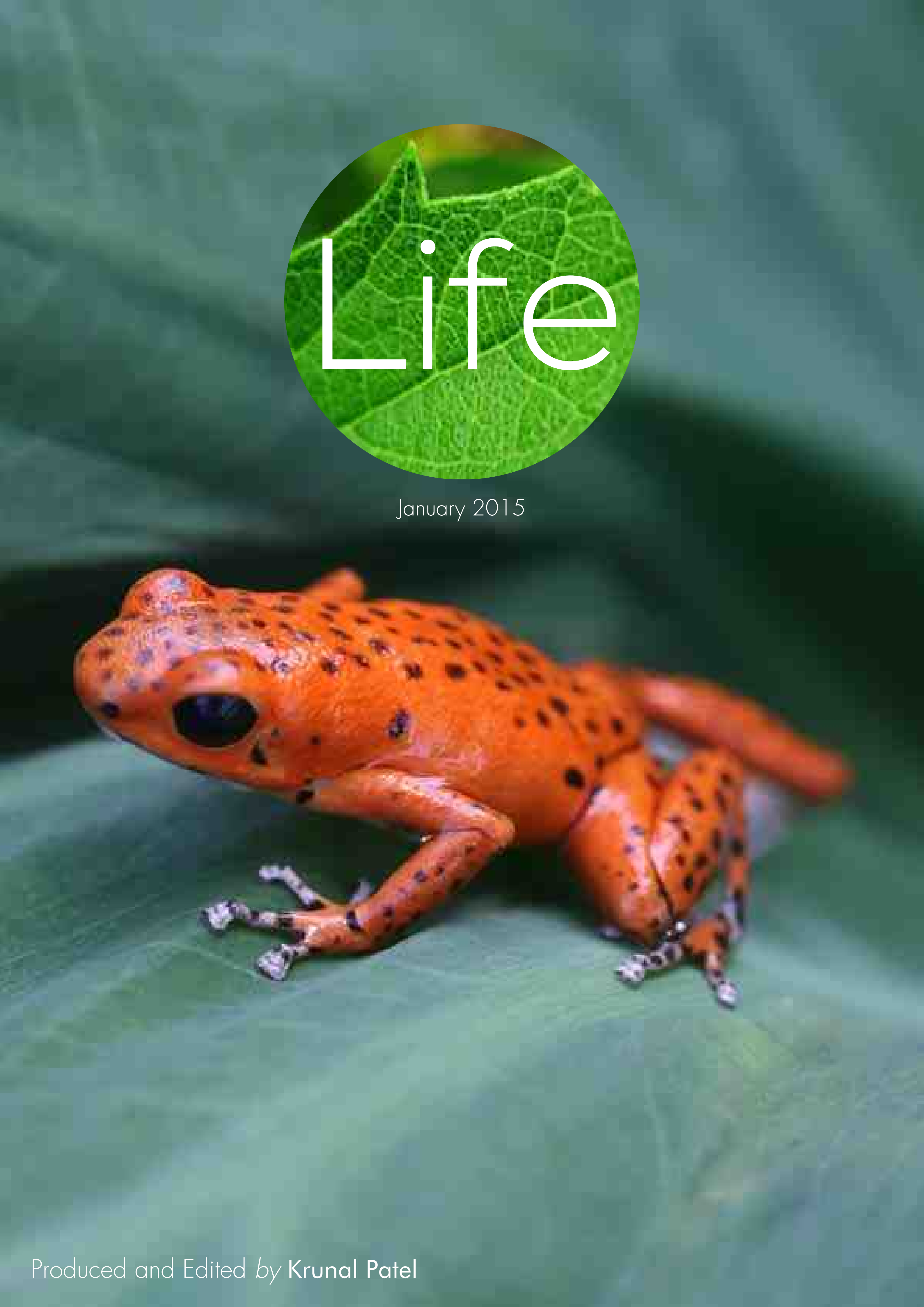
# Life

January 2015



Produced and Edited *by* **Krunal Patel**

# Contents



# The colour behind tropical frogs.

**/ Shayan Simakani** - *12 W*

In the UK, frogs tend not to stray away from their natural brown and green colours; however, this is far from the case in many tropical countries, such as Australia and in Central and South America.

Species such as the *golden poison dart frog* and the *phantasmal poison frog* are renowned for their vibrant colours and beautiful designs, yet there's more to their exotic appearance than just making the amphibians aesthetically pleasing.

According to Molly Cummings, of the University of Texas at Austin, there is a positive correlation between the brightness of the frog's skin, and the toxicity of its poison. For example, it was found that the poison of a bright orange-red frog, from Solarte Island, was in fact 40 times more toxic than a matte green frog from Colón Island. Although this does not prove much, it is inferred that the more toxic species of frog are brighter and more vibrant to warn potential predators of their poison.

This is called *aposematic colouration* - a term used to describe colours and/or patterns that act as a warning to predators that a potential prey species is unpalatable, toxic or dangerous. Various studies have shown that all vertebrates, including birds associate greens and blues, with safety, and inherently regard red, orange, yellow and white as signs of danger. It is also widely accepted that patterns incorporating stripes or spots draw attention to objects. Consequently it is no surprise to find that poisonous frogs have evolved colour schemes that reflect these facts, in order to "label" themselves as being unpleasant to eat, and thereby dissuade birds and other animals from attacking them. Equally, it is unsurprising that other species of frog have in fact evolved to mimic the patterns and colours of toxic species, in order to trick predators into leaving them alone; this is called *Batesian* mimicry and many colourful tree frogs use it as a means of safety.

It is suggested that poison dart frogs, the most infamous brightly-coloured poisonous frogs, acquired their brightly coloured skin through evolution. Many years ago, birds and other predators soon learned that some of the brighter and more colourful frogs were poisonous. These frogs thus became less susceptible to predation and through natural selection, these poisonous frogs were the ones more easily able to survive and reproduce, while still using their bright colourful skin as a warning to predators.

