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In this edition...

The COLORS of Life

By: Maissa Azab

I have to admit that this issue holds a special place in my heart because it touches on an aspect of life that is near and dear to me; the overlapping of art and science. As a matter of fact, growing up, I was always torn between my love for the arts and my fascination with life sciences—biology, chemistry, and physics. Eventually, when I had to make a choice, I opted to study art.

However, throughout my college years and afterwards, I came to realize that art and science coincide in almost every aspect of our lives. It was not strange then that I ended up working in a field where I could combine and apply both of my passions; that field being science communication through compelling printed and online publications.

In this issue, the first of several to come by, we discuss one such theme where art and science come together—the colors of life.

The truth is, it is unimaginable to us who are blessed with the endowment of color vision to envision a world without colors. Nevertheless, color in life is not only about adding beauty—as important and valuable a gift it is—it also has a major significance and value in a rainbow of life aspects.

I now invite you to leaf through this colorful issue to read some remarkable articles and features that tackle the presence and meaning of color in the cosmos at large and here on Earth—in the skies, the waters, the landscape, the flora and the fauna—as well as in us and to us, from infancy to adulthood.

We also tackle interesting issues such as the possibility of mining the skies for resources from science fiction to reality, and the new frontiers of color. Naturally, we also discuss the history and evolution of pigments and coloring agents, as well as the biological equipment and mechanism by which we see color.

As always, we hope you will enjoy the selection we offer you; we also look forward to receiving your feedback at PSCeditors@bibalex.org.

COLOR ENERGY

By: Dr. Heba Mansour
Faculty of Fine Arts, Alexandria University

Color is an important element of interior design; it is connected to various areas of our body and affects the user emotionally, physically, and mentally. By learning how each color influences us, we can effectively use colors to give us an extra boost of energy in our interiors when we need it; the choice of color that will help meet our demands is like fueling our system with the right kind of gas;thus, producing our human energy field (Aura).

The human aura is a field of subtle, luminous radiation surrounding us and extending outward from our physical form. Auras are related to the electromagnetic field of the body and serve as a visual measure of our mental, emotional, physical, and spiritual states.

The colors we experience affect the aura so it is usually in a state of flux, ever-changing, based on our mental meanderings and physical health. We are now able to capture and measure this Aura with the aid of advanced technology.

Neurologist Kurt Goldstein stated that the ancient Egyptians built healing temples of light 4000 years ago using light and color for healing.The patient was immersed into a particular color, every color having a different physical effect, depending on its wavelength and vibration.

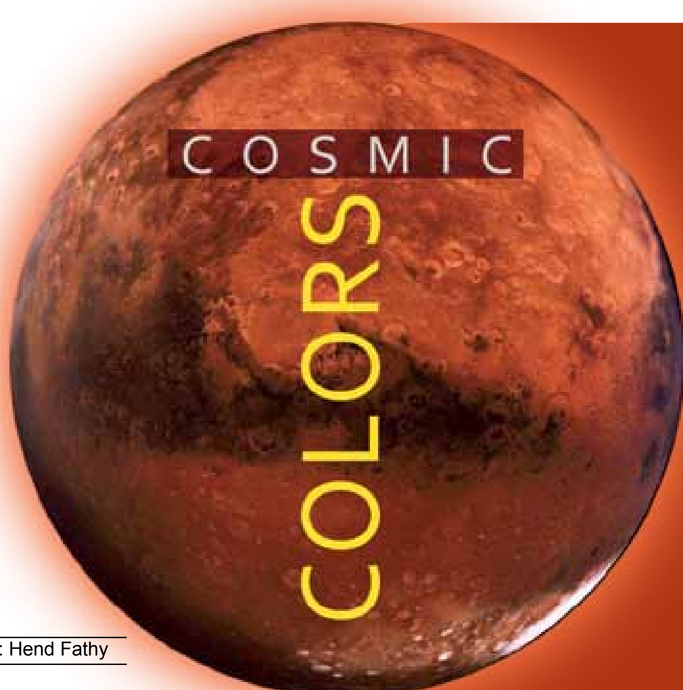
Colors have a natural ability to help the body perceive balance, making physical changes in the body cells and hormones; each color is associated with a special gland and is needed when an imbalance occurs.

For example, the vibration of the violet color affects the pituitary gland; it can help heal mental and neurological disorders, whereas red affects the reproductive and adrenal glands, and may help heal anemia. Orange affects the spleen and helps heal lung, kidney, and stomach illness; while green helps cure heart disease and high blood pressure.

Knowing the emotional, physical, and mental effects of each color is one of the basic elements necessary for a perfect choice of color scheme in the interior designing process for different functions, such as work spaces, residential areas, restaurants, hospitals and so on.

For example, the emotional effect of violet is associated with purity, creativity, and inspiration; it helps purify our thoughts and feelings, giving us inspiration in all undertakings, enhancing artistic talent and creativity.It is, thus, a perfect choice for design areas and work offices.

Whereas blue is a mentally-relaxing color that has a pacifying effect on the nervous system and brings great relaxation; ideal for solving sleep problems, and for hyper-active children; enhancing communication and speech. This makes it an appropriate color for hospital interiors and kindergarten spaces.



COSMIC COLORS

By: Hend Fathy

Color remains among the major defining features of any object, contributing in determining our perception of everything we behold. Although the blue sky—the ceiling of our life on Earth—is the farthest horizon our eyes can see, colors go much more beyond it, shaping a wonderful cosmos of colors.

Cosmic Latte

The sky—blue studded with a glorious orange Sun during daytime, black bejeweled with sparkly star clusters at night—is what we can see of the outer universe. It was not until a few years ago that scientists realized that the actual color of outer space is far less dramatic; it is beige!

A team of astrophysicists from John Hopkins University conducted a survey in which they studied more than 200,000 galaxies, and discovered that the light emitted from them all, when blended according to what the human eye would see, produces a color they dubbed 'cosmic latte'.

"You can think of this as what the eye would see if we put all the light in the Universe through a prism(1) to produce a rainbow. The intensity of the color is in proportion to its intensity in the Universe", explained astrophysicists Karl Glazebrook and Ivan Baldry. Depending on the adaptation of the eye to different amounts of light, the color would vary between pale pink, soft turquoise, and most significantly: cosmic latte.

The survey, which reached out several billion light years, was not intended just to calculate this average color; it revealed a lot about the history of star formation in the universe, which is basically responsible for the changes taking place in the cosmic spectrum.

A star has a life cycle in which it changes colors as it changes temperature and size over billions of years. Young hot stars are blue, then they gradually get redder as they grow up and expand in size to become red giants; they end up as white or black dwarfs. Accordingly, just as the color of the sky changes at sunset, the universe started blue with young blue stars, and grew gradually redder with the evolution of a generation of giant red stars.

Cosmic Black

Even when dying, stars add a touch of color to the universe. When a massive-sized star dies, its nuclear fusion reactions stop. At the same time, its gravitational field starts pulling matter inward, compressing the star's core and causing it to heat up. As a result of excessive heating, a huge supernova(2) explosion, in which the material and radiation blasts out into space, takes place.

What remains after this magnificently colorful explosion is the highly compressed massive core, the gravity of which becomes so strong that even light cannot escape; this is what scientists call a 'black hole'.

Once a black hole is formed, it becomes too black to appear because it pulls all the light into its center. Yet, scientists can spot black holes through observing the behavior of stars in space. Stars close to black holes produce a high-energy light that can be identified using special satellites and telescopes.

Luckily enough, black holes do not move around in space swallowing the celestial objects they meet; we are lucky our Solar System is safe away from any black holes. Yet, scientists have declared that there is a super-massive black hole at the center of each large galaxy; at the heart of the Milky Way lies Sagittarius A, a black hole the mass of which is 4 million times that of the Sun.

Cosmic Palette

Zooming into our Solar System, we can see planets with remarkable colors which, when studied, tells scientists a lot about their origins and formation.

Venus, the brightest object in the sky after the Sun and the Moon, acquires its unique white-yellow color from its atmosphere, featuring a thick cloud layer rich with sulfur compounds, which are responsible for the yellow coloring. Sulfur also reflects about 70% of the sunlight, making the planet brighter, though farther from the Sun than Mercury.

Mars, the Red Planet, is red because of its surface material, which contains lots of iron oxide; the same compound that gives blood and rust their hue. Just like Earth, Mars had large amounts of iron when created. Yet, due to the Earth's larger size and stronger gravity, iron sank to its core. On Mars, however, abundant iron remained in upper layers. Exposed to oxygen and some sort of weathering conditions over long years, surface iron gradually rusted, leading to Mars' reddish color.

Jupiter, the Solar System's largest planet reflects many shades of white, red, orange, brown, and yellow. Changes in Jupiter's colors is subject to storms taking place in its atmosphere; these storms allow different chemicals to rise from areas closer to the planet's core to the tops of the clouds. As different chemicals reflect the Sun's light in different colors, the previously mentioned set of colors appear dotting Jupiter's atmosphere. An extreme case in point is Jupiter's Great Red Spot, which marks a storm system that has been raging for at least 400 years now.

Unsurprisingly, the color of **Uranus** and **Neptune** comes from their atmospheres. Though helium and hydrogen are the most abundant molecules on the two planets' atmospheres, it is Methane, the third most common molecule, which gives them their colors. When sunlight hits Uranus and Neptune, some of the spectrum lights are reflected back into space and some are absorbed. Methane is more likely to absorb colors at the yellow-red end of the spectrum, and reflect those at the blue-green end; that is why Uranus is blue-green and Neptune is a bright azure blue.

Cosmic colors are the key to a fascinating myriad of universal secrets; studying them has and continues to unravel explanations that would help us further understand the universe, its origin, its evolution, and, maybe, its future.

Glossary

(1) **Prism:** A transparent optical element with triangular base, rectangular sides, and flat polished surfaces that refract light.

(2) **Supernova**: A stellar explosion of great brightness through which the star ejects most of its mass.

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MISSION POSSIBLE THE RED PLANET

By: Jailane Salem

The NASA crowd held their breath in anticipation as Curiosity entered into its 7 minutes of terror on 5 August 2012. The spacecraft was launched from Cape Canaveral Air Force Station, Florida, on 26 November 2011, but now was the moment of truth; the moment they have all been waiting for. Will the rover make it in one piece to Mars' surface, or will something go wrong and the scientists' dreams will go unfulfilled?

To fully understand the nail-biting atmosphere of the team inside Jet Propulsion Laboratory (JPL) mission control, one must understand the intricate mechanism by which the scientists designed how the rover will be landing.

Delicate Descent

During entry descent landing, the spacecraft has to go from 48,280 km/h to zero in 7 minutes, as it touches down on the surface in perfect sequence. Though it takes only 7 minutes from the top of the atmosphere down to Mars' surface, it takes 14 minutes for the signal from the spacecraft to reach Earth. Those waiting for news from the spacecraft knew that something had already happened; yet, whether good or bad, they had to wait.

Curiosity is the rover enclosed in the spacecraft, but after travelling so far for so long the spacecraft had to separate, and the rover had to land on its own. After it slowed down upon entering the atmosphere, the spacecraft was still going at 1609 km/h speed, which was where the strongest supersonic parachute ever designed by NASA opened up to slow the descent.

The next step to slow down the spacecraft was to detach the parachute and heat shield from the rover. Once this occurred, the speed reduced to 322 km/h; still not slow enough for landing. This was when the spacecraft had to descend on rockets. The rockets could not land with the rover though since it would lead to a great disturbance to the surface, sending dust and particles everywhere, which could damage some of the equipment in the rover.

Once the spacecraft reached 20 meters above the ground, the rover was lowered through tethers—cords that anchor something movable to a reference point—6 meters long, and then gently deposited the rover on its wheels on the surface. The rocket engines were then detached and flew away to a safe distance from the rover.

There was no room for error at that critical stage; thankfully, the hard work and intricate planning paid off, and Mars rover Curiosity landed successfully on the floor of Gale Crater. The crowd erupted in cheer; years of relentless work finally crystallized in front of their eyes, becoming an actual reality seen all over the world.

Cutting-Edge Curiosity

Curiosity's mission is to detect signs of past habitats on Mars. With its state-of-the-art laboratory, Curiosity should be able to send us information whether Mars could have supported microbial life in the past.

Curiosity landed near the foot of a layered mountain inside Gale Crater. Layers of this mountain contain minerals that form in water and may also preserve organics, the chemical building blocks of life. This layered mountain could hold the key within it and provide preserved evidence to indicate if there was an ancient habitable environment.

The selection of Gale Crater as a landing area for the rover's landing was preceded by the consideration of more than 30 Martian locations by more than 100 scientists participating in a series of open workshops, where the merits of each location was discussed extensively.

Curiosity gets its samples by drilling and collecting the needed material through a drill fitted into one of its robotic arms. Equipment called the Sample Acquisition/Sample Preparation and Handling System includes tools to remove dust from rock surfaces, scoop up soil, drill into rocks and collect powdered samples from rocks' interiors, sort samples by particle size with sieves, and deliver samples to the laboratory instruments.

Curiosity is fitted with cameras and other sensors in order to monitor the weather and the surrounding environment. The Mars Science Laboratory Mast Camera can take high-resolution images of the rover's surroundings; it is also capable of taking and storing high-definition video sequences, which will no doubt come in handy for the scientists carrying out the research.

Mounted on the arm is the Mars Hand Lens Imager that can take extreme close-up pictures of rocks, soil, and, if present, ice, revealing details smaller than the width of a human hair. It can also focus on hard-to-reach objects more than an arm's length away.

The rover's electrical power is supplied by a radioisotope power generator. The multi-mission radioisotope thermoelectric generator produces electricity from the heat of plutonium-238 radioactive decay. This long-lived power supply gives the mission an operating lifespan on Mars' surface of a full Mars year (687 Earth days) or more.

Stepping Strongly

So far, Curiosity has not used its advanced laboratory to analyze chemicals yet; however, it did beam back very interesting pictures.

Scientists have already speculated that water existed on the Red Planet long ago. The pictures taken by Curiosity show pebbles and gravel rounded off most probably by water; this offers the most convincing evidence so far of an ancient streambed.

It is a sign that the rocks were transported long distances by water, and smoothed out. The sizes of the rocks, which vary from a sand grain to a golf ball, indicate that "they could not have been carried by wind," said mission scientist Rebecca Williams of the Planetary Science Institute in Tucson, Arizona. There was "a vigorous flow on the surface of Mars," said chief scientist John Grotzinger of the California Institute of Technology, "We are really excited about this".

Present day Mars is a frozen desert with no water to be found on its surface, but geological studies of rocks by previous missions suggest that the planet was warmer and wetter previously. "It is unclear how long the water persisted on the surface, but it easily could have lasted thousands to millions of years," said mission scientist Bill Dietrich of the University of California, Berkeley.

Curiosity will continue its trek to the foothills of Mount Sharp where there is a better chance of finding organics. As it slowly, but surely, makes its way on the surface of the Red Planet, it is sure to send us more important and interesting data. Whether it will be able to unlock the clues hidden within the layers of rock on the Planet remains to be seen. However, its safe arrival on Mars is a testimony to the hard work and dedication of numerous scientists and their ability to dream big.

