eXPRESSION

VERSION 4.0

BIOTECHNICAL ENGINEERING ASSOSIATION

National Institute of Technology Andhra Pradesh

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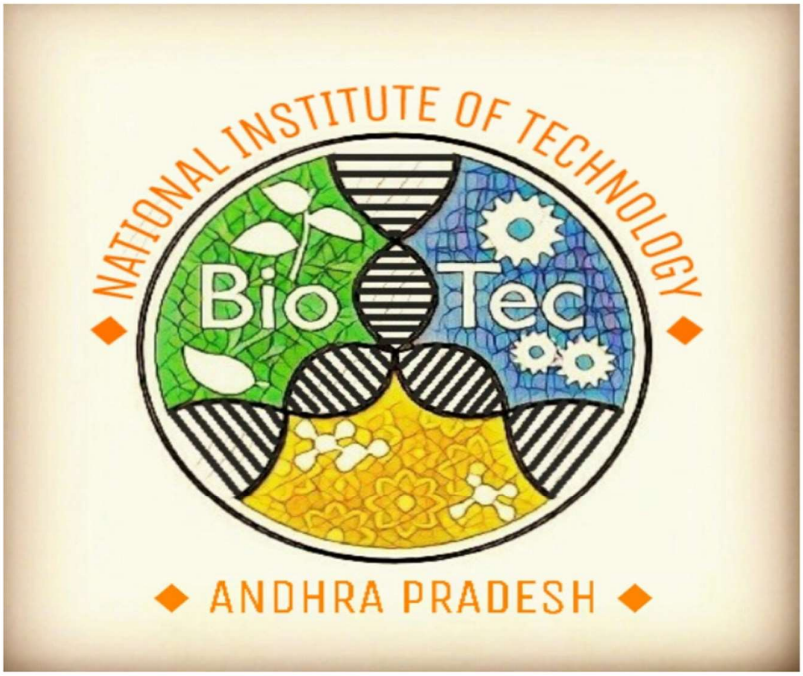
EXPRESSION 4.0

National Institute of Technology Andhra Pradesh



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EXPRESSION 4.0

National Institute of Technology Andhra Pradesh

Director's Message

National Institute of Technology a very young institute of national importance in the sun rising state of Andhra Pradesh has been witnessing a considerable growth since its inception from 2015.

The institute is eager and rich in nurturing biotechnologists to meet the challenges Of tomorrow and needs of our country. Biotechnology is the 3rd wave in biological science and an interface of basic and applied sciences, where gradual and subtle transformation of science into technology can be witnessed.

Biotechnology has a promising future and be accredited for revolutionary changes in human life through its technology. Recent advances in bio energy, bio remediation, synthetic biology, DNA Computers, Virtual cell, genomics, proteomics, bioinformatics ,nanotechnology have made significant effect in the societal needs and thus became more powerful.

Biotechnology is a golden tool to solve some of key global problems like global epidemic, fatal diseases, global warming, rising fuel crisis and above all poverty.

It is a great pleasure to see the creative expressions of N.I.T. AP B.Tech (Biotechnology) students who have contributed to the fourth edition of the magazine "Expression".

Readers will realize the tremendous efforts endowed by the students in laying a foundation to this magazine. The magazine is presenting a glimpse of their association activities and several areas of research being pursued in their field. It also holds the achievements of their talented students.

I wish the magazine is widely read, cherished and hope it will continue to inspire all the students of N.I.T. AP.

Biotechnology has also proved to be extremely productive and innovative and hope that the 21st century is century of you I am sure that our students will bear the flagship of N.I.T. AP to enormous heights. I wish to see students stand as responsible technocrats and leaders in the Nation Building. I wish the staff and students of the Department of Biotechnology success in their future endeavours. Good luck to every student pursuing their scintillating course of Biotechnology at N.I.T AP. God bless you all.

Prof C S P Rao,

Director NIT-AP.

National Institute of Technology Andhra Pradesh

Department of Biotechnology

Head of the department's Message

Greetings from the Department of Biotechnology!

The department was established in the year 2015 with an intake of 30 UG students. For the academic year 2020 - 2021 the intake has increased to 36 students. The department offers B. Tech, MS (by research, part-time) and Ph.D (full/part-time) programmes. Currently, the department has 6 Ph.D students. The department is in the process of establishing various labs which can be used by the students to perform laboratory experiments and research activities.

The biggest asset of our department is our faculty members who hail from reputed institutes with diverse research background. The students are constantly motivated to work in diverse research areas to address the socio-economic issues. The research activities performed by the students are showcased in several national and international conferences. The department is organizing several technical activities to improve the skills and job prospects of students. Recently, the department has signed MoU with Seagrass Pvt Ltd. and Dr. YSR horticulture university for training, placement and research. The progress of the department is reflected by the student's achievements in competitive exams such as GATE/ GRE, Campus placements (off/on campus) and admission for Master's programme in world class foreign institutions.

The general secretary and her team are actively involved in the various activities of the association. This magazine is one such endeavor. It gives me great pleasure to see all those activities and collective contributions made by our students. I congratulate them and wish them for their bright future.

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Dr. JAGAN MOHAN RAO

Head of the Department

Department of Biotechnology

National Institute of Technology Andhra Pradesh

Department of Biotechnology

Faculty Advisor's Message

It is a matter of immense pride to launch volume 3 of our Biotechnology Departmental magazine, 'EXPRESSION' initiated by members of Biotechnical Engineering Association (BEA).

This magazine is to bring into limelight the novel ideas and reading and writing proficiency of students. They are empowered to freely share their views and opinions on recent inventions and discoveries in the field of biotechnology. This magazine also discloses some advices from GATE toppers of our branch. We also disclose the details of students who secured admission for M.S, about the conferences attended and also about the placements. The students also share a report of BEA activities through this magazine.

I wish to convey my sincere thanks and gratitude to all the students who have contributed to this magazine in any possible way. I ardently thank the students and the administration for extending support in making this endeavor a success.

I truly hope the following pages keep you gripped to the magazine.

Dr Manasa P
Faculty Advisor,
Biotechnical Engineering Asssociation

Motto of BEA

AWARENESS ABOUT THE FIELD OF BIOTECHNOLOGY AMONG OTHER BRANCHES AND INTEGRATION OF MULTIPLE DISCIPLINES:

Generally, many people from other fields have a perception that Biotechnology is a field exclusively of biological sciences and have no importance in the field of engineering. In this regard we want to take an initiative and provide awareness about the course by converging it with other disciplines. This would bring out new inventions and create a whole new expertise. BEA provides a platform to share ideas and acknowledges it by any means to bring it into limelight. We also plan to invite esteemed guests who could give us an overview of Biotechnology.

ESTABLISHING COLLABORATIONS

We plan to interact with students and mentors from other institutes across the country and incorporate their best practices and views in our curriculum to perform research work and publish papers in symposiums.

CAREER COUNSELLING:

Inviting experts from the field of Biotechnology through which students would get to know their experiences, discuss career pathways and various opportunities Post Engineering.

PERSONALITY DEVELOPMENT:

As presenting an opinion with confidence is essential to thrive in any field, our association would organize events where students can present their opinion on a given topic and conduct group discussions

MAGAZINE PUBLICATION:

Magazine publication would be a mandatory endeavor from now on as it lays as a strong foundation for present practices and research in biotechnology. It is also, a medium through which the alumni would be able to communicate their thoughts with fresh batches that enter the institute.

EXTRACURRICULAR ACTIVITIES:

These would include interaction sessions with students of our branch, industrial trips, biotechnology inspired art and photography competitions, quizzes and games.

Acknowledgement

Members of Biotechnical Engineering Association (BEA) are grateful to our Director,

Dr. C. S. P. Rao for giving us an opportunity to launch the fourth edition of our association magazine, “Expression”.

We express our gratitude to Dr. Dinesh P Sankar Reddy, and Dr. Jagan Mohan Rao all the faculty of the Department of Biotechnology for their continuous support and co-operation.

This magazine is an outcome of the meticulous work done by Department of Biotechnology students. It is my privilege and immense pleasure to express deep sense of gratitude to D.D.S. Sampreeth for his meritorious and sincere efforts in bringing out this magazine.

I would like to render my heartfelt gratitude to our Faculty advisor Dr. Manasa P for her support and encouragement. Special thanks to BEA members and fellow students for their timely help and active participation in conducting various events held by the association.

JADALA VARSHINI,

General Secretary BEA

Executive body of BEA

The executive body of BEA, Department of Biotechnology, NIT Andhra Pradesh for the academic year 2020-21 led under the supervision of Dr. P Manasa as Faculty Advisor and consists of the following students:

HOD: Dr. Jagan Mohan Rao (9059867916) (hod_biot@nitandhra.ac.in)

Faculty Advisor: Dr. Manasa P (9740643471) (manasanaik710@gmail.com)

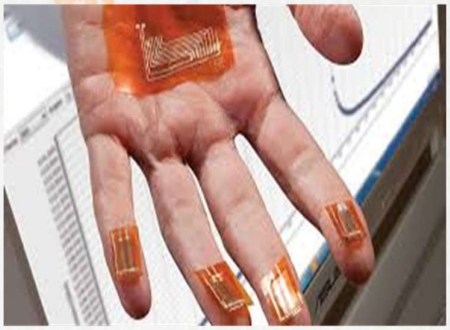
Designation	**Name of the student**	**Roll number**
Secretary	J.Varshini	111709
Additional Secretary	Matteda Hannah Susheela	111809
Executives (10)	E Aman Rao	111706
	V Rakesh	111720
	B Mounika	111702
	V Hemalatha Naga Lakshmi	111822
	Bhukya Venkatesh	111818
	Ujwal Pesaru	111818
	Dara saisrikari	111804
	Doddaboyina divya	111905
	Deyyala sai venkat	111904
	Wazir hasan ispahani	111917
Magazine Editor	D.D.S.Sampreeth	111705

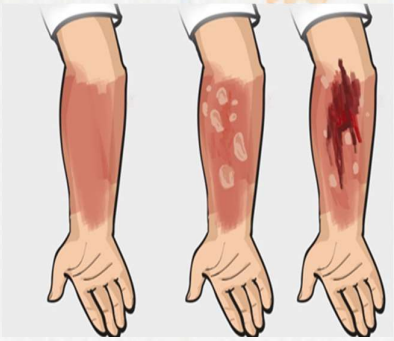
ARTIFICAL SKIN

J.VARSHINI
111709

What Is Artificial Skin?

The skin is a “smart”, multifunctional organ that is protective, self-healing and capable of sensing and many forms. Due to dermatological conditions, the research has gained the popularity over this material which are used for skin replacement. Artificial skins have been developed with properties and functionalities approximating those of natural skin.It all started with treatment of burns with the help of commercial products. Artificial skin is a collagen that includes regeneration of skin. This has been developed commercially under the name ‘intraTM’. Artificial skin also refers to flexible semi-conductor material that can sense touch for those with prosthetic limbs. The term ‘Artificial Skin’ is also used to refer skin/tissue growth in laboratories.