However, many frogs have evolved to use different tactics to evade from predators. Some use "flash colours" in an attempt to shock their predators.

– Fire-bellied toad

They tend to have inconspicuous colours on their back which generally match with the environment as a method of camouflage. However, hidden on their bellies, groins or backs of their thighs, they have patches of bright colours and patterns which they expose to predators in an effort to startle and confuse them to make them flee, or to give the frog itself enough time to escape. For example, the plain brown back of the fire-bellied toad matches the ground on which it spends most of its time. When threatened, the toad exposes its bright red underside.

There are also various other tactics frogs use to evade predation. For example, the Chilean four-eyed frog has a bright pair of spots on its rump that look like enormous eyes. When these spots are exposed, the frog gives the predator an impression that it is in fact a much larger and more intimidating animal.

Meanwhile, others can change the colour of their skin like a chameleon. This can be caused by changes to light, temperature, humidity or mood. Fear or excitement makes many frogs and toads turn pale, but others, like the African clawed frog, darken when disturbed. Colour changes like this are created by special pigment cells called *chromatorphores*. Inside these cells, grains of pigment cause colour changes by shifting their distribution. When the grains are packed together in the centre of each cell, the frog is light coloured. When the pigment grains spread out within each cell, the frog's colour darkens and intensifies.

These methods all show how fundamental colour is to frogs' survival and how many species have evolved in ways to utilise it in an effort to evade predation and to be able to successfully reproduce.

## Did you know?

***1) If you eat a polar bear liver, you will die. Human bodies can't cope with that much vitamin A.***

***2) A full head of human hair is strong enough to support 12 tonnes!***

***3) Honey does not spoil, ergo you could consume - without any harm - 3000 year old honey.***

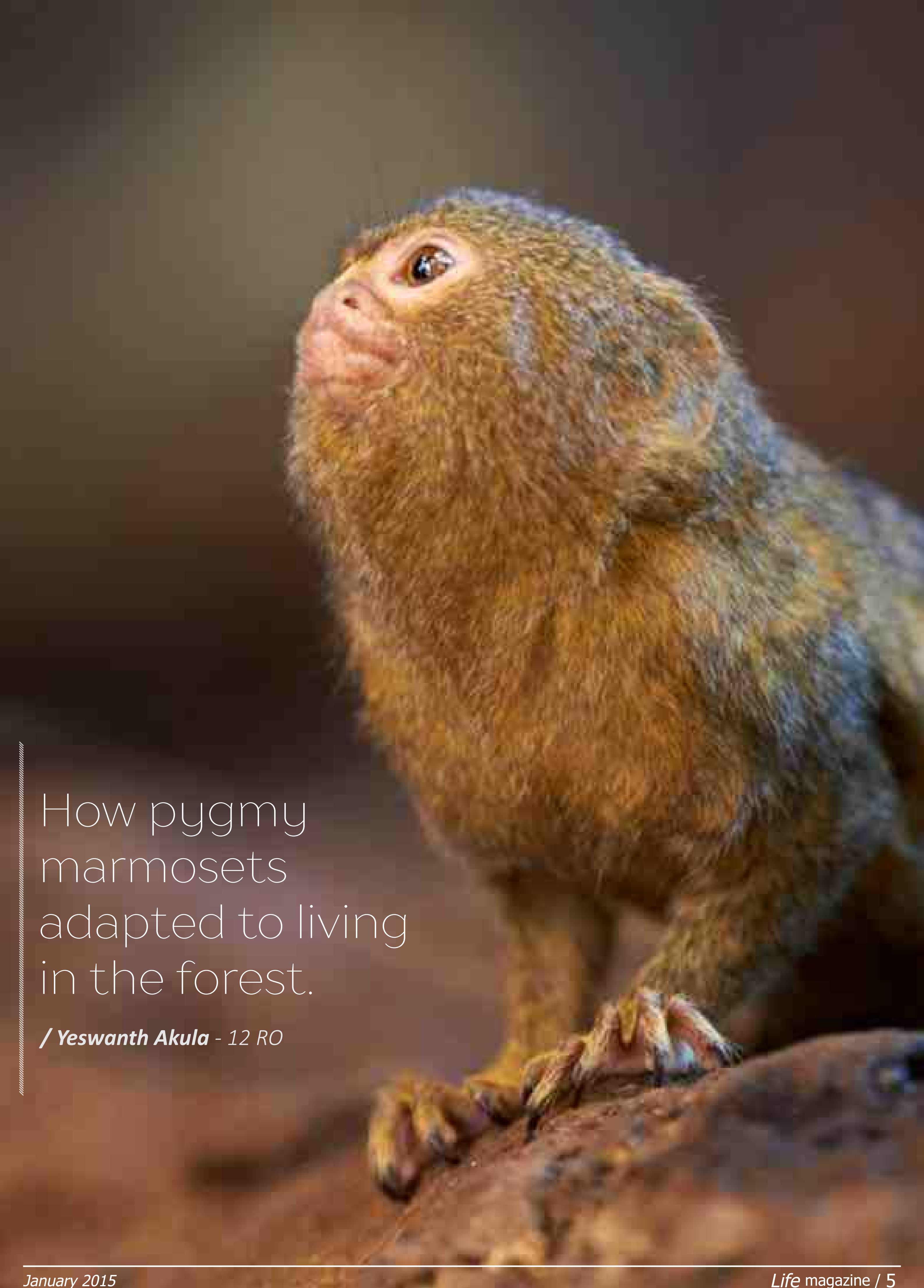
***4) The woolly mammoth was around when the pyramids were being built.***