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What if the greatest discovery of natural resources did not take place here on Earth, but in the sky? What if instead of just mining the Earth, we reached beyond our economic sphere and mined the outer space as well?

Sounds a little crazy, you might be thinking. Well, think again; sky mining is happening, and it is happening now. Planetary Resources Inc.—a company launched three years ago, but only now unveiling its plans—is spearheading an effort to start mining near-Earth asteroids for human-friendly materials; everything from water to precious platinum-group metals.

Founded by a group of audacious billionaires, the Company plans to send swarms of robots to space to scout asteroids for resources and set up mines to bring the resources back to Earth, aiming in the process to "add trillions of dollars to the Global Gross Domestic Product (GDP), help ensure humanity's prosperity and pave the way for the human settlement of space".

The announcement of their plan and their sky-high hopes raised waves of skepticism amongst scientists and media-providers alike, who struggled to see how such an endeavor—if indeed possible to achieve—can be cost effective, even with platinum and gold priced at USD 1,600 an ounce. A recent NASA mission returning with just two ounces of material from an asteroid to Earth cost about USD 1 billion. Scientists question how the company can reduce costs to the point where space mining can be profitable.

Skepticism is often my selected approach, but with the kind of genius brain power and deep-pocketed investors this project has attracted, it certainly demands attention and cannot be simply deemed unworthy.

Among the big names who founded this project are: Larry Page, Google's co-founder; Eric Schmidt, Google CEO; Peter Diamandis, the founder of the X-Prize Foundation, which first put space travel in private sector hands; Eric Anderson, the founder of the commercial space tourism company "Space Adventures"; James Cameron, Explorer-Director; Charles Simonyi, former Microsoft architect and software billionaire; Ram Shiriam, former Netscape and Amazon.com executive; and Ross Perot Jr., son of former US Presidential Candidate.

Moreover, the Chief Engineer of Planetary Resources is a former manager at NASA's well-known Jet Propulsion Laboratory (JPL); a host of other engineers and even veteran astronauts are involved. With such an impressive list, one cannot help being excited and optimistic about this daring project; a project that could change forever, and for the better, the entire nature of civilization on Earth, and open a doorway to the riches of the heavens.

Skeptics please step aside and allow us space-enthusiasts to hear their side of the argument.

The Promise

There are near-limitless numbers of asteroids floating around out there beyond our Planet's boundaries, and the thinking of this clever and very wealthy group of investors is that the time is right to look for resources somewhere beyond the Planet we call home.

"The resources of Earth pale in comparison to the wealth of the Solar System," said Co-founder Eric Anderson. There are currently 10,000 known near-Earth asteroids, 1,500 of them are "energetically as easy to reach as the Moon," according to the Company's website. They are also in Earth-like orbits with small gravity fields, making them easier to approach and depart.

They all contain valuable and useful materials such as water, iron, nickel and rare platinum group metals, more often in significantly higher concentration than found in mines on Earth. Platinum deposits on Earth actually originated from asteroids that collided with the planet; "a single metallic asteroid with a 500-meter diameter likely contains more platinum than all that has ever been extracted on Earth, making them potentially worth several billion dollars each", according to Planetary Resources.

In addition to their abundance, asteroid resources are known to have some unique characteristics that make them especially attractive. Unlike Earth, where heavier metals are close to the core, metals in asteroids are distributed throughout their body, making them easier to extract.

In terms of metal extraction, Planetary Resources hopes to go after the platinum-group metals—which include platinum, palladium, osmium, and iridium—all highly valuable commodities used in medical devices, renewable energy products, catalytic converters, and potentially in automotive fuel cells.

Initially though, the Company seeks to extract water from the asteroids; their rationale being first because water supports life, and second because water from asteroids could be broken down in space to its component parts of hydrogen and oxygen, which are key elements in rocket fuel.

Since water is very expensive to get off the ground, by extracting it from asteroids and turning it into rocket fuel, the asteroids can then act as potential refueling stations or launch pads for missions, to and from deeper parts of space. That alone could reshape the future of space exploration.

As an example, more than 80% of the cost of a mission to Mars is simply the cost of launching the fuel the vehicle must carry to get it to Mars and back to Earth. The presence of a fuel depot in low-Earth orbit from which vehicles could obtain propellant would dramatically reduce the cost of sending missions to other planets and allow for deeper and further exploration of space; it may even allow people to permanently live and work in space, another goal of Planetary Resources.

The Three-Phase Plan

On their road to sky-mining, Planetary Resources are planning a three-phase process to be completed over the next few years.

The first phase is to fully develop the technology needed for its early exploration equipment, whilst focusing on cost reduction. They admit that, in order to be successful, they will need to develop technologies that reduce the cost of space flight, and they plan to achieve that through mass production, and by taking advantage of technologies available from other companies.

Within 18-24 months, they hope to launch between two and five space-based telescopes that will identify potentially valuable asteroids. Although evidence suggests the abundance of resources on most asteroids, little detailed information is available about the current catalog of near-Earth asteroids.

Planetary Resources' "Arkyd Series 100" space telescopes, dubbed *Leo*, will begin the scouting process to identify potentially rich asteroids. The small remote-sensing telescope will sit in low-Earth orbit looking for target asteroids; however, Planetary Resources is designing Leo to be more than just a rock lookout.

The Company says, "Leo is capable of surveying near-Earth asteroids during one orbit, then be re-tasked for rainforest observation on the next. The possibilities for utility and engagement are only limited by the imagination of the user". Planetary Resources claims Leo is "the first space telescope within reach of the private citizen".

The asteroid spotting sentinels will consist of several foot long tubes, weighing just a few pounds, and should be small enough to hold in your hand. They will each run about USD 10 million, according to Company documents.

Within five to seven years, the second phase would begin by sending out a swarm of more sophisticated space telescopes, the "Arkyd 200 series" followed by the "Arkyd 300 series", allowing for more comprehensive prospecting missions, mapping out valuable asteroids in detail and identifying rich resource layers, as well as preparing for mining operations.

The final phase; the actual asteroid mining, possibly ore refining and returning the material to Earth safely; is probably the toughest phase, and Planetary Resources is still tight-lipped about its plans here, but previous studies can offer us some hint about their options.

The Mining Process

Previous research has identified three options for asteroid mining, the first being to bring raw asteroid material back to Earth for refining, which would require the transport of massive amounts of material on the journey back; not likely the cost-reduction approach Planetary Resources are planning for.

In-situ mining is the more likely option, which is to process the material on site and bring back only processed materials, allowing also for the production of propellant for the return trip. Since the extraction of resources from asteroids is predicted to be easier than the extraction from Earth's core, the equipment required would be simple, although the recovery and processing of materials in a microgravity environment would still present a challenge.

Another possibility would be to find a useful asteroid and push it to a safe orbit closer to Earth. A fairly low-power solar-electric ion engine could nudge a hunk of rock into orbit around the Earth, effectively creating a small second moon that could be easily accessed and mined on site.

A recent paper written by a team of scientists and engineers for the Keck Institute for Space Studies looked at exactly this proposition in order to use an asteroid for scientific and manned exploration. The team concluded that the technology exists, though such a plan would need at least USD 2.6 billion in funding.

Although most scientists agree that the venture Planetary Resources are embarking upon is technically feasible, the hurdles are many and high. Moreover, beyond their initial steps, the details of Planetary Resources' plans remain scarce. Prof. Jay Melosh from Purdue University said that the costs were just too high, calling space exploration "a sport that only wealthy nations, and those wishing to demonstrate their technical prowess, can afford to indulge".

Planetary Resources' Eric Anderson replied that he was used to skeptics; "there will be times when we fail and there will be times when we have to pick up the pieces and try again". However, he says the benefits to humanity far outweigh the risk; "we do understand that the pot of gold at the end of the rainbow, if successful, will be big".

The shortage of sources for raw materials on the planet has caused global inflation to spike in recent years, leading to tensions to rise between nations and putting humanity at risk. If sky mining was indeed successful, all such tension can come to an end.

Harnessing valuable minerals from a practically infinite source will provide stability on Earth, increase humanity's prosperity, and open up endless opportunities for the presence of humans in space. In my humble opinion, such a goal far outweighs the economical risks of the skeptics; I will certainly be crossing my fingers for this one.

Glossary

***The Global Gross Domestic Product (GDP)** is the combined gross national product of all the countries in the world.

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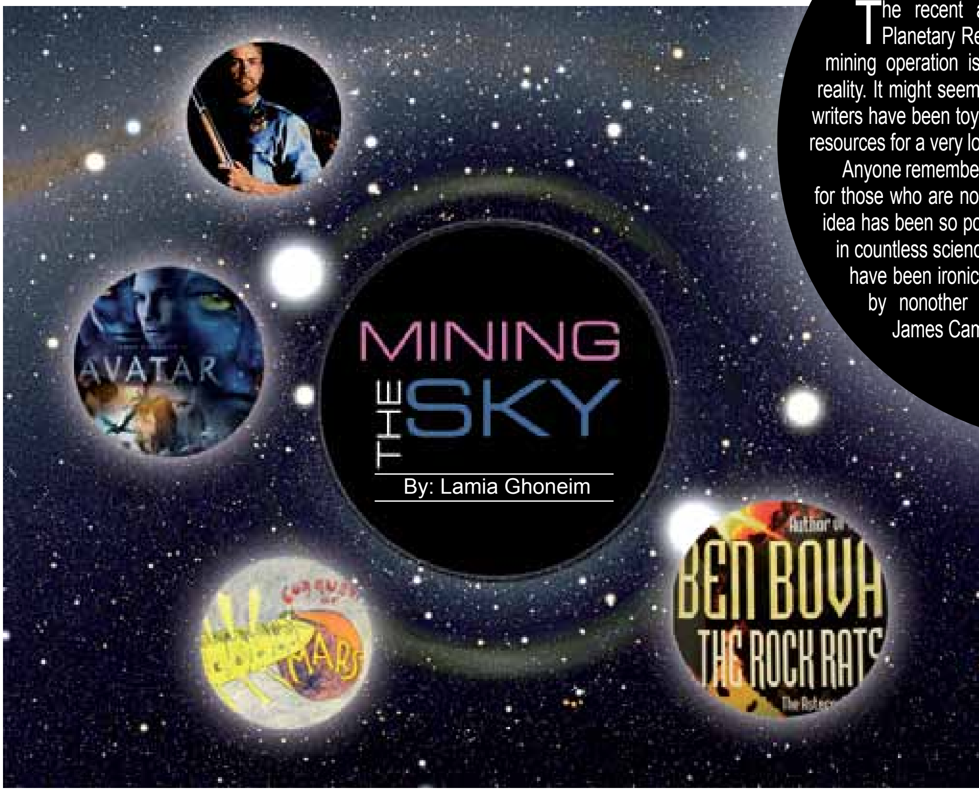

MINING THE SKY

By: Lamia Ghoneim

The recent announcement of the startup company Planetary Resources' plans to launch a privatized space mining operation is definitely the stuff of science fiction made reality. It might seem like a radical new concept, but science fiction writers have been toying with the idea of mining the space for natural resources for a very long time now.

Anyone remembers *'Aliens'* or Sean Connery's *'Outland'*? As a hint for those who are not particularly loyal science fiction followers, this idea has been so popular in the genre that it is literally a plot point in countless science fiction books and movies; two such movies have been ironically, or perhaps rather predictably, directed by nonother than Planetary Resources co-founder James Cameron himself!

What is even more amusing, or perhaps a rather bad omen, is that in both said movies, space mining operations do not end so well, with all kinds of cosmic disasters and outer space turmoil breaking loose.

While we are definitely crossing our fingers for James Cameron's latest efforts with Planetary Resources, let us take a look at how Sci-Fi imagination in both movies and books has fueled the reality. We might even get a glimpse of what might potentially happen, if life continues to imitate art.

The first mention of space mining was probably in '*Edison's Conquest of Mars'* by Garrett P. Serviss in 1892. As a sequel to an earlier book, Thomas Edison, who officially endorsed the book, travels to Mars for a little payback on the Martian race. On the way, Edison travels to an asteroid and takes out a bunch of Martians who were, as you might have guessed, mining the asteroid for resources.

Since then, asteroid mining, and space mining in general, has become a staple of the science fiction genre, appearing everywhere from the works of Robert Heinlein to Ben Bova's series of *'Asteroid War'* books. Generally speaking, space mining became a metaphor for new frontiers and human expansion; pioneers exploring the outer reaches, risking their lives for monetary gain, competing over resources, and so on. Basically, you get the same kind of stories you would get from a western, just with lasers and space ships instead of six-shooters and horses.

Sounds fun? The movie plots were not all fun and games though; in most cases the writers took the stories down dark, dangerous and often disastrous paths, perhaps to serve as a reality check for those who dare.

In the futuristic movie *'Outland'*, Federal Marshal William O'Niel (Connery) is assigned to a tour of duty in a titanium ore mining outpost on *'Lo'*, a volcanic moon of the planet Jupiter. Conditions on Lo are difficult; gravity is 1/6 that of the Earth with no breathable atmosphere, spacesuits are cumbersome, delirium attacks are often, and death by decompression is the norm.

If *'Outland'* was not enough warning, a few years later, five to be exact, Mr. Cameron's foray into space mining with the 1986 *'Aliens'* sequel should have done the trick. Not technically about asteroid mining, but a decent enough cautionary tale that you wonder how he has not thought twice about investing in Planetary Resources.

In the movie, Hadley's Hope was a small colony mining the moon of a planet called 'Archeron LV-426'. Everything was cool, until a miner stumbled across an alien spacecraft, unleashing the xenomorphs (aliens), wiping out the colony, and forcing Ellen Ripley (Sigourney Weaver) to nuke the entire site from orbit, "just to be sure".

Cameron revisited space mining with '*Avatar*', also a dark tale set in the mid-22nd century, when humans are mining a precious mineral called unobtanium on 'Pandora', a lush habitable moon in the 'Alpha Centauri' star system. The expansion of the mining colony threatens the continued existence of a local tribe of 'Na'vi'—the blue humanoid species indigenous to Pandora. Following a fierce and epic battle, the triumphant Na'vi expels all humans from Pandora and sends them back to their severely depleted Earth.

Although another cautionary tale, it is unlikely that Planetary Resources will face the ethical dilemma of displacing an indigenous population in order to take their resources, especially on the asteroids they plan to mine that are too small to hold their own atmosphere, let alone their own population.

So that is one less movie plot danger to worry about. But if we rewind back to the 1980's, we can find a much more promising and highly important piece of science fiction focused on space mining. Perhaps we should not call it fiction at all now, but mere science; it is the prophetic book by John S. Lewis, *'Mining The Sky: Untold Riches From The Asteroids, Comets, And Planets'*.