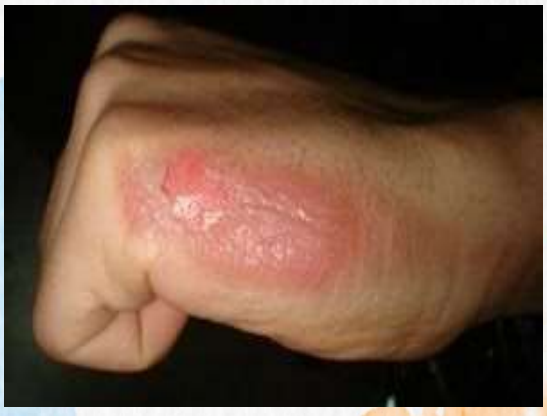


Advantages:

This Technology can be used during extensive skin burns. They can prevent the creation of additional wounds. Artificial Skin seals the wounds preventing fluid loss and bacteria from entering through the wounds. The fear of Stigmatization of the patient is eliminated

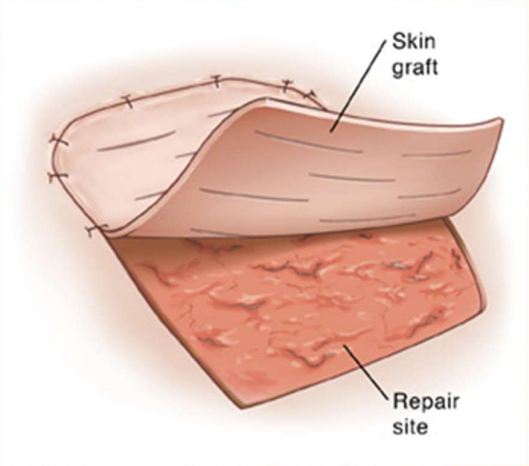
Disadvantages:

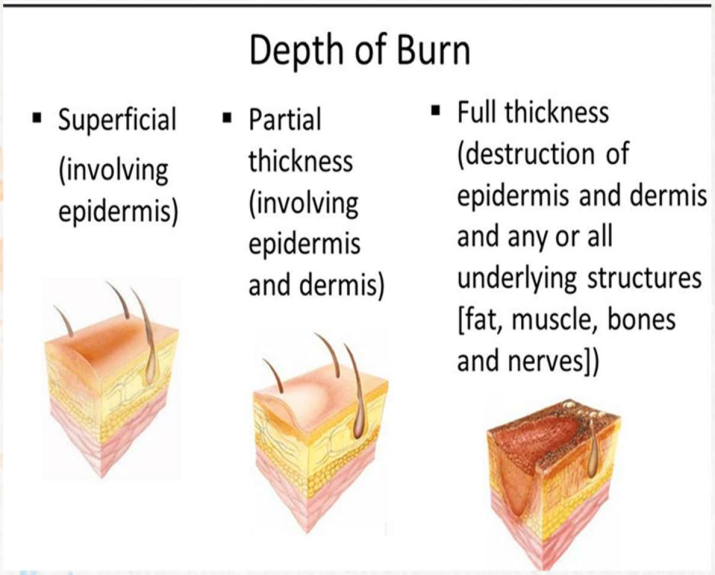
Due to high cost several people may not afford this kind of treatment. Skin Substitutes which are used may originate from species such as cows, pigs, etc which are culturally not accepted to all individuals. Tissues from other species may result in allergic reactions.



PRINCIPLE OF SKIN GRAFTS

Skin Grafting is a surgical procedure that involves removing skin from one area and moving it to different area of the body. In general, this surgery is done if the skin has burns, injuries or any other illness. They have Uni-laminar or bi-laminar membranes and are composed of synthetic biologic materials.



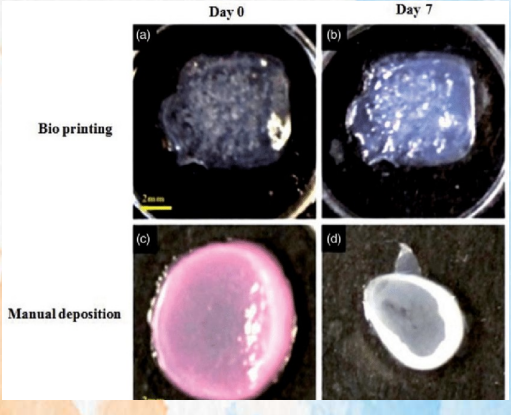


THE SURGICAL MANAGEMENT OF BURNED WOUNDS

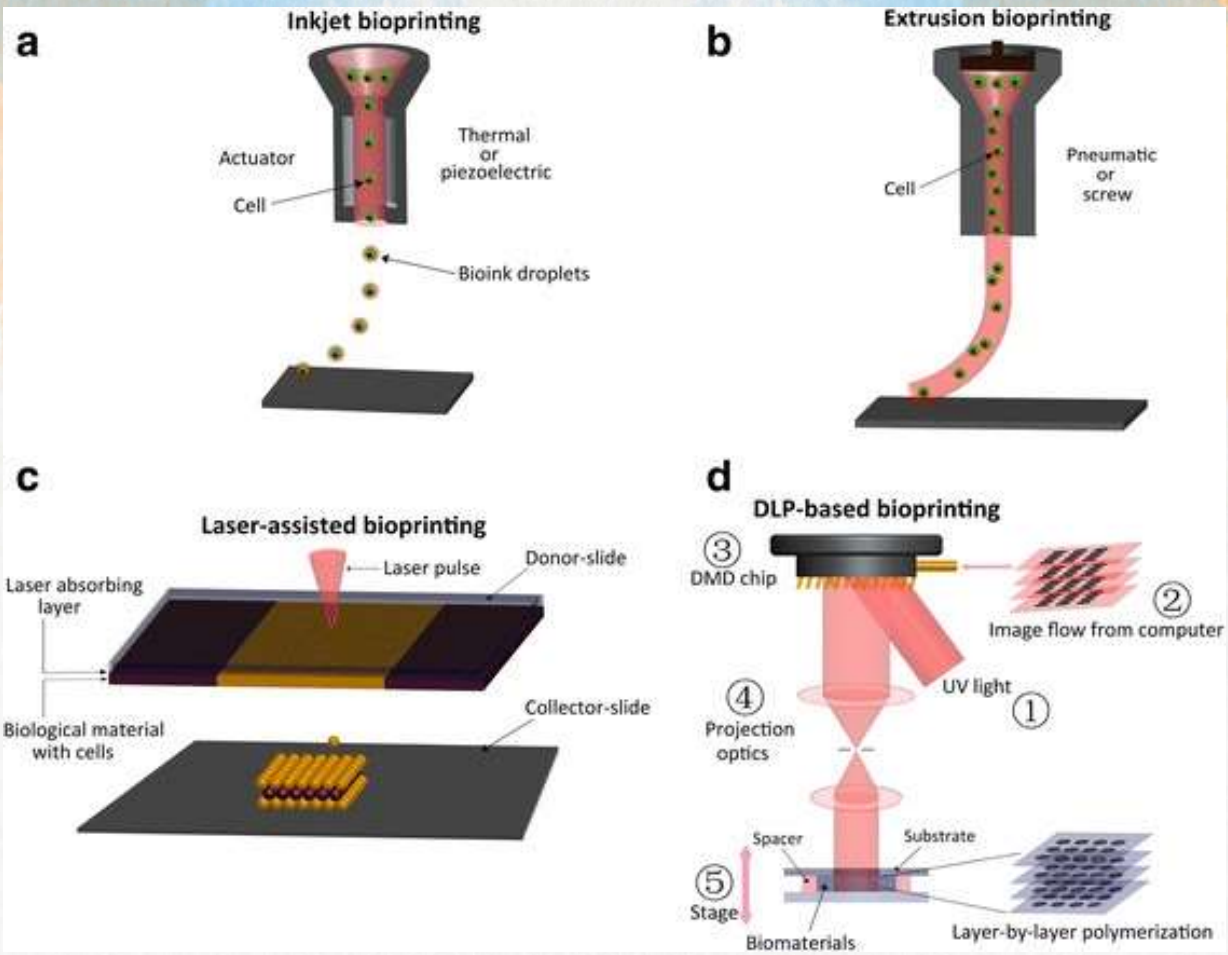
This was initially approved by the US FDA. Dermal substitutes for use in burn surgery have been commercially available since 1996. They all enable the application of an ultra-thin STAG (0.006–0.008 inches), called an epidermal autograph, to be applied to an appropriately vascularized dermal substitute. Most dermal substitutes require 1–3 weeks for vascularization following application to an excised burn wound bed. Apparent failure of their widespread adoption in burns are as follows: There are no high-quality data to support their efficacy or demonstrating reduced mortality/morbidity. They are very expensive. There are critical, surgeon-specific, human factors associated with their successful use resulting in a learning curve and the potential for wide interuser variability in results.

BIO PRINTING OF SKIN

Bioprinting is an additive manufacturing technology, which can deposit living cells, biomaterials and factors in the complex 3D constructs. High degree of flexibility and repeatability using a computer-controlled 3D printer to fabricate 3D structures via a layer-by-layer printing process.



There are many kinds of Bioprinting technologies, four of which are widely used at present: Inkjet-based printing, Extrusion-based printing, Laser-assisted printing, DLP-based printing—dynamic optical projection stereo lithography (DOPsL)



SKIN REPLACEMENT PRODUCT AND MARKET

Due to the advancement in technology the skin substitute and wound management is highly recommended. Skin substitutes are engineered dressings and designed to facilitate wound closures. They lack dermal appendages, an intact micro vascular network, immune cells or Melanocytes.

Skin substitute	Manufacturer	Origin	Structure
Apligraf	Organogenesis	Human fibroblasts, keratinocytes	bilayer
TransCyte	Advanced Tissue Sciences	Human fibroblasts, silicone sheet	dermal
Epicell	Genzyme Biosurgery	Autologous keratinocytes	epidermal

PLASTIC SURGERY

Plastic surgery is taken from the Greek word plastikos. Plastikos means to form or mold. Plastic Surgery is a special type of surgery that can change a person's appearance and ability to function. It involves the restoration, reconstruction, or alteration of the human body.