***5) If you were to remove all of the empty space from the atoms that make up every human on earth, the entire population could fit into an apple.***

***6) The tyrannosaurus rex lived closer in time to humans than to the stegosaurus.***

***7) The largest cell in the human body is the female egg; the smallest cell in the human body is the male sperm.***

***8) Your nose can remember 50,000 scents!***



# How pygmy marmosets adapted to living in the forest.

***/ Yeswanth Akula*** *- 12 RO*

The pygmy marmoset, also known as *'Cebuella pygmaea'*, is a species of small monkeys that are native to the rainforests of the western Amazon basin in South America. The organisms are among the smallest of all the primate species with the monkeys weighing in at just over 100 grams! . The marmoset has many adaptations for arboreal living including the ability to rotate its head 180 degrees, enabling it to scan the environment for predators while using sharp, claw-like nails to cling onto the branches of rainforest trees. As a primate, the animal  walks on all four limbs and can jump up to five meters across branches. In fact, the movement of the pygmy marmoset is often compared to the patterns of locomotion of squirrels; they are known for vertically holding on to tree trunks as they feed on sap.

A fully grown adult pygmy marmoset could easily fit in an adult human's hand and it weighs about as much as a stick of butter. However, its tail is longer than its body which helps the little monkey to keep its balance as it gallops through the treetops. Due to the marmoset's small size, it prefers to reside in the leaves at the highest point of the emergent trees.  An additional characteristic that aids in their eating behaviour is the shape of their lower incisors. They are narrow and elongated such that the five teeth in the front and centre of the lower jaw are all the of same length. This helps them gnaw into trees efficiently and stimulate the flow of slap out of the flora. In forests the monkey has a special diet; it feeds on the tree gum of usually 1 or 2 trees, sharing with its family of marmosets. When the trees become depleted, the group moves on to new trees, but they can also resort to consuming arachnids and insects. In terms of the group itself, there are 5 to 9 members with 1 or 2 male and female adult monkeys. Another unusual characteristic seen in pygmy marmosets is the females' ability to producing twins. A female pygmy marmoset gives birth twice a year and it is typical that the offspring are born in sets of twins.

Pygmy marmosets use sleeping sites, or roosts, each night and their day starts shortly after sunrise when all members of the group leave the sleeping site. These 'sites' are generally made of dense tangles of vines or, on rare occasion, tree holes. Each group has two or three sleeping sites but only use one on a regular basis. Male and female pygmy marmosets show differences in foraging and feeding behaviour, although gender dominance varies within the species. Males have less time to search out food sources and scavenge due to the constraints of their infant caring responsibilities and predator vigilance. Without an infant to carry, female pygmy marmosets have greater freedom to forage, giving them an apparent feeding priority. This priority may serve to compensate mothers for energy-consuming process of carrying and lactating for two offspring at a time. Females usually choose mates who invest time in infant care and the most likely reason for this is that these males usually have less time to look for food, allowing the females to feed first.

While the pygmy marmoset species is not considered to be endangered, there are definitely significant changes in their behavioural patterns due to human interaction. This has resulted in changes in the monkeys' social play and vocalization, both of which are essential in communication between animals in the species. This is particularly true of marmosets in areas of heavy tourism; pygmy marmosets have a tendency to be less noisy, less aggressive, and less playful with other individuals. Partly because of their small size, captured pygmy marmosets are often found in exotic pet trades. Capture results in even more behavioural variations, including a decrease in the both the number and the sound level of vocalisations.

# How and why were some dinosaurs so big?

***/ Arman Djalai*** *- 12 W*

Roughly 220 million years ago the largest of the dinosaurs were just the size of the largest mammals nowadays; it is estimated that it was around 20 million years later, when the Jurassic period began, that some dinosaurs grew to the large sizes that they known for. Some some estimates suggest the biggest of dinosaurs, notably the *Argentinosaurus huinculensis* weighed between 88-110 tons and other species reached up to 100 feet in height. It makes us question how they could adapt to support themselves, why they were different and how their skeletons and organ systems could cope with them being such impressive sizes.

In determining the size of the vertebrae of the dinosaur, two factors must be taken into account: the way in which the dinosaur uses its energy and the food sources available to it. One particular factor still debated today is whether the animals were warm or cold blooded. Whether dinosaurs were warm blooded or cold blooded would affect their energy expenditure; a majority believe dinosaurs were too large to be warm blooded and that they would need to take in an unrealistic supply of energy for both growth and maintaining body temperature. This seems likely as it is believed that during the period in which they inhabited the Earth, there were fewer food sources for dinosaurs, particularly grasses which would have fuelled the herbivores. However, others argue using the example of the blue whale; believed to be the largest creature ever to have lived on Earth, explaining that as these species were warm blooded that it would be just as possible for dinosaurs to have been warm blooded. Recent research indicates that some sauropods (herbivores) had fewer teeth - reducing the amount of energy used in physical digestion. Also, they would instead swallow their diet of cropped branches and leaves whole, to take in as much energy as possible to support the metabolic demands brought about due to their large size. Furthermore with fewer teeth for chewing, their heads would have been lighter and therefore their necks could have been longer, enabling sauropods to reach a wider range of vegetation from one feeding spot; meaning they would use up little energy for movement and use more for growth.

Cartilage in mammals and dinosaurs comes in a variety of different shapes and sizes, which could possibly explain how dinosaurs could support their movement at such large sizes. Research undertaken by a team comparing widths and distances between the ends of thigh bones in dinosaurs and mammals and their descendants helped reconstruct the area of joints between bones. The research concluded that as mammals grew larger, their bones became more rounded at the ends, whereas the bones in dinosaurs and their descendants tended to grow wider, flatter ends as the animals grew in size. The research found that the dinosaur joints pack more layers of cartilage as the animals increase in size meaning that they evenly distribute the pressure put on the joints, making the joints slightly deformed, less rigid and able to sustain larger forces. The theory of the structure and composition of dinosaur cartilage is difficult and not completely clear, but some evidence is given to this research as many reptiles and birds share similar, partially deformed joints to those exhibited by the dinosaurs explored in the research.