Although every chapter begins with an excerpt from a fictional "future history" textbook in which the reader "looks back" at how the Solar System was won, this is only meant as a fun touch for Sci-Fi fans, for the book is packed with scientifically backed arguments and detailed explorations of the wide range of minerals, volatiles and other useful materials to be found in all the different types of small bodies we know to be drifting about the Solar System.

John S. Lewis explains in detail how we can mine these precious resources from asteroids, comets, and planets in our own Solar System for our benefit, while exploring the outer space's endless possibilities. He contemplates milking the moons of Mars for water and hollowing out asteroids for space-bound homesteaders, all the while demonstrating the economic and technical feasibility of plans that were back then considered pure fiction but are now becoming a reality.

So now that we have explored the dangers and the promise of space mining as depicted by the minds of the creative writers of the Sci-Fi genre, let us just say we hope John Lewis, who is by the way one of the major advisors for Planetary Resources, was right all along, and there are no aliens.

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New Frontiers of Color
Non-Spectral Colors

By: Ahmed Ghoneim

I have always found electromagnetism fascinating; the fact that something, electromagnetic waves, can move through vacuum; that is neither air, dust, nor anything material is indeed amazing.

Being the geek I am, as a youngster, I encountered a simple experiment that I could not resist trying. The experiment was to put a camera in front of a remote control then start recording. While recording, you try to press the different buttons of the remote control, and then replay the video.

What I saw was quite interesting. The infrared signals sent by the remote—each button sending a different pattern of course—were visible as a red light after being recorded by the camera. At first it made sense to me; after all, cameras are much more sensitive than our eyes, and can pick up waves in the spectrum around visible light. Yet, I was left pondering the idea long after I tried the experiment.

What is the color of infrared? Is it red, or is that what the camera makes us see? Can infrared show another color then? What AIST (Advanced Industrial Science and Technology), Japan's largest research organization, has realized is that infrared can act just like the light we see. Since it has different wavelengths and can reflect and refract, it can be used as a substitute for visible light!

Infrared Vision

If you have seen the average action movie, or played a stealth game before, then you probably know about night vision. Night-vision goggles have existed since World War II, and have since gone through many improvements.

It is because infrared is not seen by the naked eye, but detectable through other sensors, which then transform an infrared image to a visible one, that the first version of night vision goggles contained infrared emitters. Surveillance cameras too are aided with infrared lamps to get a high-resolution, monochromatic picture of the place they are monitoring at night.

According to the Black-body Radiation Law, any object that has a temperature above the absolute zero emits infrared. Thermography, which is superior in that it does not need to use any artificial emitters, utilizes the differences in temperature between these objects, such as a hot human behind a passive wall, and the relationship between that and the type and intensity of infrared emitted by each object to identify targets. This type of vision can work during daytime as well.

All these technologies have been developed many years ago, and are well-known to many; so what is new?

Night-Vision in Cars

In 2000, General Motors equipped the Cadillac Deville with a night vision system. Typical non-infrared night vision systems use an image intensifier, which gives you great detail on objects that have a tiny amount of light shining on them.

The problem with implementing that in cars is that a streetlamp or the headlights of a car coming the opposite way will lead to an effect known as "whiteout". The light would be so strong in its amplified state that it will cover up the screen showing almost nothing but it.

The solution was to use thermography; instead of relying on already available light and amplifying it, thermal vision relies solely on the temperatures of the objects being filmed, and the amount of infrared they consequently produce. This gives a more consistent image regardless of the amount of illumination available at the scene. The image provided is, as expected, black and white; it is shown on a Heads-Up Display (HUD), which is a screen on the lower part of the windshield.

The technology has not stopped at that; in 2004, Honda added pedestrian detection. What it calls the "Intelligent Night Vision System" uses infrared cameras to not only show a decent black-and-white image in the dark, but also has a computer system that identifies pedestrians, surrounding the image of one in your way or about to become in your way with a box and making an alarming noise to prevent accidents.

Adding Color

Color is a blessing that we take for granted. It is not until you meet a color-blind person or watch a movie such as "Pleasantville" that you realize how important colors are to us. How else can you understand a color-coded map? Would doctors be able to treat wounds if they do not know their color? What if you are diffusing a bomb and do not know which wire is the red one?

Color is everywhere, and it is crucial to life. The people at Tenebraex, a Boston company, have realized that and, by 2007, they had invented color night-vision goggles. Through a complex mechanical system based on filters, a user of these goggles can now see in full color at night, in illumination as low as quarter-moon nights. In addition to the goggles, they have also developed software for color-blind people to help them identify colors they cannot see.

It did not stop at that however; in 2011, AIST invented color infrared-vision cameras. Infrared was always conceived as monochrome, but with a complex computer algorithm that analyzes patterns in the reflection of infrared from objects into three color components—Red, Green and Blue—they were able to produce a full color image at night. The camera relies solely on the infrared emitted from or reflected by objects; it needs no additional light source. The different intensities of the three colors analyzed are combined to obtain a pixel's real color, in a system widely known as RGB.

So as you can see, color is not confined to what the visible spectrum of light shows us. There are numerous ways in which electromagnetic waves can be used to let us see so much more than we can see through visible light, and now, we can see all this in color.

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PIGMENTS
A HISTORY

By: Jailane Salem

When one thinks of paintings, such great names as Picasso, Van Gogh and Leonardo da Vinci come to mind. These painters created amazing works of art that will always be remembered.

Painting is a form of self-expression; it is an art form that renders itself well to help humans communicate what they feel and see. The key ingredient for a painting is of course color, each holding within it properties that make it vibrant, translucent, long lasting or light reflective; it is up to the artist to choose the most suitable color for his/her art work.

Nowadays, when we walk into an art shop or stationery and ask about colors, we will be faced with a myriad of options. We have pencil colors, watercolors, oil paint, acrylic paint, glass paint, and so on. For every surface we have improvised a medium that best serves it; we can use paper, canvas, glass and others to transfer our artistic impressions to. All these materials are now manufactured in factories using natural, as well as synthetic materials.

Early humans, however, did not have all these options available to them, and their color palette was much more limited than ours. The oldest paintings ever found are on cave walls; up until this moment, we do not really know why they were painted. Some believe these paintings have religious meanings, while others believe it could have been a means of communicating with others.

Early humans had to use materials within their area, and the colors were extracted from the Earth, thus known as Earth pigments:

Red ochre: composed mainly of iron oxide, ochres vary widely in transparency; some are quite opaque, while others are valued for their glazes.

Yellow ochre: a natural mineral consisting of silica and clay, owing its color to an iron oxyhydroxide mineral, these give Earth tones that go from cream to brown.

Umber: a natural mixture of iron and manganese oxides and hydroxides, varies from cream to brown depending on the amount of iron and manganese compounds.

Other Earth pigments include **carbon black** (charcoal from fire), **bone black** (burnt bones), and **lime white** (white from ground calcite). These colors were blended to make fabulous life-like and abstract representations of animals and humans alike.

Before using Earth pigments, prehistoric dwellers used dye colors that were from animal and vegetable sources. They soon discovered that the color that was from iron oxide deposits in the Earth did not fade with the changing environment. These colors were not always easily or readily available to them though; it is believed that men traveled long distances to mine and find Earth pigments, and to ensure they had a steady supply of them. Historians have found that the main reason for all mining activities of prehistoric humans was their need for Earth pigments.

In Egypt, such cave paintings exist; one of the most popular is the Cave of Swimmers, which gained public attention after being featured in the movie “The English Patient” even though they used a set and did not film on location.

The cave and rock art were discovered in October 1933, by the Hungarian explorer, László Almásy; it contains rock painting images of people swimming. They are estimated to have been created 10,000 years ago during the most recent Ice Age. Nowadays, due to the huge influx of visitors, the cave’s climate has been altered, leading to severe deterioration to the artwork.

The use of pigments developed and improved over the ages; one can trace its development by looking at the art of each era. During Antiquity, it was the Minoans who were attributed with inventing the fresco, a durable method of painting on a wall by using watercolors on wet plaster, and applying pigments directly to a fresh lime surface.

We have all seen how beautiful the murals painted in ancient Egyptian tombs are, and how well they have survived for thousands of years. This is due to the Egyptian artists’ technique, which was to cover the limestone walls of tombs with a fine layer of plaster, then paint various scenes on them.

Painters would primarily use black, red, yellow, brown, blue, and green pigments. They mixed their colors in a binder, which is a relatively neutral or colorless material that suspends the pigment and gives the paint its adhesion to the dry plaster. Paints were produced using the ground pigment with gum or animal glue, which made them workable and fixed them to the surface being decorated.

The encaustic—a paint consisting of pigment mixed with melted beeswax and fixed with heat after application—painting technique was used widely in Greece and Rome for easel pictures. In this technique, the binder for the pigment is wax, or wax and resin. Wax and eggs were used in ancient Egypt and Rome as media for pigments. This painting technique was widely used in ancient times due to its durability.

The Medieval Age (500–1400) ushered in egg tempera painting, which made use of mixing pigments with water and egg before application; this technique was well established by the 13th century. The dried protein remaining after the water evaporated bound the pigment to the surface. If the paint was applied in thick layers it would eventually crack; to avoid this issue, it was important to apply the paint in thin layers or glazes, which gave the works of art a highly finished appearance.

During the Renaissance and Baroque Period (1400-1600), the use of eggs in combining pigments started to fade out; it

began to be replaced by walnut or linseed oil as a medium. These oils dried more slowly than tempera, and created a paint that was more versatile and applicable to canvases.

With the development in the medium used for paintings, a greater understanding of perspective and depth in the picture-plane stimulated a need for greater realism. The natural luminosity and plasticity of oil colors enabled Renaissance artists to achieve new effects of color and realism, enhancing considerably the power of their color palettes.

With the beginning of the 18th century, "color men" appeared on the scene to provide artists with ready-made paints. Artists no longer had to grind pigments into powder and mix it with other mediums; everything was ready-made for them, making the painting process much easier.

In 1766, William Reeves set up a business supplying watercolor cakes. Reeves' watercolors were a significant improvement on those of his competitors, since he discovered that adding honey to the colors prevented the cakes from cracking in storage.

The beginning of Modern Art was in the 19th century; this period witnessed a huge change for both oil painters and watercolorists. New colors and enhanced versions of established pigments popped up with regularity. Cobalt blue emerged in 1807, while viridian was introduced in 1838. Cadmium yellow appeared in 1820, Cerulean blue in 1860, to be followed by cheap synthetic French ultramarine, zinc white, and cobalt violet.

Acrylic paint was the most important painting invention of the 20th century, and was commercially available since the 1950s. At first, water-based acrylic paints were sold as interior house paints; soon enough artists and companies began to explore the potential of the new binders.

Due to acrylics ability to dry quickly, as well as provide bright colors and finishes it became a popular medium. With this popularity water-soluble artist-quality acrylic paints became commercially available in the early 1960s.

So what exactly are pigments and how do they work? To answer this question we must first have a look at "light".

Light is all around us, and can be seen by the human eye; when we look at the Sun's visible light, it appears to be colorless, known as white. However, in truth, light is not white; actually, white is not even part of the visible spectrum. Many colors form what we see as white light.

If you take a glass of water and position it so that sunlight passes through it to land on a wall, you will not see one color but a rainbow should appear on that wall. This is only possible because white light is a mixture of all the colors of the visible spectrum. During a physics lesson, you are bound to pass by the prism experiment, which was first demonstrated by Isaac Newton; he basically took a glass prism and passed sunlight through it in order to separate the colors into a rainbow spectrum. He then passed sunlight through a second glass prism, combining the two rainbows and producing white light. This simple experiment proved conclusively that white light is a mixture of colors.

You can carry out a similar experiment with three flashlights and three different colors of cellophane: Red, Green, and Blue, commonly referred to as RGB. Cover one flashlight with one to two layers of red cellophane and fasten the cellophane with a rubber band—do not use a lot of layers or you will block the light from the flashlight. Cover another flashlight with blue cellophane, and a third flashlight with green cellophane.

Enter a darkened room, turn the flashlights on and shine them against a wall so that the beams overlap. Where red and blue lights overlap, you will see magenta; where red and green lights overlap, you will see yellow; where green and blue lights overlap, you will see cyan. You will notice that white light can be produced by various combinations, such as yellow and blue, magenta and green, cyan and red, and by mixing all the colors together.

Before we move on to how pigments work, let us remind ourselves of the color wheel. The color wheel is a visual representation of colors and their various relationships to one another. To produce a color wheel, we draw a circle and then divide it into six even-sized wedges.

We fill every other wedge with the three Primary Colors—those that cannot be mixed together through the use of other colors: Red, Yellow, and Blue. With the remaining three alternate wedges we fill in our Secondary Colors—a combination of equal parts of two Primary Colors: Orange, Purple, and Green; where Red and Yellow make Orange, Yellow and Blue make Green, and Blue and Red make Purple.

Pigments are defined as follows: "A material that changes the color of reflected or transmitted light as the result of wavelength-selective absorption". Pigments absorb some of the frequencies of light, and thus remove them from the white light combination. The absorbed colors are the ones you do not see; you see only the colors that bounce back to your eye.

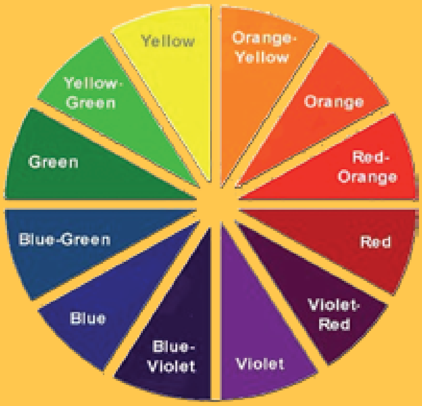
This is known as subtractive color model, and it explains how the mixing of pigments can create a full range of colors, each caused by subtracting—that is, absorbing—some wavelengths of light and reflecting the others. The color that a surface displays depends on which colors of the electromagnetic spectrum are reflected by it, and therefore made visible.

The paint or dye molecules absorb specific frequencies and bounce back, or reflect, other frequencies to your eye. The reflected frequency, or frequencies, is what you see as the color of the object. If we have a look at the primary pigments—red, blue and yellow—we can see that the red pigment is red because the chemical it is made of absorbs—subtracts—blue and yellow light that falls on it and reflects only red light to our eye. Similarly, blue pigment is blue because it absorbs red and yellow light and reflects only blue.

If we look at the leaves of green plants we will find that they contain a pigment called chlorophyll, which absorbs the blue and red colors of the spectrum and reflects the green.

The next time you hold a paint brush or a colored pencil, remember that this item in your hand comes from a long line of human innovation and creativity. From the earliest cave paintings to contemporary art pieces exhibited in galleries, we are essentially carrying on a tradition that is as old as humanity itself.

Science and art both, hand-in-hand, have collaborated to provide us with the finest and best tools to use to allow us to express our creativity and individuality, so go ahead, pick up that paint brush and let your mind roam freely, start painting, and unleash your inner artist!