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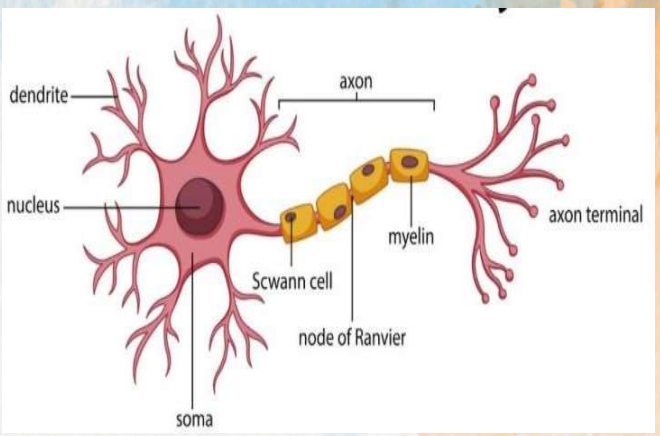
HODGKIN-HUXLEY MODEL & IT'S NEUROLOGICAL APLLICATIONS

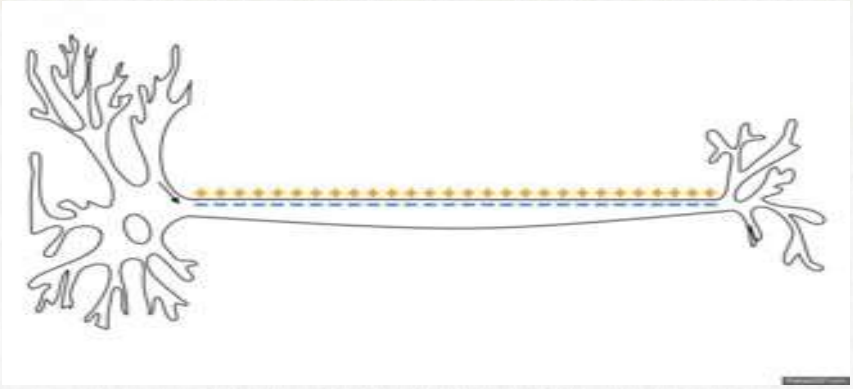
U.RACHANA
111718

Neuron and Action potential:

A neuron or nerve cell is an electrically excitable cell[1] that communicates with other cells via specialized connections called synapses. It is the main component of nervous tissue in all animals except sponges and placozoa. Plants and fungi do not have nerve cells. The signaling process is partly electrical and partly chemical. Neurons are electrically excitable, due to maintenance of voltage gradients across their membranes. If the voltage changes by a large enough amount over a short interval, the neuron generates an all- or-nothing electrochemical pulse called an action potential.

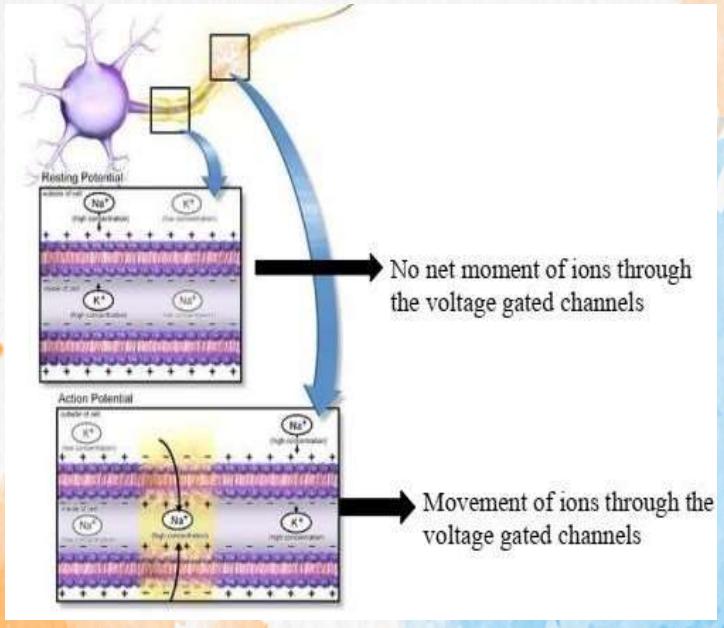


Neuron anatomy



Action potential moment in a neuron

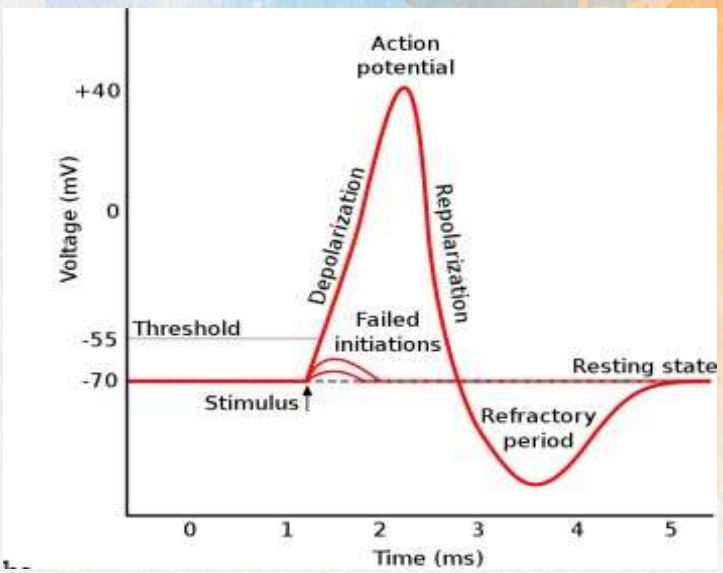
an action potential occurs when the membrane potential of a specific cell location rapidly rises and falls, this depolarization then causes adjacent locations to similarly depolarize. depolarization is a change within a cell, during which the cell undergoes a shift in electric charge distribution, resulting in less negative charge inside the cell. Depolarization is essential to the function of many cells, communication between cells, and the overall physiology of an organism.



Resting potential and action potential

Action potentials result from the presence in a cell's membrane of special types of voltage-gated ion channels. A voltage-gated ion channel is a cluster of proteins embedded in the membrane that has three key properties:

1. It is capable of assuming more than one conformation.
2. At least one of the conformations creates a channel through the membrane that is permeable to specific types of ions.
3. The transition between conformations is influenced by the membrane potential.



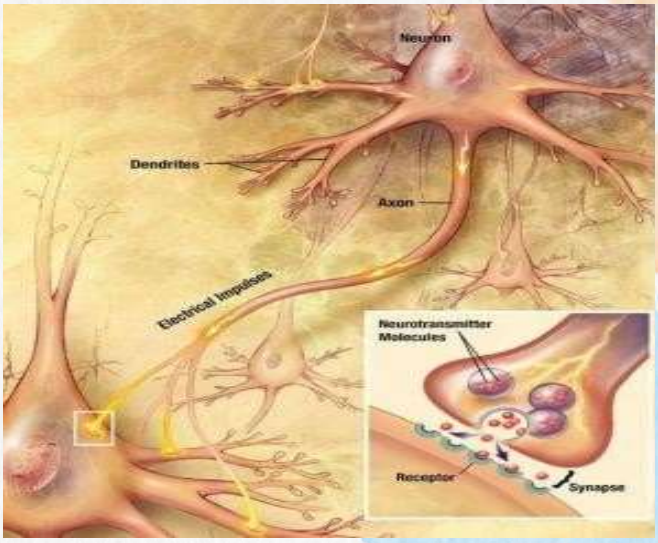
Events Occurred to Cause Action Potential

Initially in neuron the resting potential will be observed with no net moment of ions. When a stimuli like signal molecule bound to receptors the ion channel gates will opened to make theNa, K, Ca, Cl ions move through them

Neuron signal transduction:

Depolarization and repolarization caused by the moment of the positive and negative ions moves through the gates intra cellular and extra cellular vice versa. Binding failure or neurondamage may cause failure signaling transduction and no net moment in ion channels.

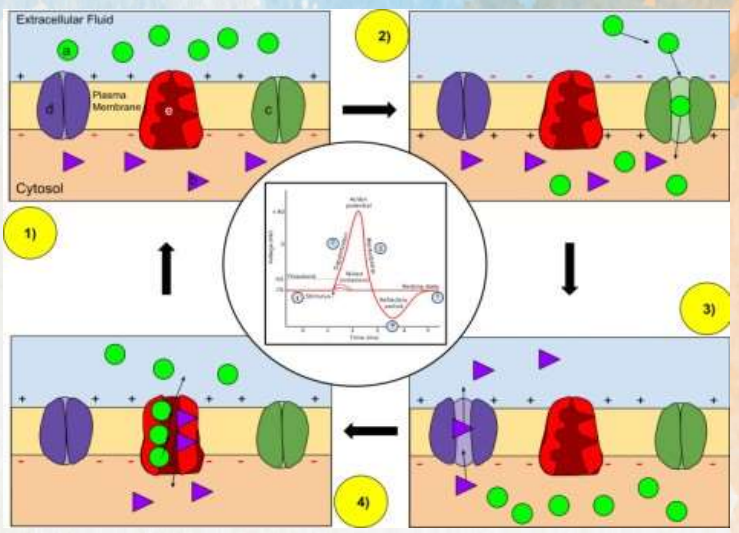
Refractory period occurred during the ion balance wrt to initial stage of the resting phase.



Signal molecules binding to the receptor at synapse

Neuron damage:

Although other cells die and are replaced, many neurons are never replaced when they die. The damage caused by multiple sclerosis can lead to the death of some of your neurons. If you lose too many neurons, you may develop permanent disability. The disability you experience relates to the neurons which are damaged. Physical damage to the brain and other parts of the central nervous system can also kill or disable neurons. Blows to the brain, or the damage. caused by a stroke, can kill neurons outright or slowly starve them of the oxygen and nutrients they need to survive.



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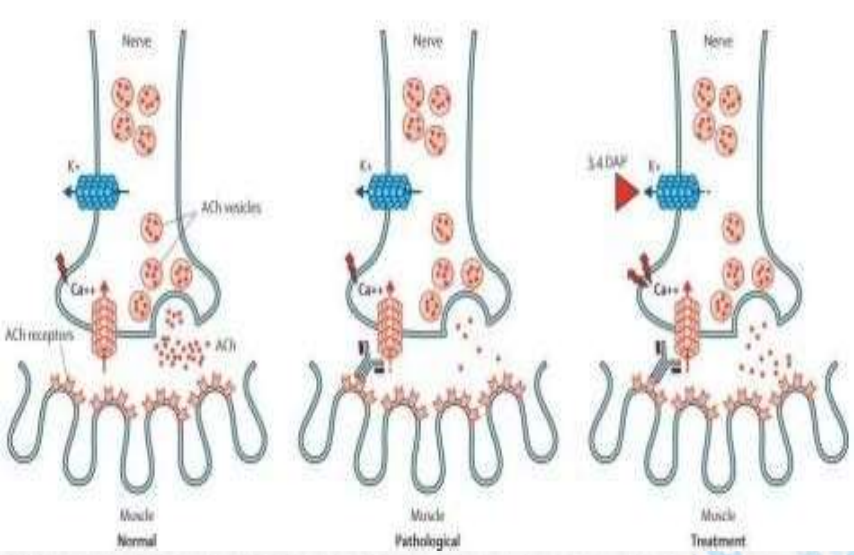
Some associated diseases with neural damage:

- ### Lambert-Eaton myasthenic syndrome:

  A disease in which the immune system attacks the body's own tissues. The attack occurs at the connection between nerve and muscle (the neuromuscular junction) and interferes with the ability of nerve cells to send signals to muscle cells.



Antibody preventing binding of Ach molecules to its receptors

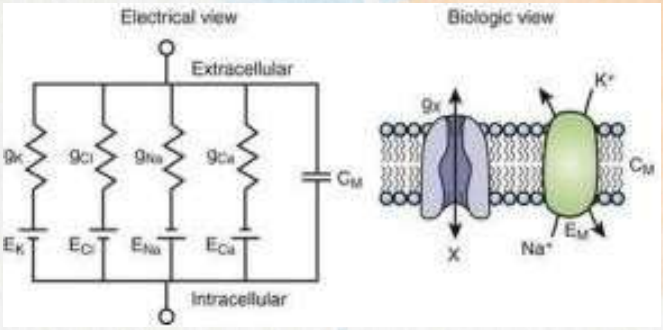
Cardiac channelopathies:

It is a genetic abnormality in heart cell proteins that control heart electrical activity and thus can cause heart rhythm disturbances.