Additionally, dinosaurs are believed to have possessed a more hollow skeleton (compared to mammals) with air sacs extending from their lungs, which would require less support than the solid mammalian bones and would cause some species to weigh significantly less than mammals if they grew to dinosaur sizes. The dinosaur is believed to have a more bird like efficient lung system with numerous air sacs around the body; some extending to near the skull and some to the thigh. Being so large the dinosaur would have significantly high demands of

oxygen and therefore a more efficient transport and exchange system would be required to allow the large animal to survive. The fact that some of the largest dinosaurs had four legs would have supported the animal in distributing the large weight of the animal. Reproductive strategies of dinosaurs are also believed to have had an effect on their size; *Sauropods* are believed to have laid around 10 eggs at a time in a small nest and instead of the mammalian strategy of investing a majority of energy into one or two offspring, carrying them internally, the sauropods reproduced quickly and left their eggs behind, reducing their energy expenditure on their offspring. This would then make it more of a reproductive advantage to being larger.

The majority of factors behind some of the dinosaur species being able to grow to such enormous sizes seem to be various ways of reducing energy expenditure of different activities, in order to focus and increase the energy used for growth. However, most of the research seems to be inconclusive as evidence provided is still not fully definitive, but using the evidence presented, researchers have compared dinosaurs to other organisms and have identified the main differences between them, giving possible explanations for the differences in size.

*– Argentinosaurus*

# Why are birds' eggs different colours?

***/ Pietro Hughes** - 11 BR*

Roughly Birds' eggs differ in colour both between species, and between individuals of a species itself. This article will discuss the various survival mechanisms employed by birds to ensure that their genes are inherited by many generations to come.

To be able to explore the circumstances in which eggs have evolved, the reproductive cycles of birds must first be understood. Courtship varies drastically between species, such that it would be time consuming and irrelevant to explore it. Thus, the 'story' is picked up once sexual intercourse has been performed and a nest, been constructed. Female birds stagger their egg laying, leaving some time between each one. However, birds do not often begin incubation immediately, once the first egg has been laid. This would cause an often undesirable imbalance in chick size and parental requirement. Consequently, most birds only begin incubation once all eggs have been laid, leaving the first laid eggs exposed and vulnerable, in the nest, until the last egg is laid.

This period has given rise to the evolution of an egg's most potent defence: camouflage. With the parent(s) fattening up before brooding, their best hope for their eggs' survival is that they remain unnoticed. Therefore, eggs have evolved to resemble the habitat in which they are most likely laid. For example, a ground nesting bird, like an Oystercatcher, has eggs speckled grey, brown and cream, like the ground upon which they are laid.
A similar example involves the Cuckoo, and its infamous ''egg dumping'' behaviour. ''Egg dumping'' refers to the laying of eggs in the nest of a different species (the host), who then raises the chick as if it were their own. A Cuckoo egg survives if it resembles the eggs of its host, down to the most minute of details. If not, the host would likely remove the Cuckoo egg from its nest, and not incubate it, preventing the hatching of the chick.
With the survival and reproduction of birds with genes for effectively camouflaged/disguised eggs, such genes spread through the species' ''pool''. Thus, by natural selection, eggs gradually change colour to augment survival chances.

Egg colour has also changed to achieve a shade close to the opposite of the aforementioned camouflage/disguise. In large Guillemot colonies, of up to many thousand parents and eggs, individuals must be able to recognise their own eggs. If this were not possible, eggs would be lost and fights had (over eggs), altogether reducing population growth, and the opportunity to pass down genes to offspring. As a result of evolution, each Guillemot egg is visibly different, with only a blue/grey background and almost conical shape shared between them. This allows for eggs of different pairs to be distinguished, rendering incubation a more efficient process and, as previously said, augmenting survival chances.

An egg's visible colour is not its sole asset, however. Female birds may develop calcium deficiency, particularly if they lay multiple broods of many eggs over the course of one breeding season. Such a deficiency is unhealthy for the female bird, and may also cause the eggshells to be brittle. As is a recurring theme of this article, evolution by natural selection improves survival chances; females can overcome their calcium deficiency and the risk of brittle shells by substituting calcium carbonate for a brown/red pigment called protoporphyrin. These calcium-deficient shells, containing protoporphyrin instead, are less to likely to be crushed by the incubating adult, increasing the embryo's chance of hatching.

To conclude, bird egg colors vary dramatically, particularly in relation to the habitat in which they are laid. However, camouflage/disguise are not the only evolved uses of colour, with the ability to differentiate between eggs, being equally useful. Moreover, colour pigments, namely protoporphyrin, reduce the brittleness of shells, particularly in calcium deficient mother birds. Whatever the adaptation, though, each collectively demonstrate the complex lengths to which egg color has evolved to improve chances of hatching.