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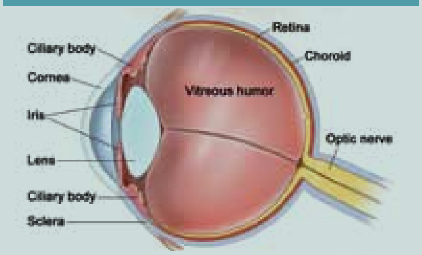
What is color, and where does it come from? Do all creatures see the same colors and shades? These thoughts have often haunted me; I have often wondered how this glassy organ, the eye, can differentiate between the different colors and objects. It is, as is everything else, a gift from God, of course; as human beings, our curiosity leads us to seek the knowledge behind the mysterious mechanisms behind these gifts.



The Gift of Sight

The human eye may seem simple from the outside, but it is one of the most complex organs of the human body. It is a sense organ that is stimulated by light; however, it does not merely detect the presence of light, it also enables us to see the colors around us, giving us a view of the surrounding environment.

The eye, in fact, can "see" or "detect" only certain frequencies of light, what we call the spectrum of visible light, which ranges from 400 to 700 nanometers. White light, or sunlight, consists of a combination of all of these frequencies; when certain frequencies are absorbed and then radiated, the eye detects the frequency of the light wave entering the eye, thereby detecting color. To understand color detection, we have to take a closer look at the structure of the human eye first.

The colored part of the eye is the iris; if you look closely in the mirror, you will observe a black dot in the center of the iris, which is your pupil, and it is actually a hole through which light enters. Light entering the eye through the pupil passes through the lens, which inverts the image and focuses it onto the retina—a screen containing light sensitive cells, which transmit impulses to the brain through the optic nerve.

An interesting function of the iris is its ability to change the size of the pupil, thereby controlling the amount of light entering the eye. In darkness, the pupil enlarges, whereas in the presence of bright light, the pupil becomes smaller.

The lens, too, can adjust itself; just like the lens on your camera. To see closer objects, it grows thicker with the help of muscles. Alternatively, to see objects far away, the lens grows thinner. All of these changes produce variations in the image formed on the retina.

The optic nerve is responsible for transmitting the readings of the light sensitive cells from the eye to the brain. Further processing in the brain turns the image the right-way-up again, and recognizes the object the eyes have seen.

IN THE EYE OF THE BEHOLDER

BY: SHAHENDA AYMAN

How is it that we see objects with different colors? What is color, and how do we identify it?

The Gift of Color

The light sensitive cells on the retina are responsible for detecting color; some of the cells are shaped like rods, while others are shaped like cones. The rods 'see' in the grayscale, and are used for viewing objects in dim light, where only the shape and shade of black can be detected. The cones, however, are sensitive to different frequencies of light; they are sensitive to colors, primarily red, green and blue. The combination of these three colors gives us all of the countless hues, tints and shades of the spectrum.

There are approximately 6 million cones in our retina; the three different types of cones are sensitive to short, medium and long wavelengths. Cones are active at high light levels, allowing us to see color and fine detail directly in front of us. They can adapt to widely varying colors and illumination levels, but do not work well in low light.

Our retina's 125 million rods, on the other hand, are monochromatic, which means that they do not perceive color. Rods account for our peripheral night vision, but do not enable us to see well when we are looking straight ahead.

However, the cones in our eyes are just the beginning of the color story. Ganglions are a type of neuron located in the retina; they receive signals via various intermediate cells from the cones and rods. Ganglion cells add and subtract signals from many cones. For example, by comparing the response of the middle-wavelength and long-wavelength cones, a ganglion cell determines the amount of green-or-red.

The result of these steps for color vision is a signal that is sent to the brain. There are three signals, corresponding to the three color attributes: the amount of green-or-red; the amount of blue-or-yellow; and the brightness.

"Neurons are relatively slow-computing machines," says Jeremy Nathans, a Howard Hughes Medical Institute investigator at the Johns Hopkins University School of Medicine. "They take several milliseconds to go from input to output; yet you see things in a fraction of a second. This is why the system needs parallel processing."

Nathans became interested in how we see color the day he heard of new discoveries about how we see black and white. It was 1980, when he was a student at Stanford Medical School, he recalls, when Lubert Stryer and Denis Baylor, both at Stanford, described their remarkable findings about the workings of rod cells.

"Baylor showed that rod cells achieve the ultimate in light sensitivity; they can respond to a single photon, or particle of light," says Nathans. "It was a beautiful experiment." Then Stryer explained how the light-sensitive receptor protein in the disk membranes of rod cells, announces the arrival of this tiny pulse of light to the signaling machinery inside the cell.

Stryer found that rhodopsin could do this only with the help of an intermediary, called a G-protein, which belonged to a family of proteins that was already known to biochemists from their study of how cells respond to hormones and growth factors. Nathans immediately realized this meant that the structure of rhodopsin itself might be similar to that of receptors for hormones; his mind began racing with possibilities.

Until then, Nathans had been studying the genetics of fruit flies. As he read a paper by Harvard University biologist George Wald—a transcript of Wald's 1967 Nobel Prize lecture on "The Molecular Basis of Visual Excitation"—Nathans set off on a different course. He determined to do what Wald himself had wished to do 40 years earlier, which is to find the receptor proteins in the retina that respond to color.

Rod cells function only in dim light and are blind to color. "Get up on a dark moonlit night and look around," suggests David Hubel of Harvard Medical School, a winner of the Nobel Prize for his research on vision. "Although you can see shapes fairly well, colors are completely absent. It is remarkable how few people realize that they do without color vision in dim light."

The human retina also contains cone cells, which operate in bright light and are responsible for high acuity vision, as well as color. Rods and cones form an uneven mosaic within the retina, with rods generally outnumbering cones more than 10 to 1—except in the retina's center, or fovea.

Cones are highly concentrated in the fovea, an area that Nathans calls "the most valuable square millimeter of tissue in the body." Even though the fovea is essential for fine vision, it is less sensitive to light than the surrounding retina. Thus, if we wish to detect a faint star at night, we must gaze slightly to the side of the star in order to project its image onto the more sensitive rods, as the star casts insufficient light to trigger a cone into action.

Critical Gift

There are a number of theories as to how the eye perceives color; the best accepted is the theory of trichromacy. There are three separate receptors in the cones of the retina for the three primary colors—red, blue and green. For example, to see a yellow shirt, the red and green receptors would be stimulated and would individually signal the brain, which would perceive the combination as yellow.

People who have difficulty in distinguishing colors are color-blind; however, the term is a misnomer, for very few people are really "blind" to color. They have difficulty in distinguishing shades of color apart; hence, the correct term should be color-deficient. Some are deficient in one or two colors but can distinguish the others. A great deal of research has finally fructified in a special contact lens, which can help tell the gross colors apart, known as an X-Chrom lens.

Early detection of color-blindness is simple with the use of color-graded charts. Occupations like a chemist's, an interior decorator's or a pilot's need acute color vision; hence, it is important to know in advance that one is not color-blind. Often one finds out too late to be able to select an alternative occupation.

What is not commonly known by most people is that a number of diseases or drugs can affect color vision. Chlorpromazine, an anti-allergy drug, can cause brown vision, barbiturates yellowish, quinine mild reddish and griseofulvin gives green vision.

The human eye can see 7,000,000 colors. Some of these are eyesores. Certain colors and color relationships can be eye irritants, cause headaches, and wreak havoc with human vision. Other colors and color combinations are soothing. Consequently, the appropriate use of color can maximize productivity, minimize visual fatigue, and relax the whole body.

Every time you differentiate between colors, be thankful for that great gift we often take for granted. Be grateful for this small magical organ that allows you to observe the whole world around you with all its magnificently colorful beauty.

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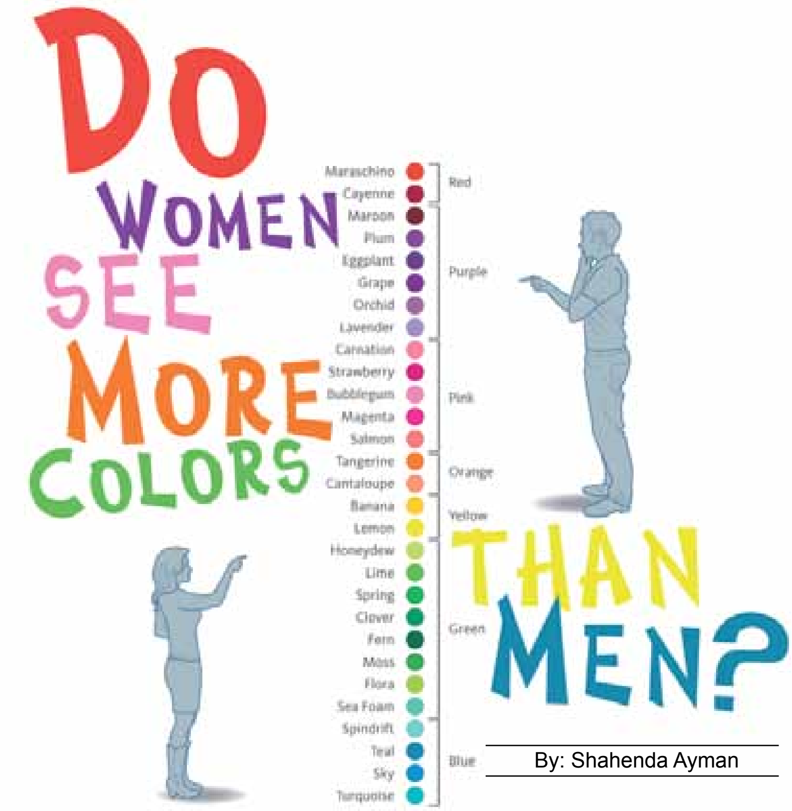
Do Women See More Colors Than Men?



By: Shahenda Ayman

Roses are red, violets are blue; or are they? The colors you see may not always be the same someone else sees. The average human can perceive one million different colors, but researchers suspect that a small percentage of women may be capable of seeing one hundred times that amount.

Women have always doubted this; now a new study has confirmed that men have a far higher chance of struggling to tell the difference between hues*, as one in 12 of them are color blind compared to one in 255 women. Researchers at Newcastle University also believe that some women may be able to see 99 million more colors than the average human being.

Vision is one of the most complicated senses. How the eyes perceive color is broken down by ocular cells called cones; each allows you to see around 100 shades. Individuals who are color blind, however, have only two types of cones, and are called "dichromatic".

Each of the three standard color-detecting cones in the retina—blue, green, and red—can pick up about 100 different color gradations, Dr. Jay Neitz, a renowned color vision researcher at the Medical College of Wisconsin, estimated. However, the brain can combine those variations exponentially, he said, so that the average person can distinguish about one million different hues.

Dr. Neitz, who conducts his research with his wife Maureen, said only women have the potential for super color vision. That is because the genes for the pigments in green and red cones lie on the X chromosome, and only women have two X chromosomes, creating the opportunity for one type of red cone to be activated on one X chromosome and the other type of red cone on the other one. In a few cases, women may have two distinct green cones on either X chromosome.

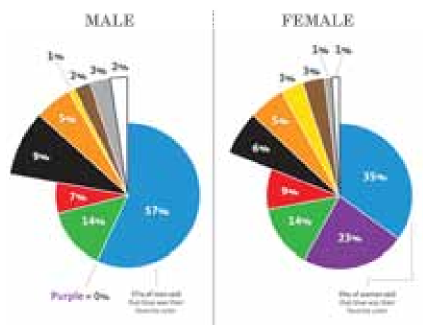
It is unlikely, Dr. Neitz said, that all of the women with four types of color cones will have the potential for superior color vision, because for many, their two red cones will be so close to each other in the wavelengths they detect that they will not see things much differently than a three-color person does. He estimated that 2% to 3% of the world's women may have the kind of fourth cone that lies between the standard red and green cones, which could give them a colossal range.

Finding tetrachromats through genetic screening is one thing; proving they can see tens of millions of additional colors is another. One research group headed by Gabriele Jordan of Newcastle University in Great Britain has identified a true tetrachromat.

Dr. Jordan started by working backward from certain "color blind" boys to their mothers. About 8% of the world's men have color deficiency, which is the term vision researchers prefer to color blindness. Most of them inherit two red or two green cones along with the standard blue cone, making it impossible for them to distinguish between red and green.

Dr. Jordan's team used vision tests to identify more than one hundred schoolboys in the Newcastle area with that kind of color deficiency. She knew that the mothers of those boys would have either two red or two green cones, and she is now in the process of testing those women to see which of them might be "strong tetrachromats", as she put it.

To single out such women, she came up with a clever test. Each woman looks into an optical device that shows her three tiny discs in rapid succession. Two of the discs are a pure orange wavelength, and the third is a nearly identical mixture of red and green; they are not told which is which.



Dr. Jordan reasoned that women with two distinct red cones would see the red-green disc differently than the orange discs. Of the 20 women she has tested so far, only one was able to instantly and accurately identify the red-green disc each time. She is now conducting genetic tests on the woman's saliva to verify whether she has the genes for distinct red cones.

Dr. Jordan said that the woman, who has not yet been identified, is a physician near Newcastle. For a doctor, she speculated, super color vision might give her the ability to tell whether a patient is ill just by noticing subtle changes in skin tone that a normal doctor would not see.

Based on Dr. Neitz's estimates, there could be 99 million women in the world with true four-color vision. However, before they pat themselves on the back for their superior evolution, he said, it is important to note that humans are just getting back to where birds, amphibians and reptiles have been for eons.

Those creatures have long had four-color vision, but a main difference is that their fourth type of color detector is in the high-frequency ultraviolet range, beyond where humans can see. In fact, that conclusion allowed scientists to figure out recently why the males of some species of birds did not appear to have brighter plumage than the females, Dr. Neitz said.

The problem was in the observers, not the birds, he said. When those species were viewed through ultraviolet detectors, the males had markedly different feathers than the females.

In a similar way, he said, our eyes are not capable of seeing the world the way a true four-color viewer perceives it, and so we have no way of knowing how many advantages that might give to tetrachromats.

There are many things in the world that are physically different from one another that you cannot tell apart now with three-color vision, but a four-color woman presumably would see the distinctions indeed!

Glossary

***Hue:** the property of light by which the color of an object is classified as red, blue, green, or yellow in reference to the spectrum.

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Nature's PALETTE

By: Sara Khattab

A glance at any natural scenery provides numerous examples of the mysteries of colors. Color comes from the energies of light; beams of light contain different energies that our eyes then interpret as certain colors. When the Sun shines on Earth and lights up the sky, it shines waves of energies containing lots of colors. It is indeed a pretty colorful world we live in!

Natural Aquarelle

Blue, green, or transparent, what is the real color of water? When you look at a glass of water, you see it is colorless; why is it then that when you stand by a lake, sea, or ocean, the water is blue?

Pure water has a slight blue color that is a result of its molecular structure and behavior; this blue color becomes increasingly visible as the thickness and volume of water increases. Bodies of water owe their blueness to selective absorption of light.

When sunlight hits the seas, oceans, or lakes, yellow, red and orange are absorbed by the water. Since blue has the shortest wavelength, it is bounced in the atmosphere more than the other colors.