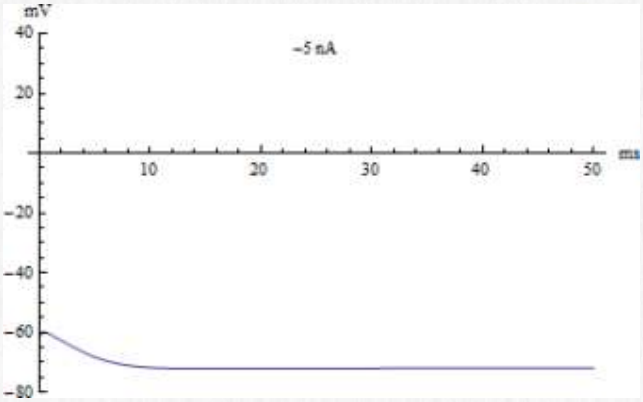
Hodgkin Huxley model:

The Hodgkin–Huxley model, or conductance-based model, is a mathematical model that describes how action potentials in neurons are initiated and propagated. It is a set of nonlinear differential equations that approximates the electrical characteristics of excitable cells such as neurons and cardiac myocytes.

It is a continuous-time dynamical system. The flow of currents within an axon can be described quantitatively by cable theory and its elaborations, such as the compartmentalmodel.



Equivalent electrical circuit to the cell membrane and ion channel



Oscilloscope simulation results of H-H model electrical circuit representing thepattern of action potential.

The lipid bilayer is represented as a capacitance (Cm), Mathematically, the current flowingthrough the lipid bilayer is written as[11]

$$I_c = C_m \frac{\mathrm{d}V_m}{\mathrm{d}t}$$

Voltage-gated ion channels are represented by electrical conductances (g_n, where n is the specific ion channel) that depend on both voltage and time. and the current through a given ion channel is the product[11]

$$I_i = g_i(V_m - V_i)$$

where I is the total membrane current per unit area, Cm is the membrane capacitance per unit area, gK and gNa are the potassium and sodium conductance per unit area, respectively, VK and VNa are the potassium and sodium reversal potentials, respectively, and gl and Vl are the leak conductance per unit area and leak reversal potential, respectively.[11]

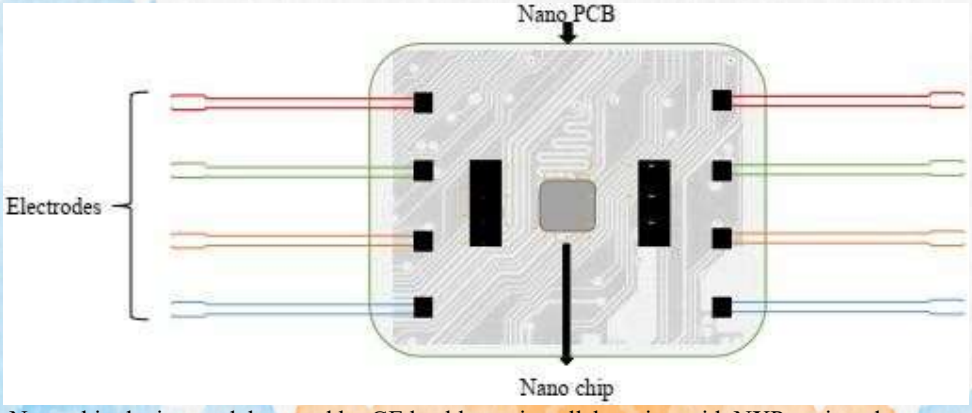
$$I = C_m \frac{\mathrm{d}V_m}{\mathrm{d}t} + g_K(V_m - V_K) + g_{Na}(V_m - V_{Na}) + g_l(V_m - V_l)$$

Other significant models derived based on H-H model:

Model	Highlights
Leaky integrate-and-fire	the memory problem is solved by adding a "leak" term to the membrane potential, reflecting the diffusion of ions that occurs through the membrane when some equilibrium is not reached in the cell
FitzHugh–Nagumo	nonlinear positive-feedback membrane voltage and recovery by a linear negative-feedback gate voltage
Morris–Lecar	voltage-gated calcium channel model with a delayed-rectifier potassium channel
The two state Markov model	The spiking neuron model by Nossenson & Messer produces the probability of the neuron to fire a spike as a function of either an external or pharmacological stimulus.

Table 1: Other neurobiological models

Components and improvising to practical model:

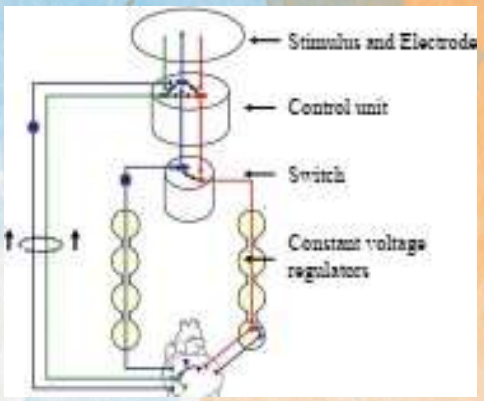


Nano chip device model created by GE healthcare in collaboration with NXPsemiconductors

application:

A combination of theoretical approaches and computer simulations, we test the hypothesis that enhanced modulation of synchronized excitatory neuronal activity in the gamma frequency range provides an advantage over a less synchronized input for various types of neurons. The results of this study show that the spike output of various types of neurons [i.e. the leaky integrate and fire neuron, the quadratic integrate and fire neuron and the Hodgkin– Huxley (HH) neuron] and that of excitatory–inhibitory coupled pairs of neurons, like the Pyramidal Intraneuronal Network Gamma (PING) model, is highly phase-locked to the larger of two gamma-modulated input signals. This implies that the neuron selectively responds to the input with the larger gamma modulation if the amplitude of the gamma modulation exceeds that of the other signals by a certain amount. In that case, the output of the neuron is entrained by one of multiple inputs and that other inputs are not represented in the output.

This mechanism for selective information transmission is enhanced for short membrane timeconstants of the neuron



Feed back assisted solution for the Cardiac channelopathies

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BIOMAGNETISM

D.D.S. SAMPREETH

111705

Introduction

Biomagnetism is a combination of two sciences;

1.Physics.

2.Biology.

It is the science where specifically designed magnets and their energy fields are used to affect the living system- the human body or what is called the Body electric. There are some basic physical laws that come into play with the body electric. The body electric is the energy flow found in the human body. Researchers through the years have identified that the healthy cell tissue quantitatively gives off a distinct high- negative, micro voltage charge (potential). When trauma, stress or malfunction occurs, the cell changes from its healthy strong negative potential, or in extreme cases changes to a positively charged state. When this occurs the nerve relay system immediately transmits the relay to the brain, which floods the problem area with healing negative charges to correct the chaotically charged cellular orientations. The negative field of a magnet is used most often to correctly stimulate and recognize the electron (spin) charge which results in creating the healthy cellular charge state of a strong negative potential. The primary point is that the properly designed Bio magnetic field can dynamically manipulate the electrical charge of the cellular tissue back to a normal, healthy condition- thereby return to health.

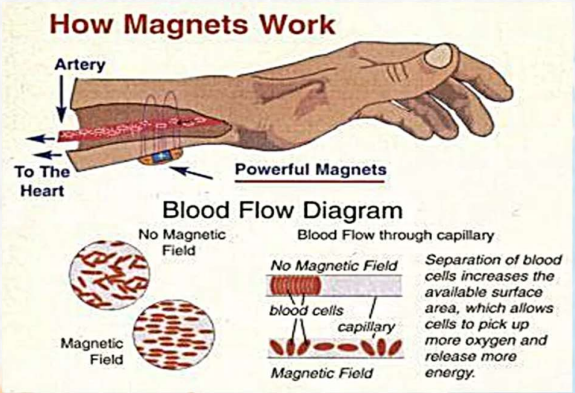
History of Biomagnetism:

Also known as the Bio magnetic Pair, it was discovered by medical doctor Isaac Goiz Duran in Mexico City, Mexico in October 1988. Although basically unknown in many countries, biomagnetism is practiced in many countries, especially in Central America, South America and parts of Europe. Dr. Isaac Goiz of Mexico first discovered the medically healing power of "pairs" of magnets over 26 years ago. His revolutionary discovery was inspired after he attended a course on bioenergy held at the medical school of the University of Guadalajara in Mexico, taught by Dr. Richard Broeringmeyer. Broeringmeyer researched methods of single pole magnets, including the effects of magnetic fields on living organisms. Dr. Broeringmeyer shared that the body's organs and tissues can become magnetically polarized. He used the technique of Kinesiology (muscle test) to locate magnetic polarizations (and pH alterations) in the body.

Biomagnetism therapy:

Inspired and enthused, Dr Goiz returned to Mexico and experimented with single-poled magnets in pairs and monitored the body's responses to these applications. Dr. Goiz discovered the first biomagnetic pair consisting of the thymus and rectum on one of his patients. Dr. Goiz calls this bi-focal relation between these two disease-causing points of the body the "biomagnetic -pair." In the years that followed, Dr. Goiz and his associates researched and uncovered hundreds biomagnetic pairs. Theses "parings" are meticulously tested in universities and hospital clinics in the United States, Mexico and Spain. Dr. Goiz found that by applying magnets to specific points the pH of the body is neutralized and the pathogens are killed off – they need specific pH values, either acidic or alkaline, in order to flourish. Since then, Dr. Goiz, has successfully treated over 350,000 patients using biomagnetism, and has reported over 25 years of successful results using the technique of biomagnetic pair therapy. Studies on the effectiveness of Biomagnetism have been and are currently being conducted in the United States and abroad including a "before and after" study.

Biomagnetism has been used when concerned with conditions such as: Acne, Allergies Alzheimer's, Anaemia, Anxiety, Arrhythmia, Arthritis, Asthmas, Diabetes, Digestive Disorders, Emotional Issues, Eczema, Fibromyalgia, Glandular Dysfunctions, Heartburn, Herpes, Attention Deficit Disorder (ADD), Autism, Back, Neck, Joints and Muscle Pain, Cancer, Carpal Tunnel, Chronic Fatigue, Chronic Pain, Depression, Migraines, Hepatitis, High Cholesterol, HIV, Impotency, Infertility, Low Libido, Lyme Disease, Lupus, Low Energy, Meningitis, Menopause and Pre



Application of Biomagnetism:

viruses and fungi have a symbiotic relationship where one is dependent on the other. Viruses provide the acidic environment necessary for fungi to grow. If we eliminate the viruses creating the acidic environment, we can then eliminate the fungi. Therapy for fungi is incomplete without the removal of their resonating viruses. A similar principal applies to bacteria and parasites. Parasites feed and grow from the consumption of bacteria. In order to properly eliminate parasites their food source, bacteria, must also be removed.

Examples:

In Biomagnetism, magnetism fields produced by organs or by magnetic contaminants of the body are studied. The example of the fields arising from iron-bearing proteins in human liver. Magnetic particles may be found in the lungs and stomach where these are commonly introduced by environmental exposures particularly for workers in industries dealing with iron or steel. Biomagnetism is a science and should be taken seriously. When proper protocols are followed Bio magnets can help the body heal itself of even chronic and long-term conditions.