# Colour change in fruit ripening.

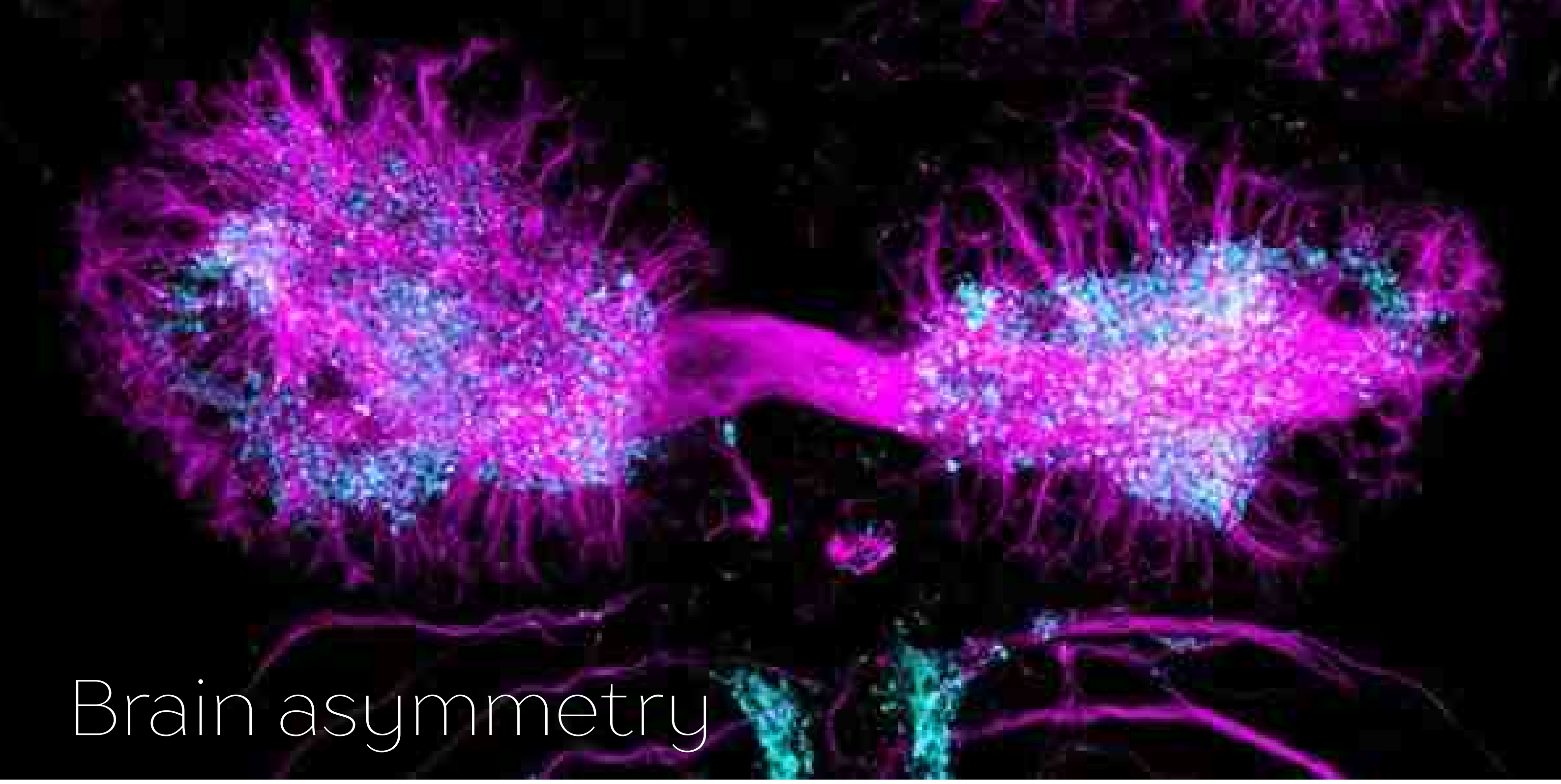
***/ Kowshijan Vasanthan*** *- 10 BL*

Domesticated plants have been the subject of intensive selective breeding programmes and, amongst the many features selected for, the colour of the fruit certainly must have been one of the key properties to assess. The skilful greengrocer arranges a display of fruits and vegetables to entice customers to purchase them, and, the aesthetic appeal of fruits and vegetables depends on their appearance as much as their taste.

The unripe fruit is usually a hard, green fruit with a sour taste and no smell. These features can sometimes be useful. A 'Granny Smith' apple has a combination of the above features. But, why is the fruit green? The unripe fruit is green in colour due to the presence of chlorophyll, a green pigment used for the absorption of light during the process of photosynthesis. The development of different colours during ripening is due to the disappearances of pigments like chlorophyll and because of the synthesis of carotenoids - another pigment present in the chloroplast. Carotenoids are form of antioxidants and area source of vitamin A.

How do they ripen? There is usually some sort of 'ripening signal' such as a burst of ethylene production. Ethylene is a simple hydrocarbon gas ($H_2C=CH_2$) that ripening fruits make and shed into the atmosphere. This ethylene signal causes developmental changes that result in fruit ripening. The ethylene signals genes to make new enzymes. These include hydrolases to help break down the chemicals found inside the fruits, amylases to accelerate hydrolysis of starch into sugar and much more. The enzymes then catalyse reactions to alter the characteristics of the fruit.

The action of the enzymes causes the ripening responses. Chlorophyll is broken down and sometimes new pigments are made so that the fruit skin of the banana changes colour from green to yellow. The sour taste is neutralised by the breaking down of acids, and degradation of starch by amylase produces sugar. This is useful to ripe other fruits as well; bananas produce so much ethylene that they can ripen other fruits such as pears if sealed in the same bag at room temperature.



# Brain asymmetry

## – Does it define our uniqueness as a species?

***/ Sammir Bushara** - 12 P*

Symmetry, while being perhaps the most fundamental and striking aesthetic element of multi-cellular organisms, is radically breached in some constituents of our internal anatomy. One feature of asymmetry which is significantly accentuated in humans is that of the brain. The profound lack of symmetry is exhibited on many levels, ranging from the distinctive 'tilt' in its positioning within our crania to the density of neurones on a cellular level.  This can be contrasted with the relatively symmetrical brains seen in other 'great apes' and, to a greater extent, other mammals. It is widely thought that this relative asymmetry is a major contributor to the cognitive 'step-up' from other animals to humans. Although the differences between our cognitive processing ability and that of other animals can be accounted for by other factors (e.g. brain size relative to body mass), evidence suggests that there are a myriad of clear-cut functional advantages provided by this apparent structural anomaly.

