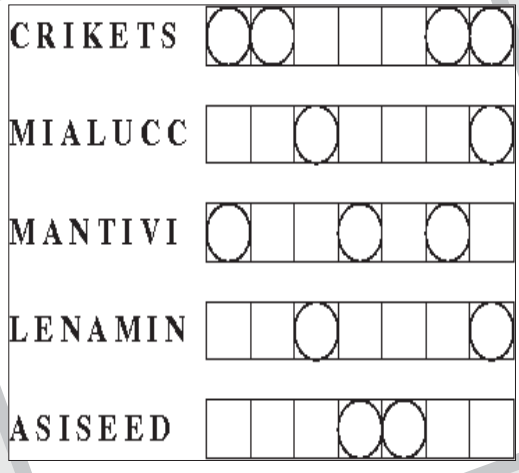
Across

3. Each possible result of an experiment (7)
5. The value that occurs the most often in a set of data
8. Consists of two or more simple events that follow or another (8,6)
11. Events that affect the probability of each other (9)
12. A value that is very different in a set of data (7)
14. Events that do not affect the probability of each other (11)
15. The average in a set of data (4)

Down

1. Estimate or guess about something that has not yet happened (10)
2. Can mix up the arrangement without problem (11)
4. Study of a small subset or part of the whole (6)
6. The final answer (8)
7. An outcome of an experiment (5)
9. Not too tall, not too short (7)
10. The difference between the greatest and the least in a set of data (5)
13. The middle number in a set of data (6)





Jumble

Unscramble the letters to get five ordinary English words. Fill them in the adjoining boxes. Make a word with the circled letters and guess the answer to the puzzle below.

Why are vitamins essential for you? Because they are:

Ans: _ _ _ _ _ _ _ _ _ _ _ _ _ .

Send in your answers to JM at the address given in the magazine. Don't forget to write in your name and address.

Solutions to May - June issue's Activities

Boggle'd

Possible words are art(s), astir, ate, await, awake, its, kit(s), kite, rat, rate, raw, rite, sat, saw, stair, stake, star, stir, straw, strike, take, tar, tie, wait, wake, war, wart, was, waste.

Alas. No-one sent in solutions to Boggle'd. Try out the one in this issue: it's a great way to improve your visual skills.

CrossWord

Across

1. Intestine 5. Radius 6. Phalanges 8. Sepsis 9. Cerebrum 10. Ear

Down

2. Tarsals 3. Triceps 4. Nose 6. Pulse 7. Auricle

Jumble

1. SHELF 2. TIDAL 3. QUAKE 4. CORAL 5. STEEP

Bears in the North and penguins in the South.

Ans: POLES.

Sudoku

EASY

6	3	4	1	5	2
1	2	5	6	3	4
3	6	2	4	1	5
4	5	1	2	6	3
5	4	6	3	2	1
2	1	3	5	4	6

MEDIUM

6	4	1	5	2	3
3	2	5	4	6	1
1	6	4	3	5	2
5	3	2	1	4	6
2	5	3	6	1	4
4	1	6	2	3	5

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Dromedary

The Indian camel is also called the **Arabian camel** or a **Dromedary**. Its origin is unclear, but it was probably domesticated in the Arabian Peninsula about 4000 years ago. The domesticated form also occurs widely in North Africa, South Asia and the Middle East.

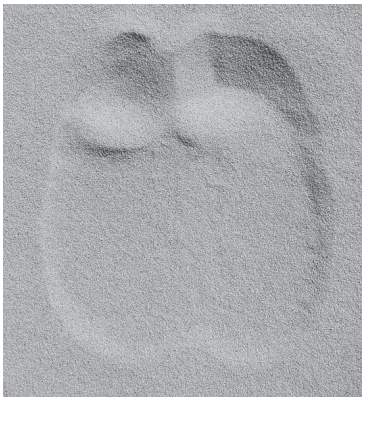
It has only one hump on its back, in contrast to the **Bactrian camel**, which has two humps. It is also slightly smaller than the Bactrian camel, about 1.8 m tall. Their colour is brown, but the variation is from a light beige to a dark brown.

The dromedary is best known for its hump, about 20 cm high. It is composed of fat bound together by fibrous tissue and allows the camel to go for long distances through dry desert land. The hump does not store any water. Instead, the hump stores up to 36 kg of fat, which a camel can break down into water and energy when sustenance is not available.

They have many other adaptations to help them exist in their desert habitat. Dromedaries have bushy eyebrows and two rows of long eyelashes to protect their eyes and can close their nostrils to face sandstorms. Their ears are also lined with protective hair.

When water-deprived they can fluctuate their body temperature by 6 degrees C, changing from a morning minimum of 34 degrees to a maximum of 40 degrees or so in the afternoon. This is to allow heat flow from the environment to the body to be reduced and thereby water loss through perspiration is prevented. They have specialized kidneys, which make them able to tolerate water loss of more than 30% of their body mass; a loss of 15% would prove fatal in most other animals. When they finally find a water source, they can stock up on water by drinking at the speed of 10-20 litres per minute!

Their diet includes foliage and desert vegetation, like thorny plants which their extremely tough mouths and thick lips allow them to eat. The dromedary has long and powerful legs with two toes on each foot, which resemble flat, leathery pads. These pads spread out when the camel puts its weight on them, and this prevents them sinking into the sand. (See the picture). This is yet another way in which they are adapted for life in the desert.



Unlike many other animals, camels move both legs on one side of the body at the same time, like giraffes, which results in a swaying motion. Any one who has gone on a camel ride will remember this well!

They have an average lifespan of 40 years, which can be extended to 50 years in captivity, when domesticated. They are generally used as beasts of burden, and their docility and toughness compared to cattle are additional advantages. The hair is a highly regarded source material for woven goods. Another useful feature is their dung which can be used as fertiliser and fuel. Their milk is also drunk, especially by nomadic tribes in the desert.

Source: Wikipedia