Current research of Biomagnetism:

Biomagnetism has been growing rapidly and its applications have been extended from diagnosing neuronal or cardiac diseases to understanding the underlying mechanisms of human brain and heart. The development of new technologies in the field of biomagnetism has been led by researchers working in biomedical engineering and its associated disciplines. This special issue includes six high quality works showing recent technological developments in the field of biomagnetism.

Magnetoencephalography (MEG):-

Magnetoencephalography is a functional neuroimaging technique for mapping brain activity by recording magnetic fields produced by electrical currents occurring naturally in the brain, using very sensitive magnetometers. which measures magnetic fields produced by the human brain, became one of the major non-invasive imaging modalities to study human brain. Compared with its high temporal resolution, however, its spatial resolution is often limited due to several factors such as limited numbers of sensors, external noises and artifacts, inherently low signal-to-noise ratio (SNR), and cancellation of magnetic fields produced by multiple sources.

How’s biomagnetism is different from magnetic therapy:

It is not similar to magnet therapy. Their only similarity is they both use magnets. Magnet therapy uses a single pole magnet solely for dysfunction or injuries under two concepts: a) South pole as analgesic, b) North pole as anti-inflammatory. The magnetic fields used for this purpose are of low intensity (between 100 to 500 gauss) and are applied for longer periods of time, hours or days, and in areas that show specific symptoms. Biomagnetism, on the other hand, uses pairs of high intensity magnets (1,000+ gauss) placed in specific locations for a relatively short amount of time (10 to 90 minutes depending on the person’s location in relation to the equator).

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BONE FRACTURE

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111708

PRIMARY INFORMATION OF BONE

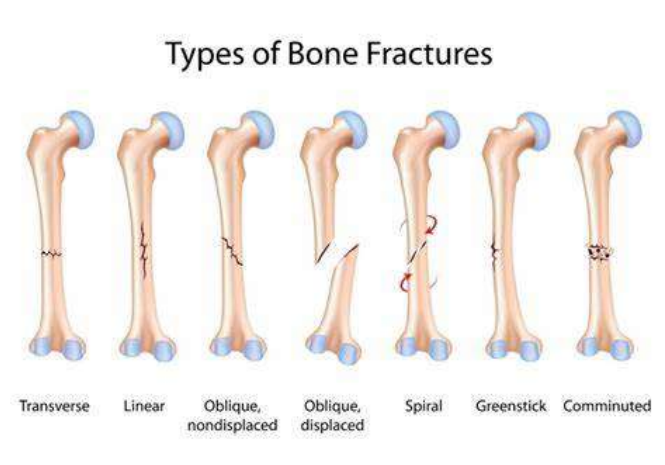
Adult human skeleton has a total of 206 bones Appendicular skeleton has 126 bones. Axial skeleton has 80 bones. Largest bone in the human body is femur or Thighbone Smallest & lightest bone in human body is Stapes. Thinnest bone is febula. Bone Made mostly of collagen, bone is living, growing tissue. Calcium phosphate is a mineral that adds strength and hardens Bone is a connective tissue. Cartilage is a resilient and smooth elastic tissue (in ear) Vitamin D : is necessary for strong bones and muscles. Without Vitamin D, our bodies cannot effectively absorb calcium. Children who lack Vitamin D develop the condition called rickets, which causes bone weakness.

ORTHOPEDIC

Orthopedic is the branch of surgery concerned with conditions involving the musculoskeletal system. Orthopedic surgeons use both surgical and nonsurgical means to treat musculoskeletal trauma, spine diseases, sports injuries, infections, tumors etc.

X-Ray of fracture

General fracture classifications: -



• Open (or) compound- bone protrudes out of skin
• Closed (or) simple- bone doesn't break through skin
• Complete- bone separates into 2 fragments
• Incomplete- bone does not separate into 2 fragments

Sign and symptoms of fracture Pain: -

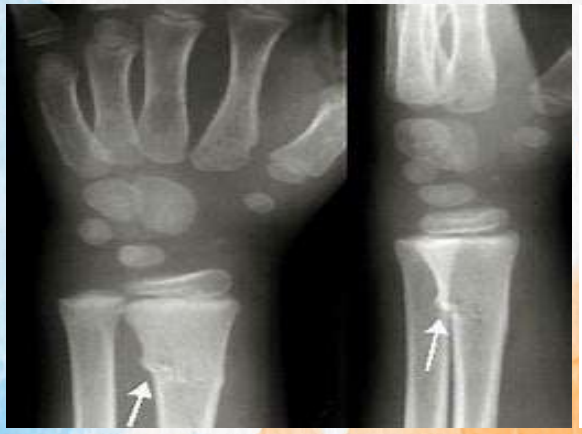
Signs and Symptoms of a Bone Fracture. The signs and symptoms of a bone fracture will depend on the severity and location of the injury. Generally, the symptoms include: Pain. Swelling. Difficulty moving. Bruising.

Effects of smoking: -

Smoking adversely affects bone mineral density, lumbar disc degeneration, the incidences of hip fractures and the dynamics of bone and wound healing. Clinical trials and demographic studies have been more widespread than biochemical analyses, and have reported poor prognosis for fracture patients who smoke.

Specific fracture classifications: -

Green-stick fracture- it's an incomplete fracture, In which one side of the bone breaks and the other side bends. It happens mainly in children.

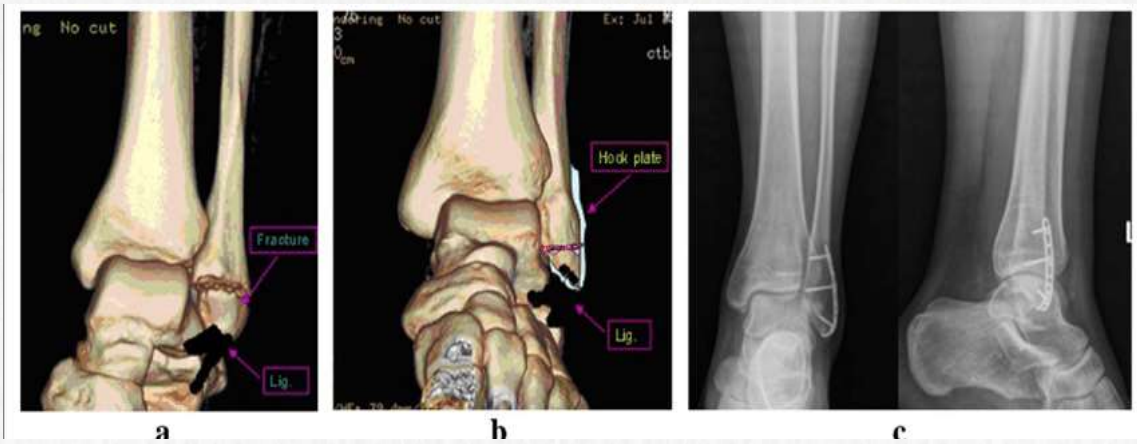


Comminuated fracture: -

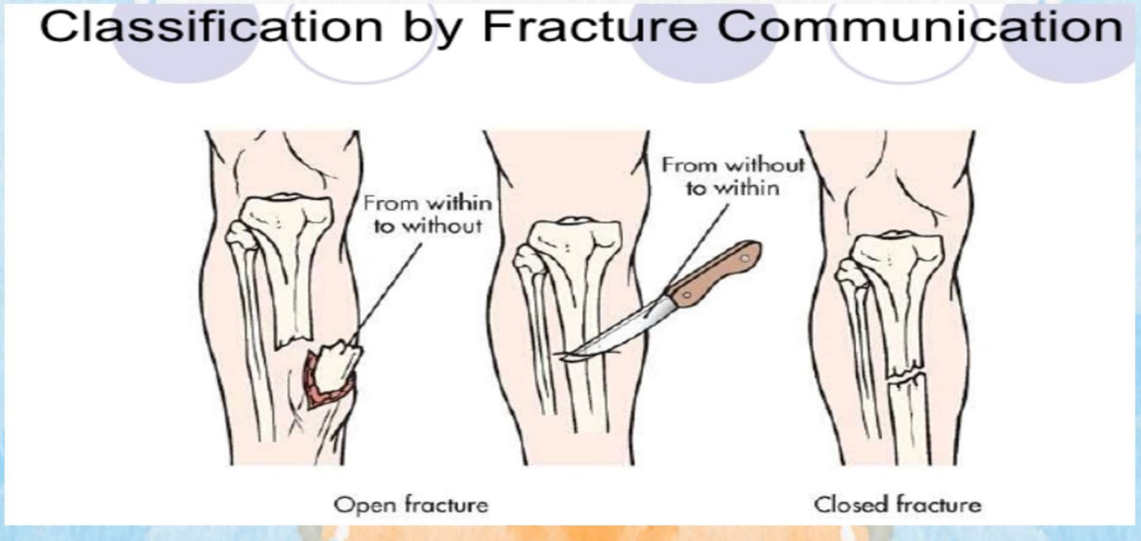
A fracture in which the bone breaks into more than two fragments, usually caused by severe forces. Impacted fracture- one end of the fracture is forcefully driven into the interior of the other. Stress fracture- A tiny crack in a bone caused by repetitive stress or force, often from overuse. Forces that can cause a stress fracture could include repeatedly jumping up and down or running long distances. Spiral fracture- fracture spiral down the bone, caused by a twisting force that creates an oblique fracture around and through the bone.

Avulsion fracture-

An avultion fracture is a bone fracture which occurs when a fragment of bone tears away from the main mass of bone as a result of physical trauma. This can occur at the ligament by the application of forces external to the body (such as a fall or pull) or at the tendon by a muscular contraction that is stronger than the forces holding the bone

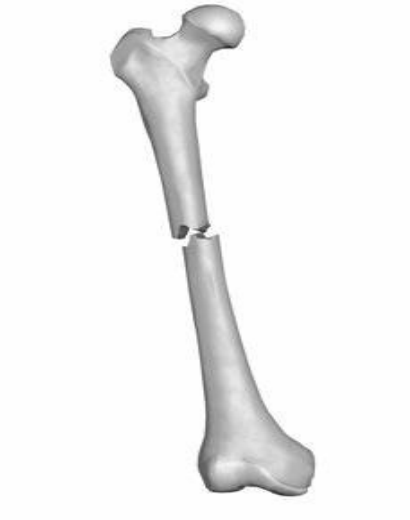


together. Generally muscular avulsion is prevented by the neurological limitations placed on muscle contractions. Highly trained athletes can overcome this neurological inhibition of strength and produce a much greater force output capable of breaking or avulsing a bone.



Transverse fracture-

Transverse fractures are complete fracture that transverse the bone perpendicular to the axis of the bone. The fracture involves the cortex circumferentially and there may be displacement.