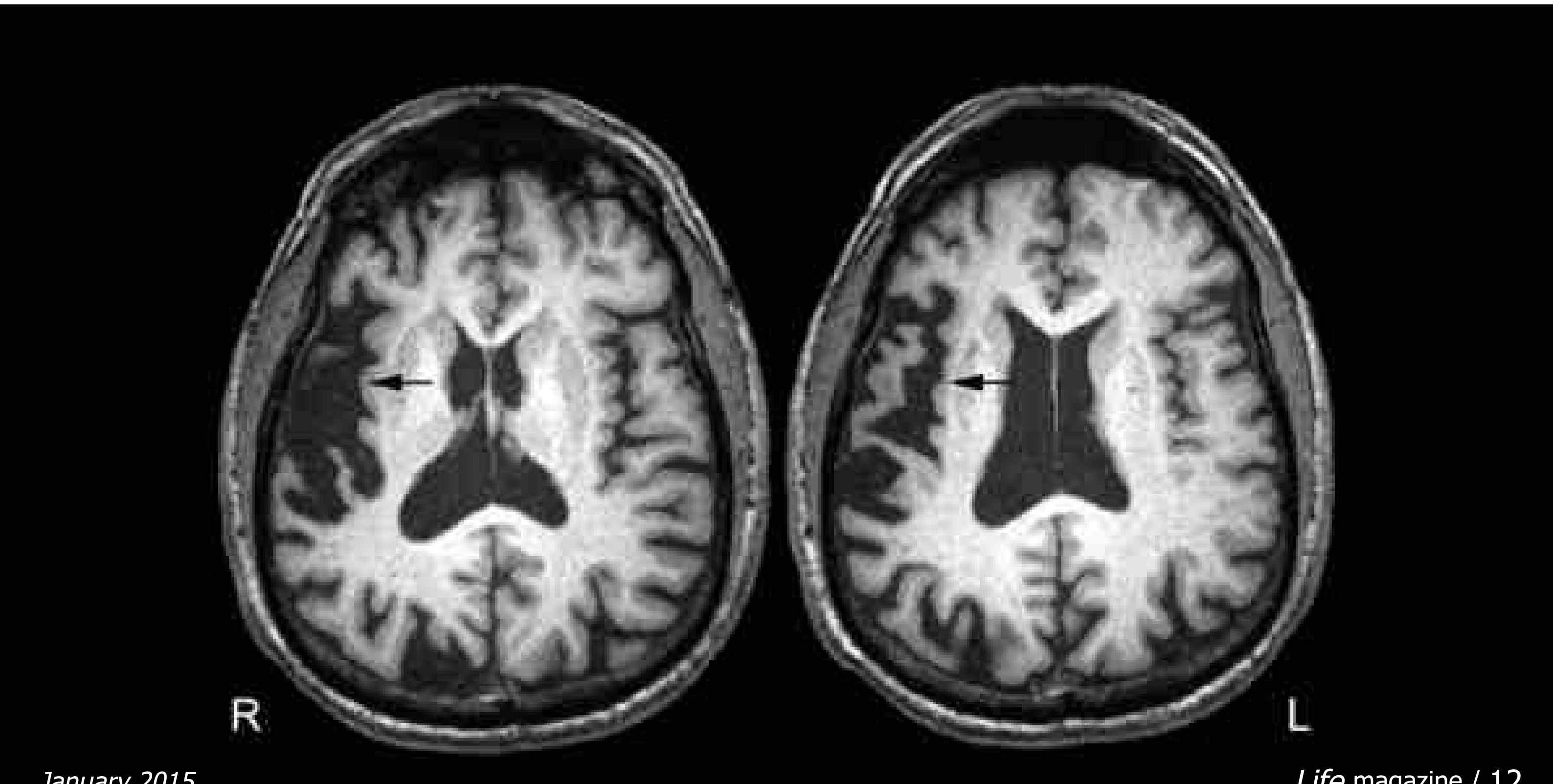
The asymmetry of human brains often manifests itself in the respective functions of the two hemispheres of the cerebrum, which control all voluntary actions. Evidence suggests that much of the functional architecture of the brain is *lateralised*, meaning that particular functions of the brain are accounted for exclusively by a particular hemisphere. Examples include language processing in the left hemisphere and visuospatial memory in the right hemisphere.  Dominance of a particular side is observable in most humans, often determined by attributes such as the dominant hand used by an individual (usually corresponding with the opposite hemisphere). There is some variation in function and dominance between individuals, as well as the capacity for adaptation in the event of physical trauma or changes in demand. This quality of plasticity is seen primarily in human brains, and it may explain the exceptional adaptability seen in the behaviour of humans.

Another interesting property of the two hemispheres is their capacity to function independently. In anatomically normal humans, the two brain hemispheres are connected by a 'broad band' of nerve fibres known as the *corpus callosum*. These facilitate communication between the two hemispheres of the brain, forming the only neural 'bridge' between the two distinct structures. This poses a fundamental question in neuroscience; how can these two hemispheres function when severed from each other - are they truly independent entities?

Research conducted by an American neurobiologist called Roger Sperry, in the mid-20th century, brings forward surprising conclusions. Studies were performed on patients who had undergone a procedure known as a *corpus callosectomy*, where this 'bundle of fibres' was severed as a last-resort method of combating severe epilepsy. Although effects were initially exhibited in the coordination of the two separate hemispheres (the function of two different hands were reported by one patient to have 'fought'), there appeared to have been an almost complete recovery of function in some patients. However, later studies in the reactions of different hemispheres to different stimuli showed that the stimulated hemisphere can occasionally react through – in the case of the left – language whereas the functions of the hemisphere not stimulated express oblivion, in this case, through text. While raising profound questions about the perception of our 'consciousness' as a unified will, it also highlights the hard-wired mechanistic manner in which each hemisphere executes its function. This demonstrates how the physical asymmetry of the two cerebral hemispheres may be integral in determining the disparity in function, and how subtly, when severed, they can coordinate only when both are exposed to stimuli.