Some constituents of seawater, in addition to impurities dissolved or suspended in it, may give it different colored appearances. Green algae in rivers and streams often lend a blue-green color to their waters, while some mountain lakes and streams that contain finely ground rock are turquoise.

Is the Red Sea really Red?

The name of the Sea does not indicate the color of the water, because it is not red in color. The Red Sea water is predominantly blue, yet sometimes it does look red. Some say that it may appear red in some places due to the reflection of the mineral-rich red mountains along its shore on the surface of the water, or the red in the beautiful coral reefs on the seabed.

In fact, the Red Sea sometimes turns red in color due to an extraordinary event in which it is filled with the seasonal blooms of the red-colored cyanobacteria *Trichodesmium Erythraeum*, which, upon dying, turn the blue-green water red.

Populations of algae fluctuate with the availability of nutrients, particularly phosphate, often resulting in a profusion of algae bloom. Algal groups are generally classified on the basis of the pigments that color their cells; most algal groups are blue-green, green, red, and brown. The growth of a particular algal species can be both sudden and massive; algal cells can increase to very high densities in the water, often thousands of cells per milliliter, coloring the water red, green or brown.

These blooms consume oxygen, increase turbidity, and clog lakes and streams; some algal species release water-soluble compounds that may be toxic to fish and shellfish. However, *Trichodesmium* algae are not necessarily toxic in their effects; they are nitrogen-fixing bacteria, and are being extensively studied for their nutrient cycling in the ocean.

A Giant Strawberry Milkshake!

Senegal is home to an extraordinary lake "Lake Retba" or "Lac Rose", which seems to be pink! During the dry summer months, when the saline levels are high, the Lake turns strawberry pink. Surprisingly, this color is not the result of chemicals being dumped in the Lake; it is actually nature playing magic tricks.

Due to high salt content, the Lake's water has the perfect living conditions for a certain salt-loving micro-algae *Dunaliella Salina*. These micro-algae are known for their ability to create large amounts of Beta-Carotene, which absorbs sunlight that reflects off the salt, and gives the algae a pink hue, turning the water pink. The Lake's water actually changes from mauve to deep pink, depending on the time of day and amount of sunlight.

The Lake may appear unsafe or useless; in fact, the *Dunaliella Salina* algae are rich in antioxidants, and are often harvested to be used in cosmetics and dietary supplements. It is also safe to swim, which is good news for the workers mining salt. Swimmers in this Lake can float easily due to its high salinity, just like the Dead Sea.

Natural Airbrush

We owe some of our most spectacular atmospheric phenomena to various types of scatterings: blue skies, colorful sunsets, and white clouds, among others. We see the sky colored because our atmosphere interacts with the sunlight passing through it.

The blue color of the sky is due to Rayleigh scattering*. As light moves through the atmosphere, most of the longer wavelengths pass straight through; because the blue light is the shortest wavelength, these waves are the most affected by the particles in our atmosphere. The resulting color, which appears like a pale blue, is actually a mixture of all the scattered colors, mainly blue and green.

On the other hand, glancing toward the Sun, the colors that were not scattered away—the longer wavelengths, such as red and yellow light—are directly visible, giving the Sun a yellowish hue. Viewed from outer space, however, the sky is black and the Sun is white.

Airborne Cotton Candy

Clouds are made of billions of small water droplets and ice crystals; so why are they white? Cloud particles are large enough to scatter any color of light that falls on them. The repeated scattering of light, known as multiple scattering, results in the white light because enough light of all colors is scattered to your eye.

A dark cloud does not always mean rain; clouds appear dark if they are in the shadow of other clouds, or sometimes, if the top of the same cloud produces a shadow on itself. There is also a darker look to some clouds if the background color is bright sunlight, making a great contrast.

Rainbow Sunsets

The immense variation in the colors of sunsets depends on the concentration of atmospheric particles; the size and concentration of these particles in the path of incoming sunlight determine the type of sunset observed.

When sunlight encounters very few particles in the atmosphere, most wavelengths of light reach the observer's eyes with almost equal intensity. The reduced scattering produces the white or yellow sunsets commonly observed in the Rocky Mountains, where the atmosphere typically contains fewer dust and assorted particles.

At sunset, the Sun's rays have much farther distance to travel through the atmosphere to reach the observer's eyes; more than 30 times the distance at midday. The volume of air through which sunlight must pass is significantly greater than when the Sun is high in the sky. The Rayleigh scattering effect is therefore increased, removing virtually all blue light from the direct path to the observer. The remaining un-scattered light is mostly of a longer wavelength giving the Sun an orange-red appearance.

Red sunsets are often observed from a beach because of the high concentration of slat particles suspended in the air over the oceans. These particles effectively scatter shorter wavelengths of light, producing red sunsets. Dust and ash particles injected into the atmosphere by volcanic eruptions can also lead to red sunsets.

After sunset, the reddened evening sunlight illuminates small particles in higher altitudes of 10-20 km above the ground, in the lower stratosphere. This reddish light combines with scattered blue light giving the reddish-purple color of the evening sky.

Living Colors

The plant and animal kingdoms abound with bright colors, from the lush green of photosynthesizing plants to the striking colors of fluttering butterflies. Colors signal the harvest time, breeding conditions, and the change of seasons. Animals can also use their colors to camouflage, or to warn other creatures.

Pigments are chemical compounds that are responsible for many of the beautiful colors we see in the plant and animal worlds. Pigments absorb some of the light they receive, and reflect only certain wavelengths of visible light.

Lively Leaves

Chlorophyll is the main pigment in plants; it harvests light energy to be converted into chemical energy in the process known as photosynthesis. Chlorophyll is green to the human eye because it is effective at absorbing the red and blue wavelengths of light.

Not all plants are green though; at least not all the time. In the Fall, leaves change color and can turn into various shades of orange, yellow and red. This occurs because chlorophyll is not the only pigment in a plant. There are also red and yellow pigments, known as anthocyanins and carotenoids, respectively. These pigments absorb green light and reflect red, or reflect just enough red and blue to create a yellowish orange color.

Plush Petals

People always admire the beautiful colors of flowers in bloom; unaware of the primary purpose of these vibrant colors, which is to attract pollinating insects to aid in the propagation of the plant.

Plants cannot move from one location to another; thus, many flowers have evolved to attract insects or animals to transfer pollen for them. Flowers that are insect-pollinated are of bright colors to attract bees, which are attracted to them as a source of sweet nectar that they process into honey for food.

Flowers are colorful because they have different pigments that reflect light, producing different petal colors: anthocyanins generate red, purple and blue; flavones make pale yellow colors; while carotenes make red, orange and bright yellow.

In addition to plant pigments, pollination and the environment impact the color of flowers. Some flowers change color as they grow, signaling to insects that it is aging and has passed the point of pollination. On the other hand, flowers growing in cooler climates tend to have more vivid colors, while those growing in warmer regions sometimes suffer from heat and water-deprivation resulting in fader colors.

Fabulous Fauna

Animals, too, produce biological pigments; the most common animal pigment is melanin, which is a brown or black polymer that occurs in skin or fur. Melanin absorbs most color wavelengths and therefore appears very dark to the eye; it produces a huge color range, from black, to sandy, to red.

The diversity of bird feathers' colors can be explained by just two factors: pigments and simple structures in the feathers that interfere with incident light. Pigment particles are embedded into the newly-grown feathers during the molting season. They absorb light of certain wavelengths, or disperse the reflected light, and so contribute to the color of the plumage.

While animals produce melanin, they are unable to make any other type of pigments; several animals, however, are colored by what they ingest.

Fancy Flamingos

Actually, flamingos are not pink; they are born with grey feathers, which gradually turn pink or reddish in color because of a natural dye they obtain from their diet. This dye comes from carotenoid proteins in their diet of animal and plant plankton, such as brine shrimp and blue-green algae. Liver enzymes break down these proteins into pink pigment molecules deposited in the feathers, bill, and legs of the flamingos.

The source of the dye varies by species, and affects the saturation of color. Flamingos, the sole diet of which is blue-green algae, are darker in color compared to those which obtain it from animals that have digested blue-green algae, such as brine shrimps.

Brine shrimps are also unable to make their own carotenoids; the tiny shrimp, however, eats microscopic algae that manufacture red and yellow pigments, so when the flamingos feed on these shrimps they acquire the pink color eventually.

In order to keep zoo flamingos pink, zoo keepers feed them a special diet that includes prawns, or mix another chemical such as beta-carotene or canthaxanthin into their food; otherwise they would be white, grey, or pale pink.

Bright Butterflies

Butterflies are among the most colorful and beautiful insects; they possess some of the most striking color displays found in nature. The coloration of butterfly wings serves a number of purposes, including camouflage, warning to predators, attracting a mate, deception, and heat collection. Moreover, there are ultraviolet patterns in butterfly wings that can be seen by other butterflies, but not human.

Most butterflies get their different shades of brown and yellow from melanin. The structural color of butterflies stems from the specific structure of the butterflies' wings, which explains why some butterfly colors seem to shift and appear so intense. Every time the observer moves, some butterflies appear to have different colors; this quality is known as iridescence, which happens when light passes through a transparent, multilayered surface, and is reflected more than once. The multiple reflections compound one another and intensify colors.

Butterfly wings amplify the effects of iridescence because they have many layers for the light to pass through, and thus many more opportunities for the light waves to reflect and magnify one another. Even though they are small, butterfly wings are covered by thousands of microscopic scales, split into two to three layers; in turn, each scale has multiple layers separated by air.

The combination of a butterfly's structural and pigmented color can create interesting effects. For example, if you saw a butterfly with yellow pigment underneath a structure that creates a blue iridescent color, you might see a green shade, made by merging of the two colors. The colors would change as the butterfly flaps its wings, and the light enters through different angles.

Luscious Landscape

With its vast red rock formations set against pure blue skies, the Chinese Zhangye Danxia mountain range resembles a real-life oil painting. Years of movement below the Earth's crust, combined with weathering on the Earth's surface, have created the mountains' unique topographical landscape and its trademark coloration.

The mountains resemble an assortment of brightly colored silks or gemstones. With the changes of time and weather, the colors vary constantly; the mountains are best viewed after rainfall when the rocks' colors are especially striking.

Research shows that about, 100 million years ago, there existed a huge inland basin in the Danxia Mountain area, where water carried silt from the surrounding mountains to the basin. As a result of elevated global temperatures, the basin dried up; due to the arid conditions of the area, sediments oxidized, turning into the color of rust. Some million years later, a thick red-colored layer formed on the basin, known as chalk bed.

Later orogenic movement lifted the whole basin many times; this severe uplifting of the area around the basin resulted in the accumulation of a mass of detrital matter, and thus the development of the deep red bed on the basin. Over millions of years, the red bed gradually eroded because of the Earth's crust uplifting.

Finally, a group of red mountains took shape out of the red bed. According to experts, orogenic movement still exists in the area; the beautiful Danxia Mountains are still growing.

The Redstone Park is full of incredible scenic wonders: cliffs, caves, natural bridges, and valleys. The mountain is covered with sub-tropical evergreen forests, lush, and green all the year round. The river flowing out of the Forest reflects bamboo, trees, and rocks, enhancing the colorful landscape.

Whether it be the pale blue sky of the day, sometimes animated with floating dreamy clouds, almost always adorned with the shiny golden globe of the Sun, or the dramatic, crimson sky of dusk as the Sun sinks behind the horizon; whether it be the ever-moving blue, green, sometimes red, or even black seawater, or the calmly motionless but colorful landscapes; whether it be the serene fields of swaying green crops, or the vibrant, cheerful beds of blooms of every color, buzzing with kaleidoscopes of mesmerizing butterflies; nature's palette is infinitely awesome and no matter how many of its secrets we unveil, its treasure troves never cease to amaze.

Glossary

***Rayleigh scattering** is the elastic scattering of light, or other electromagnetic radiation by particles much smaller than the wavelength of the light. It can occur when light travels through transparent solids and liquids, but is most prominently seen in gases.

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Wild Hide and Seek

By: Hend Fathy

In the wilderness, ruled by the motto "survival of the fittest", every advantage increases a creature's chances of survival and reproducing. Some animals are luckily gifted special adaptation techniques that help them find food and keep them from becoming food themselves; one such technique is color camouflage.

Camouflage is a process through which animals change colors in accordance with the surrounding environment, becoming hardly distinguishable from it. Some animals disguise themselves as something dangerous or uninteresting to keep off their predators. The two most common processes animals use to change color are chemical or physical coloration.

In chemical coloration, animals use microscopic natural pigments in their body named chromatophores, which absorb some colors of light and reflect others. In physical coloration, on the other hand, animals produce colors via microscopic physical structures that function like prisms, refractingand scattering light causing a certain combination of colors to reflect. Some creatures use the two processes combined; they have a layer of skin with yellow pigment and another that scatters light reflecting blue, together producing a green color.

Let me now introduce you to some of the most fascinating creatures using different color camouflage techniques.

Chameleons

The best-known color-changing animals, these magnificent reptiles live in Northern Africa, the Middle East, India, and Madagascar, which alone hosts about 50% of the known chameleon species. There are over one-hundred species of chameleons, most of which change in colors between brown and green; some can turn into any color.

Chameleons have natural pigment cells—chromatophores—under the outer skin. Usually, the top layers have red or yellow pigments, while the lower ones have blue or white pigments. The chameleon's skin color changes through controling and manipulating these cells.

Besides being a major defensing mechanism, chameleons also change color due to other factors, such as temperature and mood. For example, when feeling cold, a chameleon might turn into a darker color to absorb more heat; when it gets angry, it turns into red and yellow.

Mimic Octopodes

Lurking in the Indonesian and Malaysian shallow open waters is the newely dicovered master of underwater color camouflage: the Mimic Octopus. Like chameleons, Mimic Octopodes use pigment-filled chromatophores for coloration; not only that, to dodge away hungry predators, these creatures skillfuly contort to impersonate a large variety of sea creatures including sea snakes, lionfish, jellyfish and sole fish.

To mimic a lionfish, the Mimic Octopus adopts striped patterns on its skin and swims surrounded by its floating arms that resembles the fish's many venomous spines. Similarly, to mimic deadly sea snakes, it buries its body, leaving two arms out and moving them together.

According to the kind of threat it faces, this octopus reacts by changing its color and shape to look as predators of its own predators.

Polar Bears

Far at the Arctic ice sheets, one of the planet's coldest environments, live the stark white polar bears. Believe it or not, these creatures are originally black with translucent fur. However, black skin would make an animal an easy target against such a snowy white background.

Polar bears use physical coloration techniques to develop stark white fur coats that provide the needed camouflage. The bears' translucent fur carries the microscopic prism-like structures that reflect sunlight and the surrounding snow of its habitat, making the bear appear white.

Unfortunately, though, polar bears are diminishing in number and are listed among highly threatened species. This is the result of the drastic accelerated changes in its environment due to global warming. Unless humans change the path they are on now, the world will be losing these magnificent creatures as early as the fifth decade of this century, as suggested by latest released studies.