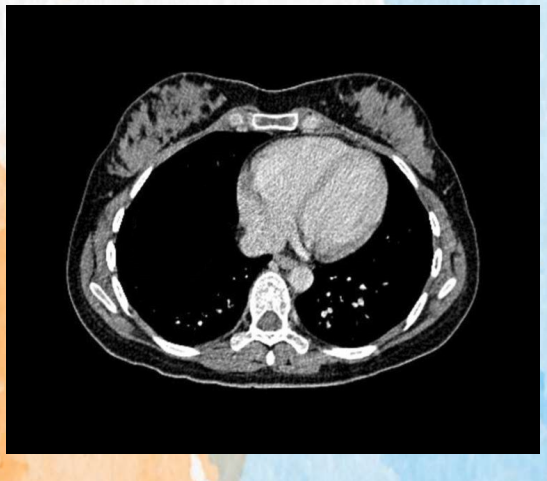
Oblique fracture-

An Oblique Fracture is a fairly common form of a broken bone in which the bone breaks at an angle, normally diagonally. The severity of Oblique Fractures is quite variable depending on the bone that breaks and the severity of the fracture.

Diagnosing bone fracture: -

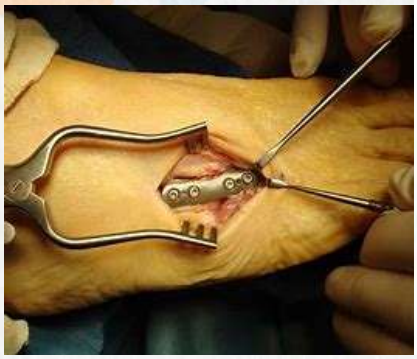
X-ray examinations- determines location and extent of fracture. Some fractures are difficult to see in an X-ray so CT (Computed tomography), scan, Magnetic resonance imaging (MRI), or other bones scans are used

1 .X-ray 2. CT scan



Treatment of fractures:

There are two types of treatments. External fixation: casts Internal fixation: surgery. Wires: used on the small fractures. Plates- hold two lengths of bone together with screws. Nails (or) rods- placed in canters of long bones and held in place with screws. Screws: most common method used by self (or) with other items.



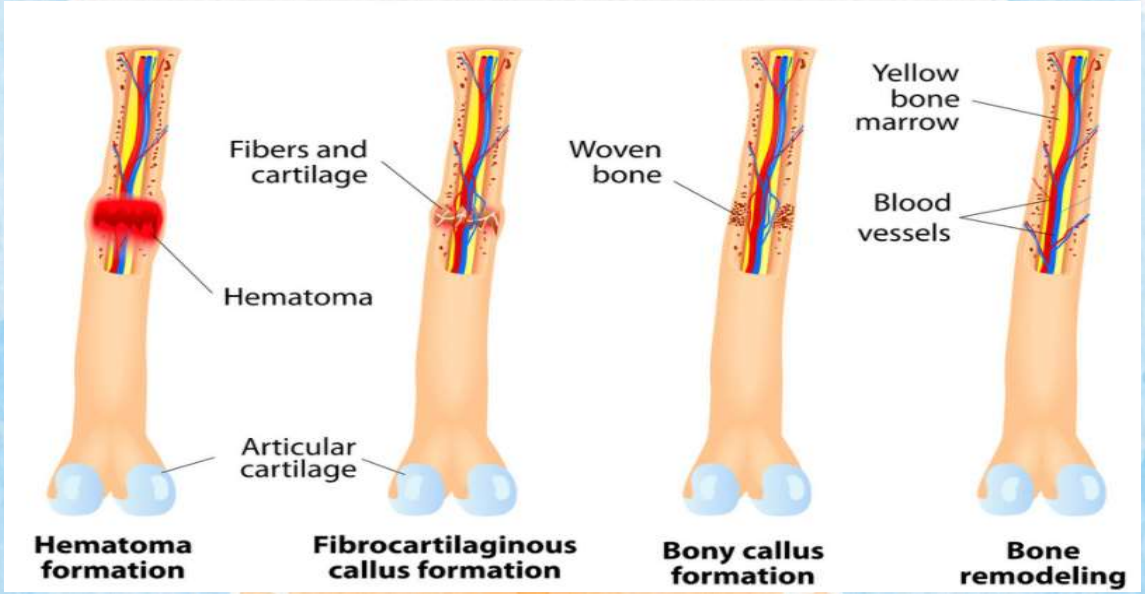
Fracture treatments: -

Healing of fractures: -

Healing time varies for each individual Healing time also depends on: Which bone was broken Severity of break, Age of individual and Bones take longer to heal the order that we get

Bone repair: -

When bone breaks, so do the blood vessels that supply the boneA clot forms in the damaged



area which Blood vessels and cells invade the clot and produce a fibrous network and cartilage between broken bones. Osteoblasts enter cullus and begin forming concellous bone. Concellous bone is remodeled to form compact and concellous bone. Where the Repair is complete.

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BIOLOGICAL COMPUTERS

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111711

What is Biological Computing?

Biological Computing means such a computing process which use synthesized biological components to store and manipulate data analogous to processes in the human body. The result is small; faster computing process that operates with great accuracy. Main biological component used in Biological Computing is: DNA. Biological computers are made from living cells. Instead of electrical wiring and signaling, biological computers use chemical inputs and other biologically derived molecules such as proteins and DNA. Just like a desktop computer, these organic computers can respond to data and process it. the fact that researchers have been able to get biological computers to complete logic gate is notable achievement

Potential of biological computers?

Once you've programmed a single biological cell, it's extremely cost-effective to grow billions more with only the cost of the nutrient solutions and a lab tech's time. It's also anticipated that biocomputers might actually be more reliable than their electronic counterparts. To illustrate, think about how our bodies still survive even though millions of our cells die off, but a computer built from wires can stop functioning if one wire is severed. In addition, every cell has a mini-factory at its disposal, so once it's been programmed, it can synthesize any biological chemical. Instead of what's done today when bioengineers map genes and try to uncover their secrets, they can just program cells to do the job they need them to do — for example, program cells to fight cancer or deliver insulin to a diabetic's bloodstream.

Challenges of biocomputing?

Although biocomputing has similarities with biology and computer science, it doesn't fit seamlessly with either one. In biology, the goal is to reverse engineer things that have already been built. Biocomputing aims to forward engineer biology. Experts in computer science are accustomed to machines executing programmed commands; when dealing with biological environments in what is known as a "wet lab. The culprit could be the cell's programming, or it could easily be something external such as the environmental conditions, nutrition, or timing.

How are the Computer Systems Similar to Biological Organisms?

Two of the terms used in biological computing are “genetic algorithms” and “neural networks.” Both of these refer to the ability of computing systems to learn and to make decisions based on the information they are given. Human brains contain an average of 86 billion neurons that transmit and process information. Neural networks are artificial systems built on the same principle. Genetic algorithms are code sequences that help the computer decide upon a course of action based on predetermined or predicted outcomes. Regular computers must be programmed for every reaction, but biologically-based computers could use the data to evaluate and “learn” how to react.

What is the Future of Biologically-based Computers?

Biologically based computing is not just making computers that resemble organic functioning. It also may involve using organic material to build the computers, such as the magnet-making bacteria used in experiments in the UK. As the machines become more sophisticated, they will be used in increasingly complicated tasks. For instance, many genetic diseases are the result of faulty DNA, like the missing comma in the space shuttle example. A computer system that can isolate the faulty “code” can someday fix it. Interestingly, one of the best uses, according to quora is the construction of simulated organisms in applications to study how they will react to certain environments. Mimicked life will mimic life. In fact, today biocomputing is science fiction becoming just accepted science.

Differences between biological & traditional computers?

Types of Biological Computers?

- Bio chemical computers.
- Bio-mechanical computers.
- Bio-electronic computers

1. Bio-chemical Computers

Feedback loops. Characteristic biological chemical reactions, where as Positive and Negative Feedback**.** Unusual concepts are biochemical computers, such as the DNA computer, and the quantum-mechanical computer. The following presents both of these concepts although their realizations are still far away. Both examples show that it is important to enlarge the scope beyond the nanoelectronics implemented in solid-state materials. In this challenging case we have to consider all possible ways that lead to an efficient parallel processing

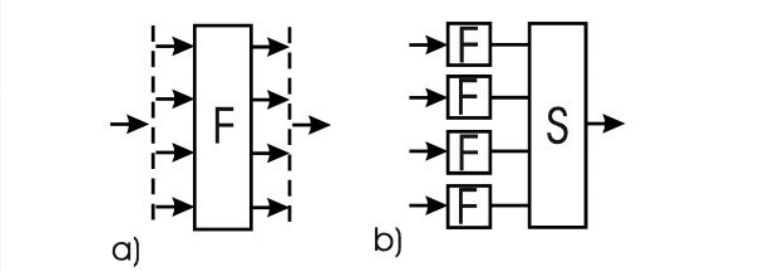
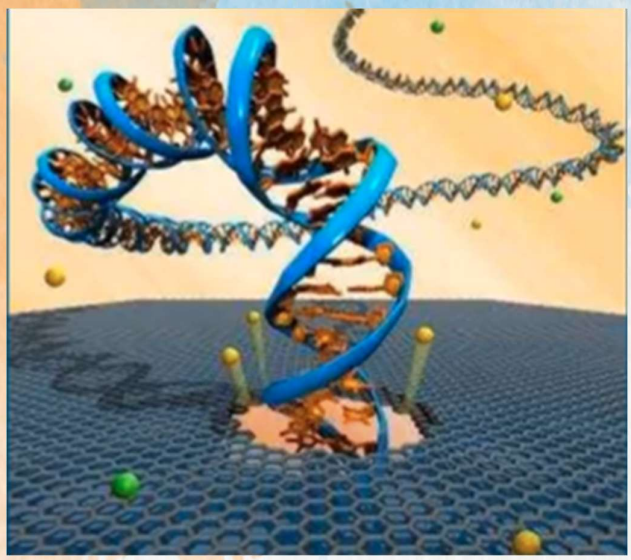


Fig. 5.1. Two unusual concepts for parallel processing: (a)quantum-mechanical computer, (b) DNA computer, processing unit (F), selector (S)

Information Processing with Chemical Reactions

If we regard the excellent solutions for information processing of nature it is obvious to copy them. An example of this is the DNA computer that carries out the computations by chemical reactions. The data are molecules inside a test tube. By adding extra substances, the intended reactions are carried out whereas a robot can automatically perform all mechanical operations and measuring techniques In this concept the single molecules are the nano computers producing a huge number of solutions. The problem is to find the correct solution among the enormous number of results.



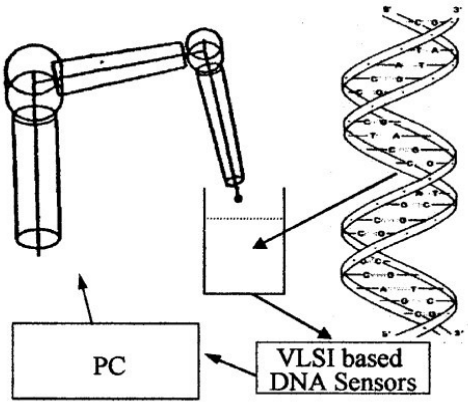


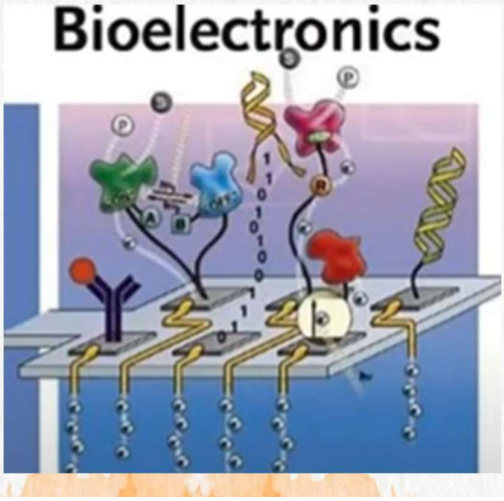
Fig. 5.2. Principle of a DNA computer: The information process occurs in a test tube, a robot can handle the operations automatically

2. Bio-mechanical computers

Similar to biochemical computers, Difference-output signal, Rely on nature of specific molecules**.** Three-dimensional structure and the increasing availability of computational resources will lead to more and detailed complex models of the human body.