Furthermore, profound effects in specialised functions have been described in those with a congenital absence of the *corpus callosum*. This birth defect is extremely rare, but a well-publicised example is seen in the form of the late Kim Peek, inspiration for the film *Rain Man*, who had exhibited pre-eminent abilities of memory retention. Astonishingly, he had verbally memorised the contents of 12,000 books throughout his lifetime, with the ability to rapidly scan two pages with both eyes simultaneously. Therefore, he had managed to maintain a unified memory of the text using both hemispheres at once. This can serve as an illustration of the effect, while generally detrimental, that having to adapt to total isolation of the hemispheres has on cognition and behaviour can have. However, the benefits of the independent functioning of asymmetric halves in normal humans are accentuated in areas which require little coordination, such as the memorisation of text. This may be a result of human brain plasticity, connections being made to compensate for other difficulties.

Research such as this, allowing us an insight into the function and specialisation of the respective hemispheres of the brain, demonstrates the significance impact the difference in structural symmetry has on cognitive and functional advantages that humans have relative to other species of animals. As the two hemispheres can function independently, the ensuing coordination can be used for higher-order processes such as language and the generation of abstract 'ideas' through different experiences. Furthermore, it allows, in a manner analogous to a dual processor in a computer, for us to iterate different types of information simultaneously, increasing the efficiency of the brain's operation.



# Why does the fur colour of Arctic foxes change?

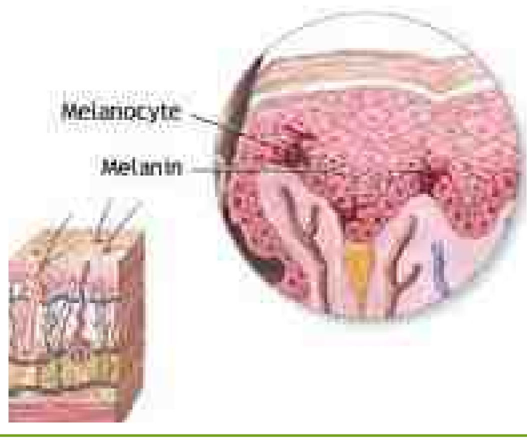
***/ Daniel O'Neill*** *- 8 BL*

As some of you may already know, arctic foxes change the colour of their fur in relation to the corresponding changes in season, but do we really know why and how? Imagine if your hair changed colour according to what time of the year it was - wouldn't this be rather peculiar?

Arctic foxes change the colour of their fur for survival. In the winter seasons they have white fur as the habitat they live in would be covered in snow and would be open plains. Apparently to their advantage, when food is scarce, they would become camouflaged and could hunt on prey without being seen. When food is very low they would follow polar bears and eat the scraps left behind, hence the requirement of the camouflage, otherwise the arctic fox would be hunted by the polar bear. In the other months their fur turns grey, brown and a blue colour to blend in with the rocky and grassy plains. During this season, the birds fly over to breed, so the fox has a lot of food available but birds such as geese would put up a fight for their young, therefore the fox would have to approach stealthily to ensure survival.

Now, we move on to the main question: how do they change the colour of their fur? The answer to this is to do with a gene in the fox called MC1R or melancortin-1-receptor discovered first in 2005. This gene is one of the key proteins involved in regulating the skin and hair colour of mammals. It is located in the plasma membrane of specialized cells known as melanocytes, which are cells that produce the pigment melanin, through a process known as melanogenesis. This process works by controlling the type of melanin being produced; the activation of the MC1R gene causes the melanocyte to switch from generating the yellow or red pigment phaeomelanin to the brown or black pigment eumelanin.

So in conclusion, the Arctic fox changes the colour of its fur to increase the element of surprise when hunting and to stay hidden from predators like polar bears when scavenging, or when sneaking up on prey, in the form of eggs, without being seen by the parents. It is able to change fur colour because of a gene that changes the type of pigment produced in the process of melanogenesis. Perhaps a question to ponder now is whether there are any other animals that can change skin or fur colour, and if so, what advantage does it give them?



# Convergent evolution.

*/ **Daniel Binks** & **Harry Ashworth** - 9 R*

The snake slithers between the grass, oblivious to its approaching predator and its incredible defence mechanism. Closer the predator gets. Closer again. Suddenly it notices the stripes on the milk snake's back, which reveal, or so the predator thinks, its venomous nature. The predator clears off to find a tastier, less dangerous meal. Contradictory to the pattern on the snake's body, the milk snake is not venomous. For some reason (which will be explained in this article) this reptile has adapted to look like a hazardous animal to ward off predators. How on earth does it do that?

Convergent evolution is the process by which unrelated or distantly related organisms evolve similar body forms, colouration, organs, and adaptations. A most common form of convergent evolution is *mimicry*. Mimicry is a superficial resemblance of two or more organisms that are not closely related taxonomically. This resemblance confers an advantage—such as protection from predation—upon one or both organisms. Mimicry evolves after one species, the 'model', has become aposematic (warningly coloured) because it is toxic or poisonous. When an organism eats it, the animal either becomes sick or dies from the venom. Over time the predator learns to avoid that organism so the animal is left alone. There are two main types of Mimicry: *Batesian* and *Müllerian*.