Golden Tortoise Beetles

Moving into the world of insects, the Golden Tortoise Beetle—a common North American beetle—adapts a very special color camouflage technique. This beetle's metallic appearance makes it look like a shiny dew drop on the surface of a leaf. Yet, only one glance away and we may think it went away to be replaced by a red ladybug.

The coloring process depends on the amount of liquid filling the grooves in the layers beneath the transparent outer shell. The beetles can control these liquids through microscopic valves; when filled with liquids, these grooves turn the shell into a mirror reflecting sunlight in different shades. In Spring and Summer, the beetles are bright gold; in Fall and Winter, they become less lustrous, reflecting more orange and bronze than gold.

To protect themselves from predators, these delicious bird-meal beetles change color to disguise as the less tasty black-spotted red lady beetles. When disturbed or threatened, the beetles fluids are displaced revealing a red color with ladybug-like markings in the bottom most layer.

Seahorses

known as the chameleons of the seas, seahorses are known for their skillful color camouflage abilities that set them among the most famous hiders and seekers in marine life.

Seahorses are beautiful small sea creatures that swim in an upright position with their tails down and their heads up. They exsit in tens of species distributed all over the world, usually inhabiting coral reefs and seagrass beds.

These small creatures change color in response to different factors including stress, social interactions, temperature, disease and diet. Being poor swimmers, seahorses also change color to blend with their surroundings, seeking protection from their predators and aiming to catch their preys.

Seahorses change color through contracting or expanding the pigment cells in their skin, showing a wide set of colors including shades of green, orange, red, black and white. Moreover, some species can grow extra skin filaments that make them similar in shape to fronds of seaweed, or long appendages that make them match the surrounding corals even better.

Animals using color camouflage have not only developed a unique defensive tool to survive, but also inspired humans who have been adapting this technique since the beginning of human civilization until this very day. For example, in the jungle, hunters' customs are green and brown to match the forest foliage and dirt; while in desert warfares, military forces use a range of tan colors.

Magical color camouflage techniques—among many other fascinating features known about the animal kingdom—reflect the richness of Earth's biodiversity, which we are severely abusing. Indulged too in the survival for the fittest race, tragically, Man has ruined the means of other creatures' lives, and it is high time he realized that even the fittest cannot survive alone.

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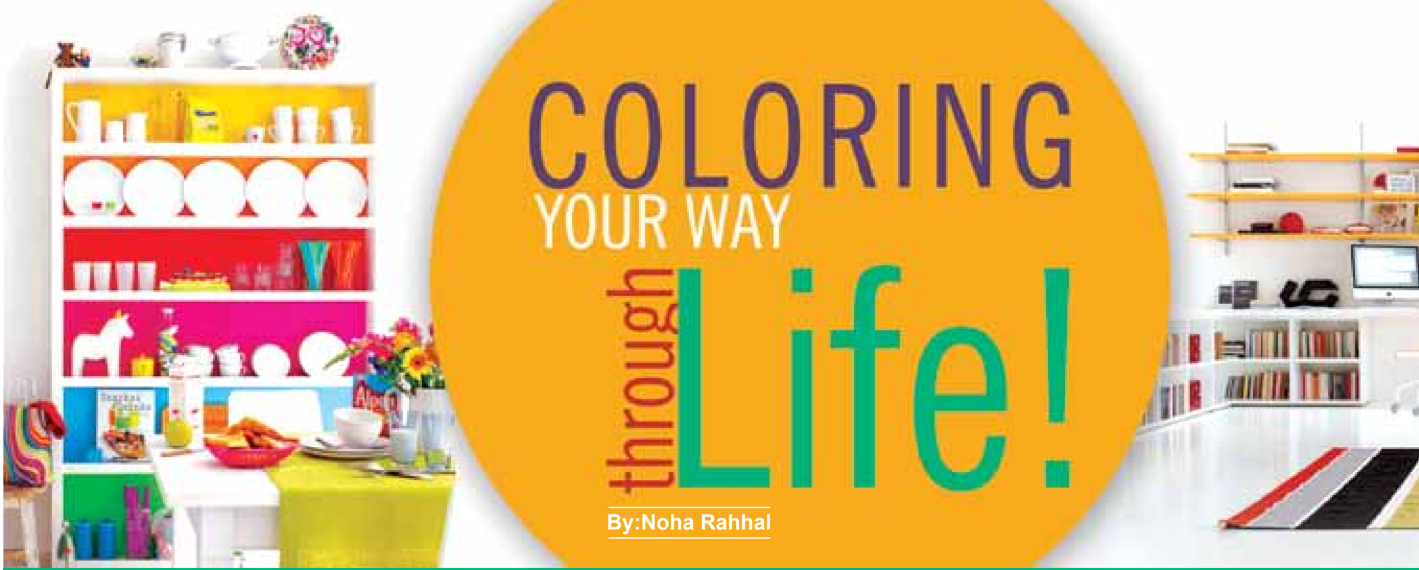

COLORING YOUR WAY through Life!

By: Noha Rahhal

When shopping, we usually go for the latest trends when it comes to colors. When painting an office or even an apartment, we normally opt for our favorite colors. But, have we ever thought of the effect of a certain color or even a specific shade on our psyche and wellbeing?

Surprisingly, there is a whole field dedicated to this topic: Color Psychology. Color psychology is the study of color as a determinant of human behavior. It explores many topics that are highly related to daily life; such as colors preferences, the relationship between the color of a classroom's walls, and the behavior of students, etc.

With multiple shades of different colors, color psychology may be regarded as a too broad field; however, there are basic principles on which this field relies. The first principle is that color can carry a specific meaning, which can be an acquired meaning or a biologically innate one.

Moreover, color psychology explores how a person perceives a certain color and how they behave or react to their own perception. Context is also another important factor when studying color psychology; that is why it is usually taken into consideration when studying a color's meaning and effect.

Analyzing the Color Palette

Since colors are regarded as a non-verbal form of communication through which people can express a certain attitude, behavior, position or even a message, I have gathered some colors and included their interpretations and the effects they are believed to have on people's body, mind and soul.

I have started with the four psychologically primary colors: red, blue, yellow and green. Respectively, each one affects the body, mind, emotions and the essential balance between these three.

Red has the longest wavelength; it is thus regarded as a powerful color with a physical effect. Red stimulates people and raises the pulse rate—blood pressure in some cases—that is why it is used in traffic lights worldwide. On the other hand, red connotes strength, self-confidence, energy, courage and excitement. However, it can send out the wrong message as a sign of defiance, aggression and strain, especially when it is used excessively.

Known for its soothing effect, **blue** is the color of the mind; it affects people mentally as opposed to red, which stimulates physical action. It connotes communication, intelligence, serenity and logic; that is why blue is normally used in classrooms and places where there is a high need for reflection and relaxation as well. However, it can sometimes be regarded as cold, unemotional or unfriendly.

Like red, **yellow** has a long wavelength; however, it is not physically stimulating. On the contrary, it is emotionally stimulating; it connotes a sense of optimism, self-esteem, creativity and emotional strength. However, if it is used excessively or in a wrong shade, it can lead to poor self-esteem, fragility and anxiety.

Whenever **green** is mentioned, certain notions, such as Green Energy and Green Life, start popping into one's mind; this is because green is normally associated with prosperity and resourcefulness of water. Green is highly regarded as a restful color; as it is in the center of the spectrum, it usually stands for balance. Green connotes refreshment, universal love and peace; however, it can appear as dull in some cases if used the wrong way.

A mixture of both red and yellow, **orange** is known for being an emotional and physical stimulant at the same time. It is regarded as a fun color that focuses people's minds on food, passion, warmth and physical comfort. However, it might connote frustration and immaturity.

Indigo is not a very common color, but it is one of the light spectrum colors. It usually stands for intuition and idealism. However, it can be regarded as a ritualistic and addictive color.

The last color in the color rainbow, **violet** has the shortest wavelength. It is known as the spiritual color that encourages meditation and reflection. It is also associated with royalty and high-quality lifestyle. However, if used excessively, violet may connote suppression and inferiority.

Blue Vs. Red

- Avicenna wrote once that "Color is an observable symptom of disease". He even developed a chart that related color to the temperature and physical condition of the body. He believed that red moved the blood, blue or white cooled it, whereas yellow reduced muscular pain and inflammation.
- Red may be a sign of good health as opposed to anemic paleness. According to a recent evolutionary explanation, anger is used as a stimulant for a number of people. When blood flushes due to anger, this indicates they are healthy people; conversely, those who have anemia do not show any sign of flushing blood when they get angry.
- Men tend to be "redder" than women! This is because facial redness is associated with testosterone levels in humans.
- In 1876, blue has been a source of inspiration for an American Civil War General named Augustus Pleasonton, who conducted his own experiments and published a book entitled, *The Influence Of The Blue Ray Of The Sunlight And Of The Blue Color Of The Sky*, where he stated his theories and beliefs regarding how blue can improve the growth of crops and help heal human diseases.
- Blue lighting was used in 2000 in certain neighborhoods in Glasgow, and it was found that crime rates decreased significantly. In Japan, blue lighting was used in railway stations to reduce the number of suicide attempts.
- Red is the only color that has an entirely separate name for its tints, such as: pink, crimson and burgundy. Tints of blue, on the other hand, are simply called baby blue, navy blue, etc.

Color Psychology & Interior Design

Color psychology has influenced a lot of disciplines, such as interior design and marketing. Interior designers have been aware of the power of color for so long that they do not only make their color choices based on space or use, but also according to their clients' psyche and comfort zones. Here are some guidelines that you can easily follow when furnishing your house or when repainting your office:

Bedrooms: They are the place where people normally aim to relax, reflect and spend quality time. Blue can be a perfect choice for coloring the walls of bedrooms due to its calming effects. It is a serene color that stimulates thinking and contemplation; it is also thought to prevent nightmares.

Moreover, violet is considered as a good option as it is associated with fertility, happiness and creativity. Oppositely, shades of grey should be avoided as they can induce depression and frustration.

Living rooms: They are usually associated with warmth. They are places where family, friends or even random people gather and share pieces of their minds with one another. That is why red and orange are recommended when painting the walls of living rooms as they are thought to stimulate conversations.

Bathrooms: Like bedrooms, bathrooms are places where people usually spend a good portion of their time. That is why whites and warm colors are highly preferred as they connote purity and cleanliness. Blues and greens are permissible too due to their refreshing and rejuvenating influences.

Kitchens: If you do not have weight issues or concerns, go for red or orange; they both stimulate appetite and conversation.

Classrooms: In a 2003 study entitled "The Impact of Color on Learning", on the relationship of color psychology and education, it was proved that end wall treatments inside classrooms can reduce eye strains by helping students' eyes relax. The study has shown that end wall colors should be a medium hue. Colors can also be used to enhance students' attention span, in addition to students' and teachers' sense of time and productivity.

Promising as this may sound, it can be somewhat tricky. This is actually attributed to the fact that there are specific color preferences related to each educational stage. A case in point is preschools, which prefer warm and bright colors, whereas junior high and high schools prefer cool colors, such as blue, due to these colors' effect on enhancing the levels of concentration for students of such critical ages.

Offices: Choosing the colors of your office's walls depends to a great extent on the nature of your work. For instance, if you need to concentrate while working, you will need to be surrounded with relaxing colors, such as blue and green. Conversely, if your work entails a lot of action and energy, you have to go for strong colors, such as orange and magenta, which are known for raising blood pressure and thus keeping people more alert.

Hospitals: It is highly advised that hospitals' walls should be in whites, greens, or even blues. White is known for its soothing effects; it implies cleanness and sterilization. Greens and blues are also known for their relaxing effects; they both promote peacefulness, calmness and balance. Blue also induces healing effects to patients' souls.

Color Psychology & Fashion

Being obsessed with fashion shows, the latest trends and all that beauty rush, I wondered whether fashion designers have a clue about color psychology and adopt its principles when working on their new collection, or they go merely for their passions and simple interests. I also wondered whether the colors of our outfits affect our psyche the same way a simple plain wall can affect our wellbeing or emotional state.

While sitting in a café, I started observing other clients at the same place and tried to take note of my impressions about them based on the colors of their outfits. Involuntarily, I found myself a bit intimidated by men in dark suits, especially navy blue ones. However, I felt more encouraged to talk to the waiters who were all dressed in red.

I was not sure whether that was directly related to color psychology or my own personal preferences, so I decided to dig into it and try to find a scientific answer to my concerns. I found out that the colors of our clothes affect our psyche due to the influence of the magnetic energy of each color; thus, the color of each outfit we put on results in different emotional responses. It turned out that we all have the same subconscious reaction to colors despite our personal preferences.

Here are a few tips if you want to leave a good impression through the colors of your outfits:

To appear friendly and approachable, go for earth colors, such as beiges and browns. Also try out some warm colors, such as orange, as they stimulate conversation and interaction.

To appear professional, choose dark colors, such as navy blue, grey and black. Such colors connote seriousness, commitment and assertiveness.

To appear calm and reassuring, wear subtle colors, such as pastels and green. They are thought to be diplomatic colors as they deflect criticism and convey a sense of serenity and peacefulness.

Color Psychology & Business

As mentioned earlier, color psychology has influenced the business world to a great extent, especially marketing. You might think that this applies to big projects with mass productions where huge marketing campaigns are created and extensive research conducted, but you will be surprised when you know that some of the places or things that you are exposed to in your daily life take color psychology into consideration.

A case in point is restaurants which make use of color psychology. If you notice some of the popular restaurants in town, you will find that reds and oranges are used extensively as they are appetite stimulants. They also encourage people to spend more time in those restaurants.

Interesting Colorful Facts from the Business World

McDonald's arches are painted in bright yellow, which is known for instilling happiness and youth.

The walls of **Starbucks** coffee shops are painted in deep green and maroon as both colors instill warmth and comfort.

Hershey's chocolate bars are wrapped in attractive dark brown paper as it sparks emotions of simplicity and health.

The **IBM website** has a very professional color scheme, which includes blue, grey and white, connoting a sense of seriousness and professionalism.

Barbie's website is all about pinks. This is because the website mainly targets young girls who are innocent, fresh and young and pink conveys all of that.

By now, you have a proper understanding of colors, which you may have taken for granted for so long. With such knowledge, you can try to apply what you have learnt so far to your surroundings or even your appearance. Whether you will be renovating your house or office, choosing the layout of your corporate's website or even making a change in your wardrobe, I am sure you will have a total different outlook on how things should look.

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We all have our favorite colors; babies are no exception. We do not just develop an appreciation for color as adults; babies and children are also affected by it, both positively and negatively. We need to know how color can have a positive or negative effect on our children, and how to harmonize their feelings; it might help them sleep better.

By: Reham Elbannan

Baby Blue

Newborns happen to be extremely sensitive to colors. They can even be affected by the color of their clothes, as well as the color of those cute little baby hats you see so often.

Color therapist June McLeod, who worked with a nursery childcare organization on a study about color, has seen how the proper use of color can have an extremely positive effect on the children involved, including the following advantages:

- Improved emotional development;
- Increased sharing and cooperation;
- Decreased noise levels;
- Reduced tension and aggression;
- Babies slept more easily and peacefully;
- A calmer, happier and more relaxed environment was created;
- Children found it easier to organize their own thoughts, which could lead to better intellectual development in the long term.