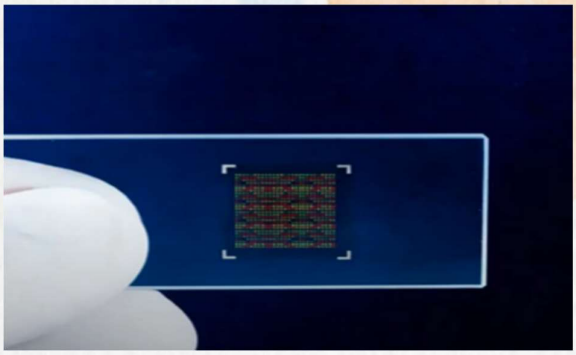
3. Bio-electronic computers

Range of topics (Biology, medicine, security), Heavy research focus, Act as electronic computers



DNA molecular machines have great potential for use in computing systems. Since Adleman originally introduced the concept of DNA computing through his use of DNA strands to solve a Hamiltonian path problem, a range of DNA-based computing elements

have been developed, including logic gates, neural networks, finite state machines (FSMs) and non-deterministic universal Turing machines. It has also been established that DNA molecular machines can be controlled using electrical signals and that the state of DNA nanodevices can be measured using an electrochemical readout. However, to the best of our knowledge there has as yet been no demonstration of a fully integrated biomolecular computing system that has multiple levels of information processing capacity, can accept electronic inputs and is capable of independent operation.

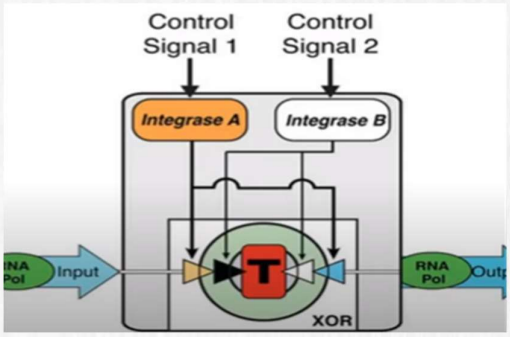


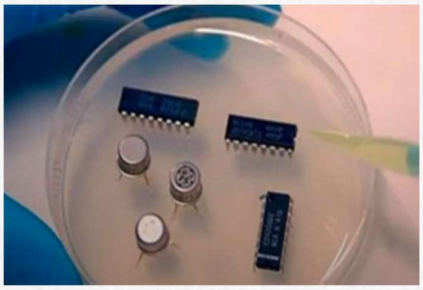
Origin

- Started out in test tubes
- Moved to gold plated “chips

Biological transistors

- Made of DNA & RNA, called a “transcriptor”, Enzyme flow vs electrical current, combined to implement logic gates





Applications: Medical industry (Genetic recombination, Personalized medicine), Mass data storage, Novel ways of data transmission, Solving of complex problems

Advantages of biomolecular computers are Massive parallel processing of data. Expanded capacity of storing information and Compatibility with living organisms. Dis-advantages of biomolecular computers are Organic compounds degrade, Hard to analyze results, not accurate, Requires constant supply of proteins and enzymes.

Conclusion

Biological computers showing enormous potential. especially for medical purposes as well as data processing applications. Still a lot of work and resources required to develop it into a fully-fledged product.

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BIO-MECHATRONICS

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Biomechatronics:-

Biomechatronics is the merging of man with machine -- like the cyborg of science fiction. It is an interdisciplinary field encompassing biology, neurosciences, mechanics, electronics and robotics. Biomechatronic scientists attempt to make devices that interact with human muscle, skeleton, and nervous systems with the goals of assisting or enhancing human motor control that can be lost or impaired by trauma, disease or birth defects.

Consider what happens when you lift your foot to walk:

The motor centre of your brain sends impulses to the muscles in your foot and leg. The appropriate muscles contract in the appropriate sequence to move and lift your foot. Nerve cells in your foot sense the ground and feedback information to your brain to adjust the force, or the number of muscle groups required to walk across the surface. You don't apply the same force to walk on a wooden floor as you do to walk through snow or mud, for example. Nerve cells in your leg muscle spindles sense the position of the floor and feedback information to the brain. You do not have to look at the floor to know where it is. Once you raise your foot to take a step, your brain sends appropriate signals to the leg and foot muscles to set it down. This system has **sensors** (nerve cells, muscle spindles), **actuators** (muscles) and a **controller** (brain/spinal cord). In this article, we will find out how biomechatronic devices work using these components, explore the current progress of biomechatronic research and learn about the benefits of such devices.

Biomechatronic Components

Any biomechatronic system must have the same types of components:

Biosensors

Biosensors detect the user's "intentions." Depending upon the impairment and type of device, this information can come from the user's nervous and/or muscle system.

The biosensor relates this information to a controller located either externally or inside the device itself, in the case of a prosthetic. Biosensors also feedback from the limb and actuator (such as the limb position and applied force) and relate this information to the controller or the user's nervous/muscle system.

Biosensors may be wires that detect electrical activity such as **galvanic detectors** (which detect an electric current produced by chemical means) on the skin, needle electrodes implanted in muscle, and/or solid-state electrode arrays with nerves growing through them.

Mechanical Sensors

Mechanical sensors measure information about the device (such as limb position, applied force and load) and relate to the biosensor and/or the controller. These are mechanical devices such as force meters and accelerometers.

Controller

The controller is interfacing the user's nerve or muscle system and the device. It relays and/or interprets intention commands from the user to the actuators of the device. It also relays and/or interprets feedback information from the mechanical and biosensors to the user. The controller also monitors and controls the movements of the biomechatronic device.

Actuator

The actuator is an artificial muscle that produces force or movement. The actuator can be a motor that aids or replaces the user's native muscle depending upon whether the device is orthotic or prosthetic.

ORTHOTICS VS. PROSTHETICS

Orthotic devices artificially assist human movement without replacing the impaired limb. In contrast, **prosthetic devices** replace the lost or injured limb to restore movement.

Why use biomechatronics rather than conventional orthotic/prosthetic devices? While many new orthotic/prosthetic devices use microelectronics and robotic components, they cannot accurately emulate the complex motions of human limbs.

Current orthotic/prosthetic devices do not feedback to people or adjust to variable loads or complex terrains. They do not adjust on a moment-to-moment basis to the individual wearer. Biomechatronic devices promise to overcome these limitations by interfacing directly with the wearer's muscle and nervous systems to assist/restore motor control.

Biomechatronics Research

Several laboratories around the world conduct research in biomechatronics, including MIT, University of Twente (Netherlands), and University of California at Berkeley. Current research focuses on three main areas:

1. Analyze human motions, which are complex, to aid in the design of biomechatronic devices
2. Study how electronic devices can be interfaced with the nervous system (implantable electrodes in brain and muscle, surface galvanic electrodes on skin)
3. Test ways of using living muscle tissue as actuators for electronic devices

Analyze Human Motions

Human motions are complex, whether it be reaching for a glass or walking over rough terrain. We must understand how humans move so that we can design biomechatronic devices that effectively mimic and aid human movement.

Dr. Peter Veltink and colleagues at the University of Twente are analysing walking movements (gait analysis) by measuring body movements with camera systems, ground reactive forces with force meters, and muscle activity with electromyograms (recordings of the electrical activity produced by muscle contractions). The analysis of normal and impaired patients will help understand free walking motions and diagnose specific gait problems in impaired patients. Veltink's group similarly evaluates balance control while walking and standing.

Dr. Hugh Herr's Biomechatronics group at MIT uses computer models and camera analyses of movement to study balance, leg retraction during running, and angular momentum conservation during walking.

Interfacing Electronic Devices with Humans

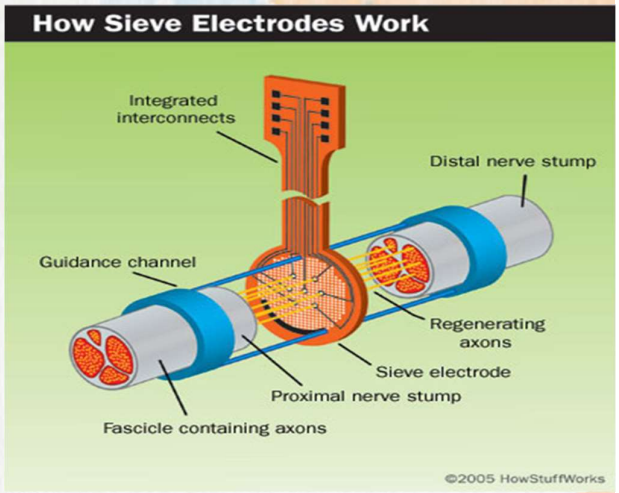
An important aspect that separates biomechatronics devices from conventional orthotic and prosthetic devices is the ability to connect with the nerves and muscle systems of the user so he can send and receive information from the device. Peter Veltink's group in the Netherlands is using implantable electrodes to stimulate the calf muscles. They are developing sensing and control methods for the dorsiflexor muscles, which lift the foot during walking. This will help to treat paralysis and stroke victims who cannot control this foot during walking (i.e. dropped foot).

Hermie Hermens and Laura Kallenberg of Veltink's group are using electrodes placed on the skin to monitor the electrical activity of the underlying muscles (**electromyography**) rather than using electrodes implanted directly into them. This reduces pain and discomfort and may also be a pathway for 2-way communication.

Veltink's group is also using electromyogram surface electrodes for feedback and control of lower-leg prosthetics. In the prosthetic, the knee angle is detected and the information is relayed by electromyography to the stump muscles in the amputated leg. The wearer can sense the activity and be taught to interpret it. Eventually the electrical activity of the stump muscles might be used to control the prosthetic.

Hugh Herr and MIT Biomechantronics

Hugh Herr's group at MIT is developing a **sieve integrated circuit electrode** (an integrated circuit is a tiny plastic chip with an entire electrical circuit imprinted on it). In this setup, two stumps of nerve are connected through a **guidance channel** (a small tube that keeps the nerve endings close to each other). In the channel, there is a sieve with each hole connected to an electrode on an integrated circuit board. As the nerve fibers grow through the holes to connect with each end, they contact the electrodes, thereby creating an interface.