Batesian Mimicry is a consequence of warning coloration and it demonstrates the power of natural selection. An organism that commonly occurs in a community along with a poisonous species can evolve certain colourations or similar body forms to appear like the poisonous organism. As predators that have experienced contact with the model species, and have learned to avoid it, mistake the mimic species for the model, it is avoided as well. Sometimes – in rare circumstances - an organism already has a certain resemblance to the poisonous species and is also avoided, even though it is quite palatable. Batesian mimicry greatly benefits the mimic, but not always the model. Batesian mimicry is disadvantageous to the model species because some predators will encounter palatable or harmless mimics and thereby take longer to learn to avoid the model. The greater the proportion of mimics to models, the longer is the time required for the predator to learn and the greater the number of model injuries or deaths. In fact, if mimics became more abundant than models, predators might not learn to avoid the prey item at all but might actively search out model and mimic alike. That is why there is usually a lower proportion of mimics to models.


– Sabre-tooth Blenny.

The second type of mimicry is Müllerian Mimicry. Müllerian mimicry is different, and occurs when two species, both distasteful and dangerous, mimic one another. Because potential predators encounter several species of Müllerian mimics more frequently than just a single species, they learn to avoid them faster, and the relationship is actually beneficial to *both* prey species.

One example of an animal with this amazing evolutionary feature is *Lampropeltis triangulum*, also known as the milk snake, which is a 20-60 inch king snake with shiny scales and alternating bands red, black and yellow or white, black and red. Some milk snakes have a strong resemblance to the venomous coral snake, which is a clever way to avoid predators. They are found in south-eastern Canada, most of the United States and central and south America. There is a handy mnemonic to know whether the snake you encounter is the deadly coral snake or the harmless milk snake:
*"Red on yellow will kill a fellow, but red on black is a friend of Jack."*

Another fascinating and deceptive example of Mimicry is the *Sabre-toothed Blenny.* The Blenny is a mimic of the *Cleaner Wrasse*. However this example of mimicry is the complete opposite to the milk snake. The Blenny uses its appearance to gain a meal instead of becoming a meal through a stunning process. Cleaner wrasses approach larger fish and offer their parasite and dead skin removal services in exchange for a meal. A "dance" coupled with a display of unique colours notifies the recipient, often a predator of small fish, that these individuals are service crew and not food. The dance also cues the recipient to adopt positions favourable to cleaning treatment, including flared gill covers. The sabre-tooth blenny takes advantage of this unique trust by mimicking the wrasse in shape, markings, and behaviour. Getting close to a larger fish, the blenny then approach normally. But instead of gently removing a parasite, the blenny bites into the fish's flesh and escapes.

Mimicry is an amazing example of how organisms evolve strange and strategic ways purely to survive and how oblivious to this they can be. It shows that we are not the only species that have adapted well to thrive and that over millions of years and millions of generations, animals can change only a little just to maintain the existence of their species.

– Batesian mimicry in butterflies

# Chameleon Camouflage.

/ ***Gabriel Tweedale*** *- 10 BR*

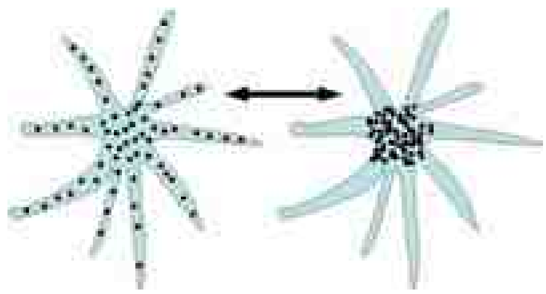
We all know that Chameleons have the ability to change the colour of their skin… but how do they do it? This article will not only show you just how they do it, but why.

***Why?*** - Most people would think that this fascinating reptile changes colour to match their surroundings, although this is a common mistake. Chameleons change colour to regulate their temperature or show their mood. Bearing in mind that reptiles can't generate their own body heat, the ability to change skin colour helps to maintain a stable core temperature. For example, a cold chameleon would turn a dark colour to absorb heat, whereas an overheating chameleon may turn a light colour to reflect the sun's heat to avoid further excessive heat absorption. Colour change is also used as a form of communication and expression. For example bright colours signal dominance, whereas dark colours signal aggression. Moods can be shown through colour change too; an excited chameleon may turn bright red.

***How?*** - A Chameleon's skin is composed of five different layers of specialized cells. The outermost layer is transparent and mainly used for protection. Beneath this are four more layers of cells called chromophores. These are filled with sacs containing different types of pigment, which enable chameleons to change colour.

- The top layer of chromophores are called *xanthophores* which contain a yellow pigment.
- Next, are the *erythrophores* containing a red pigment.
- Second from the bottom are the *iridophores* with a blue/white pigment.
- Finally at the base are the *melanophores*. These contain the pigment melanin – the same pigment that gives human skin its colour.

Chameleons change their skin colour by expanding and contracting the pigmented tissue, which is normally locked away in small sacks. When a change in temperature or mood occurs, the reptile's nervous system reacts by signalling which layers of chromophores should expand, and which ones should contract, therefore achieving a wide range of different, bright colours.



Here, the expanded pigment on the left covers a large area causing the skin to appear dark black. On the right, however, the pigmented tissue contracts causing the pigment to become less visible, allowing other chromophores of different colours to be seen.

# Life Editorial

This brings the latest issue of ***Life*** magazine to an end. The overarching theme of this edition was *'Shapes, Sizes and Colours'*, but this must have become apparent while reading the various thought-provoking articles. The team (SGS Leavers 2016) will continue to produce another issue in the coming weeks!

More specifically, the theme of the next one will be ***'Future advancements in Biology'***, so if you're interested in writing something and getting involved in all things biological, contact Mr Davis using the email address listed below.

Visit **www.sgsbiology.co.uk** to view past issues.

We hope you enjoyed reading the new issue of ***Life!***

*If you are interested an article for the next edition of **Life** magazine, please email Mr Davis (Head of Biology) at **pdavis@suttonlea.org.***