It is thus important to make sure babies do not get upset by the colors that surround them. That is why pastels are all good colors for baby clothes, booties, blankets and so on. You may think pastel colors for babies are a bit boring and old-fashioned but there is some sense in choosing pale pinks and blues for babies' bedrooms because babies are far happier surrounded by calming soothing pastel shades. The traditional pink and blue is not necessarily gender specific at all, both work well for babies of either sex.

These new little arrivals have a lot of adjusting to do and thrive in a calming environment. Avoid busy patterns and strong colors in their rooms as this will encourage hyperactivity, lack of sleep and restlessness. If you are preparing your baby's room, and do not know the sex, you could opt for a calming pale lilac, which is suitable for both sexes and has an equally calming effect.

However, this does not mean babies should be kept away from vibrancy at all times. Babies deserve the positive aspects of the outside world, including its colors, so bright things can be saved for special play time. For toddlers, color can be used effectively to help stimulate intellectual development.

"However," warns June, "toddlers can only take short bursts of time in 'loud' colorful environments. Bright, primary-colored environments can be beneficial for short periods of time, but not for full days, as strong colors will bombard their senses."

In order to avoid overstimulation, June recommends sticking to calm pastels on walls, and introducing the brighter primary colors with toys, equipment and soft furnishings. "Brightly colored toys can then easily be moved or stored away to create a more restful atmosphere for quiet times."

Also to encourage peace and tranquility in the bedroom, June advises using a coral, peach or soft pink shade on the ceiling space. "Your child will spend time each day and night looking at the ceiling and these colors not only encourage intellectual development but also create the feeling of a safe and secure space."

If you are now worried that an incorrect color choice will result in endless tantrums and sleepless nights, fear not; general color rules are relatively easy to follow.

Red, orange and yellow are considered "magnetic" colors; they make a strong impact, are warm, energizing and uplifting. On the other hand, blue, indigo and violet are "electrical" and, therefore, are cool, soothing and calming.

Green lies in the middle of the spectrum; being neither warm nor cold, it creates balance. We often retreat to the green of nature when we need space, calm and a sense of peace; using green in décor thus helps create a feeling of harmony and balance.

Generally speaking, red symbolizes fire, and as such, stimulates and excites the blood and nerves. It helps revitalize you when you are feeling tired and lethargic, and can be effective against colds and chills.

Orange reputedly strengthens the lungs, pancreas and spleen. By warming the emotions, it creates a sense of well-being and can increase vitality and appetite. Orange also is said to be good for muscle cramps, asthma, bronchitis and colon cleansing!

Yellow is a lovely, sunny, positive color, and is said to help the nervous system and intellect. Moreover, yellow allegedly helps the liver eliminate toxins, alleviates skin problems, purifies the intestines and aids the mind with problems such as nervous exhaustion and depression. It is also useful for indigestion and constipation. As for pink, it is useful for both adults and children; it stimulates creativity and strength in children.

Green is always associated with nature, and therefore, its harmonizing effects are obvious to us. Green symbolizes new life, freshness and brightness; it can help with high blood pressure, heart problems, headaches and flu. Be warned though; too much green can leave the child too relaxed.

Blue acts completely oppositely to red, contracting and restricting rather than stimulating; it is antiseptic and cooling, helping the body slow down to fight diseases with a fever and calm down after a shock. Blue can bring peace of mind, which is useful when there has been too much mental exertion and exhaustion.

Finally, violet is an essential color for people who are naturally highly strung and anxious because of its soothing and tranquillizing effect. It is said to help develop a person's spiritual and intuitive side so it is a handy color for meditation. Physically, it can be used for all mental and nervous afflictions.

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THE COLORS of Medication

By: Hend Fathy

Like anything else in life, medications have gone through major scientific advancements; they have transformed from little round balls containing medicinal ingredients mixed with clay or bread some 5000 years ago in ancient Egypt, to an enormous variety of pills, capsules, and syrups, among several other forms, designed to target and cure different diseases. This variation is, once again not unlike anything else in life, not devoid of the touch of color, which, in fact, can tell us a lot about these medications.

Until the second half of the 20th century, colorful medications were almost non-existent; most tablets were a hue of white. However, with the introduction of soft and hard gelatin capsules in the 1960s, colors invaded the pharmaceutical industry and have since had a major medical and commercial role to play. The very early colors included red, green, and yellow; today, more than 80,000 color combinations are readily available for pill coatings, and more is yet to come.

Do colors really matter here? The answer is: Yes, they do. The colors of medication are of great importance to both producers and consumers in several ways. Color may be used to identify a particular manufacturer or drug; in a highly competitive market, pharmaceutical companies seek innovative unique color and shape configuration to enhance the identity of their products.

Since it has a significant role in transforming a plain white pill into a brand image that brings millions of dollars to the producing company, the color of a drug is as heavily researched as its formulation. Moreover, drug marketers are aware that colors hold patients loyal to the branded product, even beyond its patent date, and thus protect it from generic competition.

Selecting colors for medications is not a haphazard process, though. Color-coding is the systematic, standardized application of a color system that aims at classifying and identifying drugs that fall within the same pharmacologic class(1). This system allows consumers to link between particular colors and their specific functions.

For instance, the use of medication color codes to communicate hazard levels; for example, red can be used to represent highly hazardous drugs, or as an alarming color reminding the elderly to take their heart medication. Some institutions concerned with safe medication practices recommend using black-capped packages for drugs containing potassium chloride, because of the high potential risks of misusing or confusing them with other medications.

Other technical issues are also considered. Some medical formulations necessitate opaque capsules to protect them from light, infrared and/or ultra violet radiations. Others need them to increase the stability of ingredients and decrease the formation of free radicals(2), which keeps the medication effective for a longer time. Drugs with oily fills are also recommended to have opaque coatings as it keeps them from becoming rancid.

Ancient Romans stated that people “eat with their eyes first”; this applies to medication, although we do not technically eat them. Colored medications have powerful synesthetic effects that help make them appealing to patients, especially when these colors are associated with smell and/or taste. For example, a pink syrup would definitely be more appealing to a child than a dull one, as it brings about an image of strawberry juice.

Just give it a thought: How do you think a grey capsule would taste or smell like: smoky or fruity? What about a pink one: sweet or sour? A team of researchers at the University of Bombay, in India, conducted a survey of 600 people to study how the color of a medicine influences patients’ perception of it. The results showed that red and pink are favored over other colors.

Fourteen percent of surveyed people think that pink tablets taste sweeter than red, and that yellow ones are salty; eleven percent think white and blue tablets taste bitter, and ten percent believed orange ones are sour. The purpose of the survey was to further emphasize the role of the sensory elements of a medication in creating positive perceptions that complement its medical attributes.

Medications are more likely to provide better effects if their colors correspond with the intended result. A calm blue pill would do great for a good night’s sleep, while a lime green one would not for nausea. Also, if a pleasantly-looking drug makes a patient believe it will achieve the desired results, he/she are more likely to receive greater benefits from it.

This fact makes the colors of medication important; in Medicine, every factor that would positively contribute to making patients more faithful to taking medication is considered crucial in recovery. That is why, on both the medical and commercial levels, pharmaceutical companies should make smart decisions regarding appropriate color combinations to give the medicine a boost, improve its effect and even probably reduce its side effects.

Another major role the colors of drugs play is reducing medical errors associated with misidentifying the correct medications or doses. Three-quarters of the people questioned at the University of Bombay survey stated that the color of their tablets helps them easily remember the exact medications to take.

Medical prescription drug errors by doctors, pharmacists or patients is a major hazard that accounts for a countless number of deaths annually. Hence, distinctly colored medications are highly appreciated for preventing patients, especially the elderly who take various medications, from taking the wrong pills by mistake, for such visual cues serve as their last defense mechanism.

Similarly, colored drugs can be life-saving in cases of emergency when each moment is precious. While patients are unable to communicate verbally the name of the drug that would save their life, distinguishing red tablets from others of different colors, would be easier for them than distinguishing a white tablet from others of the same color.

Medications are a necessary evil, no doubt; though nobody wants to take them, nobody can really do without them. Being a source of hazard, though, people should be very cautious when dealing with them; it is here where color interferes to make these groups of interacting chemicals more appealing and safer to use.

Glossary

(1) Pharmacologic Classes are classes into which medications are grouped according to the organ or system on which they act and/or their therapeutic and chemical characteristics.

(2) Free Radicals are atoms containing at least one unpaired electron, therefore remaining unstable and highly reactive, seeking to bond with surrounding atoms, usually leading to disturbance.

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EAT YOUR COLORS

By: Lamia Ghoneim

There is no doubt that eating three to five servings of fruits and vegetables daily will improve your health. However, more and more experts are saying healthy eating is not only about how many servings of fruits and vegetables you eat, but also about how many colors you consume!

Say, today you managed to eat a particularly healthy and balanced diet; you filled your fruits and vegetables serving requirements with cauliflower, mushrooms, onions, turnips, coconut, and bananas on your wholesome menu. You are thinking now you must have taken all the valuable nutrients your body needs; experts say you are wrong.

While the menu described has many servings of fruits and vegetables, they are solely white colored; even if they were mainly red, or green, or any other color, your diet would still be lacking.

More and more research has now shown that, in order to gain all the benefits of nutrition that your body needs, you need to eat an array of different colored fruits and vegetables. In other words, you do not only need to eat your greens, but also your blues, your reds, your purples and even your yellows and oranges!

However, shouldn't we be talking about vitamins and minerals? What does color have to do with anything? The answer is in the "Phytochemicals".

Phytochemicals—*phyto* meaning "plant" in Greek—are the chemical compounds that help give plants their colors, smells, taste and other organoleptic—aka sense engaging—properties, such as the deep blue hue of blueberries and the pungent smell of garlic. As it turns out, they do much more than that; they are, in fact, manufactured by plants in order to protect themselves from the damage caused by sources, such as pests and ultra-violet radiation.

Now, experts are saying that, by consuming them, they also provide us with the same protection they give plants. Research has shown that these unique compounds can produce a wide variety of healthful effects, touching all of the body's major systems; they can sustain energy, maintain good health, reduce the risk of disease, and support growth and development.

Though not technically classified as nutrients, phytochemicals are now believed to be extremely beneficial, most importantly for their properties associated with disease prevention and treatment, particularly those relating to cancer, diabetes, cardiovascular disease, and hypertension.

It is easy to identify phytochemicals as they are responsible for the plants' distinctive colors; the highest concentrations of different phytochemicals can be detected just by looking at a plant's color and shade. They are also as diverse as the colors they produce, with more than 1000 different types identified, each with a corresponding health benefit, as no one color group does it all. Instead, they complement each other and work together, as well as with vitamins and minerals, naturally and in ways that supplements cannot reproduce.

Eating regularly from each color group provides the widest health protection possible provided by all the different types of phytochemicals, so find out below some of what each color group offers.

Deep Oranges and Bright Yellows

As kids, we are told to eat our carrots for stronger vision. Unless you are vitamin A deficient, this statement is not entirely accurate; it does, however, have a "phytochemical" scientific basis.

Carrots, along with sweet potatoes, pumpkins, cantaloupe, mangoes, and peaches, all contain beta-carotene; a common phytochemical within a group of over 600 called carotenoids. In the body, beta-carotene is converted into vitamin A, which has many vital functions, including the growth and repair of body tissues, the formation of bones and teeth, the resistance of the body to infection, and of course, the development of healthy eye tissues—hence the saying.

Citrus fruits, such as oranges, grapefruits, and tangerines, on the other hand, contain bioflavonoids; a group of phytochemicals that work together with vitamin C to help reduce the risk of cancer, strengthen bones and teeth, help heal wounds, keep skin healthy, and lower the risk of heart attack.

Deep Greens

It is obvious we need our greens, but did you know they can also protect us from eye disease and cancer?

Leafy vegetables, such as spinach, Romaine lettuce, collard greens, kale, and broccoli contain lutein photochemical; a powerful antioxidant that helps reduce the risk of cataracts and macular degeneration, both common eye diseases. Green peas, honeydew melon, kiwi, and avocado are also excellent sources of lutein.

Cruciferous vegetables, such as broccoli, cauliflower, cabbage, and Brussels sprouts all contain indoles, which help protect against breast cancer in women and prostate cancer in men. In a recent study, men who ate cruciferous vegetables at least three times a week had a 42% reduction in their risk of prostate cancer.

Deep Reds and Bright Pinks

It is true red foods are appetizing just by merit of their vibrant color, but there are more reasons to satisfy our hunger with red, including protecting our hearts!

Watermelons, pink grapefruits, and tomatoes are all good sources of lycopene; one of the 600 carotenoids that greatly benefit the heart and circulatory system by helping build healthy cell walls. This improves blood pressure, organ function, and circulation. Tomato-based products, such as tomato sauce, tomato soup, and tomato juice have the most concentrated source of lycopene.

Moreover, the vibrant, red betacyanins phytochemicals found in beets are natural antioxidants and are thought to fight heart disease and cancer, and improve the health by combating free radicals in the body.

Blues and Purples

Want to stay young? Eat your blues! Blueberries, blackberries, grapes, plums, raisins, and eggplant contain the disease-fighting phytochemicals anthocyanine and polyphenols. These powerful antioxidants help reduce the risk of several diseases including cancer, heart disease, and Alzheimer's; they may even slow down aging. Research suggests that eating blueberries, in particular, may prevent some of the effects of aging by improving cell communication in the central nervous system.

Whites

Yes, you should avoid a diet filled with white foods, but the rule mostly refers to processed foods such as white bread and potato chips—not fruits, veggies, or beans.

Garlic, onions, and leeks may be lacking color, yet they are bursting with powerful phytochemicals, including allicin; the most common phytochemical in this group. Research has shown that eating allicin containing garlic and onions every day lowers cholesterol and blood pressure, and increases the body's ability to fight infections. Nutrition research also shows that eating vegetables from the onion family may speed recovery from colds, reduce the risk of heart attacks, and even stop the spread of certain cancers, particularly stomach and colon cancer.

There you have it; beyond the visual appeal of a colorful menu lies a wide range of healthful benefits. So remember, for a healthy vibrant you, always eat a rainbow.

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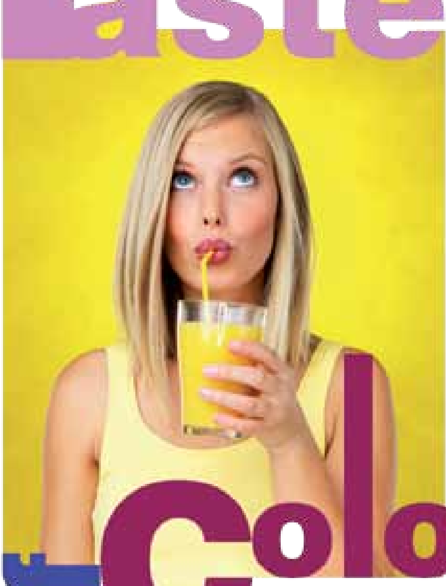
The Taste of Color



By: Lamia Ghoneim

We have all heard the old saying "You are what you eat"; now, new science asserts it could be "You eat what you see".

It is no secret that the way food looks has a drastic effect on our willingness to eat it; it is why top chefs spend so much time perfecting the presentation of their plates, and food companies spend so much money on the visual appearance of their products. However, how big a role does "color" in particular play on our perception of taste?

A surprisingly big one, scientists declare. The results of several studies have confirmed that the changing of food color can radically affect how it tastes. Brightly-colored foods were frequently perceived as better tasting than bland-looking foods, even when flavor compounds were identical; while experiments with foods that were somehow off-color showed they were perceived as having unpleasant, off-tastes.

Brighter Orange = Sweeter Taste

Color can indeed fool our taste buds into sensing taste differences where none is present. One study went as far as to demonstrate that color can override other parts of the eating experience, including real differences in flavor.

The study, published in the *Journal of Consumer Research*, found that the color of a beverage greatly influenced how people interpreted its taste, even more so than the actual sweetness of the beverage.

The researchers manipulated orange juice by changing color (with food coloring), sweetness (with sugar), or by labeling the cups with brand and quality information. They found that though the brand name influenced people's preferences for one cup of juice over another, labeling one cup a premium brand and the other an inexpensive store brand had no effect on perceptions of taste.

In contrast, the tint of the orange juice had a huge effect on the tasters' perceptions of taste. Given two cups of the same orange juice, with one cup brightened with food coloring, the members of the researcher's sample group perceived differences in taste that did not exist, and much preferred the brightened samples. However, when given two cups of orange juice that were the same color, with one cup sweetened with sugar, the same people failed to perceive taste differences, hence proving that color is even more important than the actual flavor!

Blue Steak and Green Fries

The importance of color can be dated back to historical times when humans once scavenged for food, relying on visual cues to help determine what is edible. The color of fruit would tell them whether it is ripe, the color of meat whether it is rancid. Flavor researchers manipulate this primitive instinct by using colored lights to modify the influence of visual cues during taste tests.

During a past experiment, people were served an oddly tinted meal of steak and French fries that appeared normal beneath colored lights. Everyone thought the meal tasted fine until the lighting was changed. Once it became apparent that the steak was actually blue and the fries were green, some people became ill. (Experiment recounted from the book: *Fast Food Nation*)

This reaction is generally attributed to our instinctual aversion to certain colors of food, blue and purple chief among them. Since these colors do not occur very often in natural foods, and in fact are sometimes associated with spoiled, moldy food, we have an expectation that foods of this color will not taste very good or will be bad for us, although there are exceptions, of course.

On the opposite end of the spectrum, certain colors enhance our enjoyment of food because we have linked the taste of a food with a color, even if it differs from that food's natural color. A prime example of this is butter, which in its original state can be nearly white, but for commercial purposes is dyed yellow because it is seen as more appealing.

Seeing Crystal, Tasting Brown

While food companies know that consumers can be influenced by the intentional use of dyes to make food more appetizing, there have also been some attempts by these companies to go the opposite route; creating products in strange colors.

One not-so-successful example of this type of marketing ploy was the introduction of Crystal Pepsi in 1992. Except for its lack of caramel coloring, it was just like regular Pepsi. It should have tasted exactly the same, but it did not, and the product was a miserable failure.

Consumers could not get past the odd juxtaposition of flavor and taste, and the feeling that something was just off. It was hard for them to imagine a Cola being clear, and some claimed it tasted like lemon-lime soda, even though those flavors were not in the beverage—another example of color association affecting taste.

Senses Crossover

Such strong color taste associations led scientists to believe that the sense of taste initially begins in the brain, not the tongue. The information we receive from our eyes leads us to anticipate a flavor based upon the color of a food or beverage, and that initial assumption can override the information we receive from our taste buds.

Biologically speaking, flavor perception arises from the central integration of peripherally distinct sensory inputs—sight, taste, smell, texture, temperature, and even sound of foods—that combine together to give rise to a unified oral sensation. Each sense has a pathway to the brain that is parallel to the pathways of the other senses, which is how they work together to produce a combined sensation.

However, in some situations, a crossover from one pathway to the other occurs. Seeing the color yellow-green may evoke taste sensations of sourness; pink may evoke sweetness. Seeing the color grey may evoke olefactory (smell) sensations of smokiness. It is the same reason why brighter orange juice tastes sweeter, and blue steaks and green fries taste unpleasant, it is the crossover of our senses that causes such color taste connections to occur.

For a few people, the crossover of senses is so strong to the extent that they can really feel color; they can taste it, smell it, and even hear it. The condition is known as synaesthesia, but that is another story. The next time you eat one of your favorite colorful foods, take a second to think whether you truly love the flavor, or if you are really just enjoying the taste of its color.

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By: Maissa Azab

Human Colors

Throughout this issue we have discussed many aspects of color in our life here on Earth and beyond it; it is not conceivable that we finish it without discussing color in us. The truth is that the human rainbow of colors raises a myriad of intriguing questions that haunt many, if not all of us; questions such as: Why and how did we come to look so different and so diverse? Why is it that the majority of Africans have deep dark skin, while most Europeans have pale pink skin? And so on.

A human "race" is often defined as a group of people with certain features in common that distinguish them from other groups of people. Currently, there are four major human "races": Australoid (4%), Caucasoid (55%), Mongoloid (33%), and Negroid (8%).

Interestingly, research on racial differences has led scientists to at least three major conclusions: the first is that there are many more differences among people than just hair texture, skin color, and facial features. Other variations have been found to exist, one such variation is the variability of apocrine glands, which produce scents we commonly refer to as body odor.

Another remarkable variation is metabolic rates, which can differ significantly among races; the higher the metabolic rate, the higher the threshold for sensing cold. The Eskimo's metabolic rate is 15-30% higher than that of a European, while equatorial people have the lowest metabolism of all as fewer calories are needed to keep warm.

On the other hand, research has shown that, in many cases, a population's survival is aided by its genetic variability; what we can relate to the term "survival of the fittest". Nevertheless, scientific research indicates that, while it is possible to classify a great many people on the basis of certain physical characteristics, there are no known features, or groups of features, that will do the job in all cases.

For example, it has been suggested that skin color might be a criterion for race determination; this provides innumerable difficulties. For instance, some Africans, living in the sub-Saharan regions, have skin coloration that is no darker than that of some Spaniards, Italians, Greeks, or Lebanese.

Various appearance features have also been suggested as the criterion for race determination. Distinguishing features such as hair color, eye color, hair form, the shapes of noses and lips, and many other traits set forth as "markers" of one race or another are found distributed all too often throughout many races.

The complexity of this issue increases; the world is filled with populations that just seem to defy classification. Well-known examples of that include: the Bushmen of southern Africa who appear to be as much Mongoloid as Negroid; the Negritos of the South Pacific who look Negroid but are far removed from Africa and have no known links to that continent; the Ainu of Japan, a hairy, aboriginal type of people who appear to be more Caucasoid than anything else; the Aborigines of Australia who sometimes look Negroid, but often have straight or wavy hair and are occasionally blond as children.

The question is: Why are there so many different racial characteristics? What is their origin? How long did it take for all this to occur?

Racial Dilemma

There is only one species of Man on Earth: *Homo sapiens*. Anthropologists and biologists place all races in existence today as a single species, which points to the fact that the differences between human races are not really all that great.

As a matter of fact, compared with many other mammalian species, humans are genetically far less diverse; a counterintuitive finding, given our large population and worldwide distribution. For example, the subspecies of the chimpanzee that lives just in central Africa, *Pan troglodytes troglodytes*, has higher levels of diversity than do humans globally. Moreover, the genetic differentiation between the western (*P.t. verus*) and central (*P.t. troglodytes*) subspecies of chimpanzees is much greater than that between human populations.

It is interesting to note that "differences" within human groups are just as pronounced as the differences among the groups themselves. Negroid people range in color from black to light yellowish-brown; Mongoloid people range from yellow, to white, to bronze-brown; Caucasoids range from pink (as in England) to dark brown (as in Southern India).

As a matter of fact, early studies of human diversity showed that most genetic diversity was found between individuals rather than between populations or continents, and that variation in human diversity is best described by geographic gradients, or clines.

A wide-ranging study published in 2004 found that 87.6% of the total modern human genetic diversity is accounted for by the differences between individuals, and only 9.2% between continents. In general, 5%–15% of genetic variation occurs between large groups living in different continents, with the remaining majority of the variation occurring within such groups.

These results show that when individuals are sampled from around the globe, the pattern seen is not a matter of discrete clusters, but rather gradients in genetic variation that extend over the entire world. Therefore, there is no reason to assume that major genetic discontinuities exist between peoples on different continents or "races".

As a matter of fact, skin color, to which most people refer when they speak of a "race" of people, is due to the brown pigment in the skin known as melanin. Melanin does far more than simply provide the body with pigmentation; its most important role is protecting the body by absorbing ultraviolet (UV) radiation from sunlight, which can damage the skin and produce skin cancer if not filtered out by the melanin.

The more melanin a person has, the darker the skin will be as an adult; conversely, the less melanin in the skin, the lighter the skin will be as an adult. A person whose skin possesses no melanin is referred to as an albino, and cannot produce body pigment. Such a person's pinkish-white color is due to blood vessels showing through the colorless skin.

The claim that there are many different skin colors in the world is thus not altogether accurate. There is only one coloring agent for the human race; the shade of color simply depends upon how much melanin is present.

Racial Roots

It has been suggested that, anatomically, modern humans first appeared in Africa about 200,000 years ago. In this model, one group remained in Africa, while at least one other group migrated out of Africa, and evolved into all non-African populations. Different characteristics would have arisen within this time span.

In humans, production of the skin coloring agent melanin is controlled by two pairs of genes; we can designate them Aa and Bb, the capital letters representing dominant genes and the small letters recessive genes. A and B, being dominant, produce melanin very well; being recessive, a and b produce less melanin.

A person born AABB carries genes for the darkest coloration possible, and since all genes are dominant, has no genes for lightness. If that person married another person who likewise carried all dominant genes, and moved to an area where no intermarriage with people of different colors occurred, the offspring resulting from this marriage then would carry the same dominant genes.

Conversely, if a person who is aabb, and thus the lightest possible, marries another person who likewise carries all recessive genes, and moves into an area where no intermarriage with people of other colors occurs, henceforth this union will produce only offspring of the lightest possible coloration.

However, starting with any two parents who were "heterozygous"—AaBb; that is, middle-brown in color—extreme racial colors could be produced in such a way that races would have permanently different colors.

Of course, it is also possible to produce a middle-brown race that will have a fixed middle-brown color. If the original middle-brown parents produce offspring of either AAbb or aaBB, and these offspring marry only others their own color, avoiding intermarriage with those not of their own genetic makeup, their descendants will be a fixed middle-brown color.

In reality, however, race mixing has not only been a fact of human history but is, in this day of unprecedented global mobility, taking place at a more rapid rate than ever. It is not farfetched then to envision the day when the entire "complexion" of major population centers will be different.

Not entirely genetic, at least some of the differences that arose can be attributed to the various environments in which the people found themselves. While it certainly is true that genes control melanin production, it also is true that the body has the ability to "respond" (adapt), within certain limits, to environmental pressures.

Accordingly, those people with darker skins who moved into equatorial regions could better adapt. Likewise, people with fairer skins who moved into Scandinavian countries would be favored, since darker-skinned people could not produce Vitamin D as easily, and therefore would suffer from such diseases as rickets. Environmental pressures, therefore, could affect the genetic machinery; at least to some extent.

Racial Genetics

The DNA of all people around the world contains a record of how living populations are related to one another, and how far back those genetic relationships go. Understanding the spread of modern human populations relies on the identification of genetic markers, which are rare mutations in DNA passed on through generations.

Different populations carry distinct markers. Once markers have been identified, they can be traced back in time to their origin—the most recent common ancestor of everyone who carries the marker. Following these markers through the generations reveals a genetic tree of many diverse branches, each of which may be followed back to where they all join—a common African root.

The mitochondria inside each cell are the power stations of the body; they generate the energy necessary for cellular organisms to live and function. Mitochondria have their own DNA, abbreviated mtDNA, distinct from the DNA inside the nucleus of each cell. mtDNA passes down from mother to offspring in every generation; the more female offspring a mother and her female descendants produce, the more common her mtDNA type will become.

However, mtDNA mutate across many generations; hence, mtDNA types have changed over the millennia. A natural mutation modifying the mtDNA in the reproductive cells of one woman will from then on characterize her descendants. These two fundamentals—inheritance along the mother line and occasional mutation—allow geneticists to reconstruct ancient genetic prehistory from the variations in mtDNA types that occur today around the world.

Population genetics often use haplogroups, which are branches on the tree of early human migrations and genetic evolution. They are defined by genetic mutations or "markers" found in molecular testing of chromosomes and mtDNA. These markers link the members of a haplogroup back to the marker's first appearance in the group's most recent common ancestor. Haplogroups often have a geographic relation.

A synthesis of mtDNA studies concluded that an early migration out of Africa, evidenced by the remains at Skhul and Qafzeh by 135,000 years to 100,000 years ago, has not left any descendants in today's Eurasian mtDNA pool.

By contrast, the successful migration of women carrying M and N mtDNA, ancestral to all non-African mtDNA today, at around 60,000 years ago, may coincide with the unprecedented low sea-levels at that time, probably opening a route across the Red Sea to Yemen.

Another study of the a subset of the human mtDNA sequence yielded similar results, finding that the most recent common ancestor of all the Eurasian, American, Australian, Papua New Guinean, and African lineages dates to between 73,000 years and 57,000 years ago, while the average age of convergence, or coalescence time, of the three basic non-African founding haplogroups M, N, and R is 45,000 years ago.

This information has enabled scientists to develop intriguing hypotheses about when dispersals took place to different regions of the world. These hypotheses can be tested with further studies of genetics and fossils.

The truth is, this subject is quite fascinatingly extensive and multifaceted that we would not possibly be able to cover it in one feature. This was just a simple overview that taps the surface of this mesmerizing, vast aspect of life, which surely continues intriguing our curiosity; we are sure to continue paying it our utmost attention because revealing its mysteries is sure to teach us a lot about ourselves and our true colors.

References

www.apologeticspress.org
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EAT a RAINBOW

Nutrition researches have shown that to obtain all the benefits our bodies need, our diet should contain an array of colorful foods. Fruits and vegetables contain different phytochemicals that are responsible for giving them distinct colors. Different groups of phytochemicals are associated with different healthful effects crucial for keeping us healthy and maintaining the different human body systems functioning properly. Phytochemicals help us sustain energy, and support our healthy growth and development. They also help in the prevention and treatment of many diseases, such as cancer, diabetes, heart attacks and osteoporosis. In order to remain healthy and energetic, always remember to eat according to the Rainbow Food Chart.

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