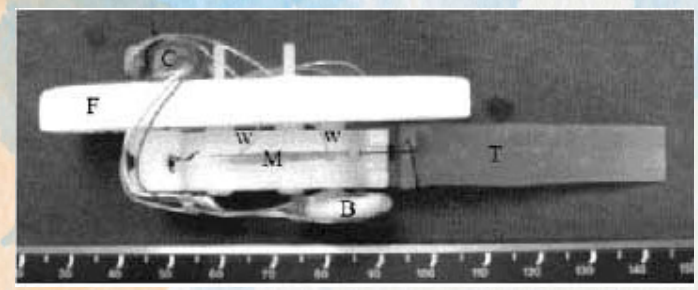


Advanced Orthotics and Prosthetic Devices

Hugh Herr's lab is also making prosthetic devices that better mimic true human movements

A knee prosthesis senses knee force, torque, and position and adjusts the swing and movement of the knee to the individual user. In the knee is a **magnetorheologic fluid**, which is oil containing a suspension of tiny iron particles (0.1-10 microns in diameter). An electromagnetic field applied across the oil can change the thickness or viscosity of the fluid because the iron particles form chains as they align with the magnetic field. Because the viscosity of the fluid can be adjusted by fine tuning the electromagnetic field, this controls and adjusts the resistance of the knee on a moment-to-moment basis, thereby giving the user a realist gait. To treat drop foot gait, an orthotic device was developed that controls and varies the stiffness of the ankle joint on a moment-to-moment basis as the user steps forward. This device gives the user a more normal gait than current orthotic devices

Current and Future Uses of Biomechatronics



MIT's Biomechatronic Robotic Platform. The main components of the system are: semitendinosus muscles (M), Styrofoam float (F), electrode wires (w), cast silicone tail assembly (T), lithium batteries (B), and encapsulated microcontroller, infra-red sensor, and stimulator unit (C).

Most actuators that are used in orthotic and prosthetic devices are electrical motors or electrical wires that shrink when current is passed through them. While these devices can provide contractile force, they do not come close to mimicking the dynamic flexibility of living muscle tissue. But what if you could make real muscle actuators? In Hugh Herr's laboratory at MIT, they have made a robotic fish that propelled by living muscle tissue taken from frog legs.

The robotic fish had the following components:

A styrofoam float allows the fish to float, Electrical wires make the connections, A silicone tail provides the swimming force, Lithium batteries provide power, A microcontroller control the robot's movement, An infrared sensor enables the microcontroller to communicate with a handheld device, A stimulator unit electrically stimulates the muscles

The frog muscles were attached to either side of the tail and to the plastic spine of the robot and electrodes from the stimulator were attached to them. The muscles on either side were alternately stimulated to produce a swimming motion. The robotic fish was placed in a tank of salt solution designed to keep the muscles alive. The fish swam for 4 hours out of 42 with a velocity greater than 75 percent of its maximum. The robot could swim forward, backward, turn, and stop. This was a prototype of a biomechatronic device with a living actuator.

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NANOMEDICINE

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ABSTRACT: -

The application of nanotechnology for medical purposes has been termed nanomedicine and is defined as the use of nanomaterials for diagnosis, monitoring, control, prevention and treatment of diseases.

Nanoparticles are materials with overall dimensions in the nanoscale i.e., under 100nm.

Physical features of nanoparticles

Size

NPs are small, with at least one dimension in the range of 1 to 100 nm, although they can also be micrometer (μm)-sized particles. NPs have novel structural, optical, and electronic properties that many larger molecules or bulk solids. They also have improved solubility, so they may be used to bulk drug counterparts that are known to have poor solubility.

This property may provide the ability to convert insoluble or poorly soluble drugs into soluble aqueous suspensions, thus eliminating the need for toxic organic solvents. Another benefit related to the small size of NPs is an increased bioavailability and circulation time. particles under 200 nm have longer circulation times, compared with larger particles, irrespective of any surface modifications present.

Shape

NPs come in a variety of shapes, including spheres, discs, hemispheres, cylinders, cones, tubes, and wires. NPs can also be hollow, porous, or solid. These characteristics of NPs can be selected on the basis of interactivity, loading capacity, and transport capabilities. For example, a hollow NP may be an attractive carrier for drug therapies or imaging contrast agents.

Surface area

NPs that gives them unique physical properties is a large surface area relative to size. As particle size decreases, total surface area increases exponentially. An increase in surface area means that a greater proportion of atoms are located on the particle surface relative to the core. This phenomenon makes NPs more reactive compared with conventional larger

molecules. Increased surface area is also responsible for the enhanced water solubility and bioavailability that often occur with NPs.

Permeability

If NPs are properly designed, their small size can enable them to cross physiological barriers to deliver drugs to sites that are not normally accessible by traditional means. For example, the increased permeability of an NP may allow it to transport cancer drugs into tumors by passing through pores that are less than 1 μm in diameter. The increased permeability of NPs may also allow them to cross the blood–brain barrier through the use of different uptake mechanisms.

Specific nanoparticles and nano materials

A wide variety of NPs and materials are used in nanomedicine, depending on the application. Among the most widely used are liposomes, polymers, quantum dots, iron oxide particles, and carbon nanotubes and nano shells.

Liposomes

A liposome is a spherical vesicle composed of a lipid bilayer membrane and an empty core that usually carries an aqueous solution. Liposomes are usually 90 to 150 nm in diameter and are thus slightly larger than conventional NPs. Liposomes are often designed to carry biomolecules (e.g., monoclonal antibodies, antigens) that are conjugated to the surface as ligands.

Liposomes are often used in nanomedical research because they have many unique properties. The components of liposomes are similar to natural human cell membranes; thus, they confer liposomal drug delivery with several intrinsic benefits. Liposomes circulate in the bloodstream for an extended time, compared with non-liposomal drugs, providing a longer treatment effect.

Polymers

Polymer NPs are widely used in nanomedical research. Polymer NPs can be fabricated in a wide range of varieties and sizes, ranging from 10 nm to 1 μm. Some polymer NPs can facilitate drug release for weeks and do not accumulate in the body. As such, polymeric NPs are considered promising carriers for numerous medications, including those used in cancer,

cardiovascular disease, and diabetes treatments; bone-healing therapies; and vaccinations. Contrast agents can also be conjugated to the surface of polymeric NPs, allowing them to be used in diagnostic imaging.

Quantum dots

Quantum dots (QDs) are semiconductor nanocrystals that range in size from 2 to 10 nm and usually consist of 10 to 50 atoms. QDs have unique optical and electronic properties, making them valuable as luminescent probes in many biomedical applications. QDs are fluorescent and emit light over a broad range, from the near-ultraviolet (UV) to mid-infrared spectrum. They have size-dependent optical properties, extraordinary photostability, and surface properties that can be fine-tuned, which make them ideal for optical imaging. QDs coefficients that are 10 to 50 times larger than those of organic dyes, making them much brighter in in vivo conditions. They have long blood circulation times and can fluoresce for several months in vivo.

Carbon nanoshells:

Carbon nanoshells are composed of a silica core that is covered by a thin metallic shell, usually composed of gold. Carbon nanoshells have an ability to scatter light, a feature that is useful for cancer imaging. However, their primary use continues to be in thermal therapy. Alternatively, focused lasers have been useful for cancer thermotherapy, but they cannot discriminate between diseased and healthy tissue. However, when carbon nanoshells are used for targeting in thermal therapy, thermal energy passes through healthy tissue without causing harm, killing only the targeted tumor cells.

Applications of nanomedicine:

Cancer treatment

The treatment involves injecting tiny nanoparticles directly into the cancer. Then you heat up the nanoparticles from outside using lasers. It is a strong interaction between the nanoparticles and the laser light, which causes the particles to heat up nanodevices such as quantum dots, nanowires, nanotubes, and nanopores, nanoshells and nanoparticles are the most promising applications for various cancer treatments. The gold nanoshell-antibody complex can be used for breast cancer cells.

Nano biosensor

A nanobiosensor is defined as a compact analysis device that incorporates biological (nucleic acid, enzyme, antibody, receptor, tissue, cell) . Interaction between the compound or microorganism of interest and the recognition element produces a variation in one or more physical-chemical properties (e.g., pH, electron transfer, heat, potential, mass, optical properties, etc.) that are detected by the transducer. The resulting electronic signal indicates the presence of the analyte of interest and its concentration in the sample. These sensors can be electronically gated to respond to the binding of a single molecule. Prototype sensors have been successfully used to detect nucleic acids, proteins and ions.

Blood purification

Pathogens can cause bloodstream infections and the most straightforward cure is to remove the disease-causing factors from a patient's blood as quickly as possible. Several methods, like dialysis and plasma filtration/exchange. Toxins or pathogens can be selectively removed from whole blood within minutes. Functionalized nanomagnets can access substances of different masses and sizes for blood purification. The direct injection of stable nanomagnets into whole blood for the efficient, magnetic-extraction-based removal of low- and high-molecular-weight compounds.

Nanoparticle antibacterial treatments

Nanoparticle antibacterial treatments offers exciting possibilities, including the ability for using nanoparticles to: treat antibiotic resistant infections, treat s infections. release antibiotics when a infection starts in a wound, One of the earliest nanomedicine applications was the use of nanocrystalline silver which is as an antimicrobial agent for the treatment of wounds. Developing a technique to kill bacteria using gold nanoparticles and infrared light. Use of polymer coated iron oxide nanoparticles to treat chronic bacterial infections. The nanoparticles contain nitric oxide gas, which is known to kill bacteria.

Advantages:

- Reduced negative effects of drugs and surgical procedures. Unsolved medical problems such as cancer, benefiting from the Nano medical approach. Nanomedicines, due to their size, preferentially accumulate in tissues. No surgery required

Disadvantages:

- It is very expensive and its developing cost is high. Its manufacturing is difficult. Nanomedicine can be used in a negative way, because of their micro size, they can be inserted in anyone's body and that could be hurting anyone's privacy. Side effects and toxicity

Conclusion:

- Nanomedicine one of the important applications of the nanotechnology has made a revolutionary development in the medical field. Nanomedicine is a new nanotechnology that has a huge impact on the human lives. Nanomedicine is a new improvement in technology and it can create unknown risks and problems

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POST TRANSCRITPTIONAL GENE SILENCING

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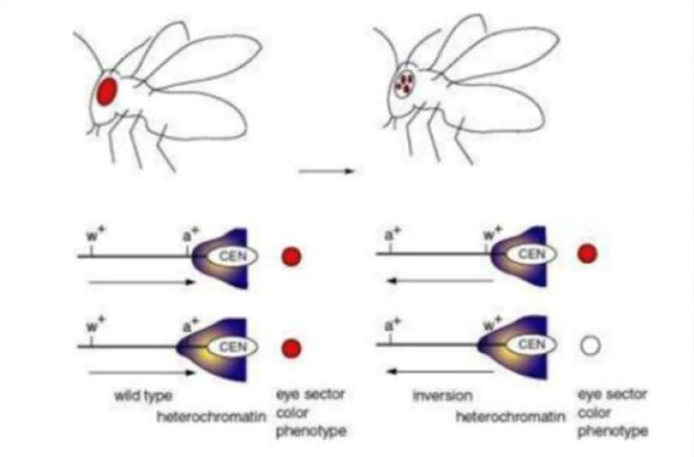
Introduction

Gene silencing is a technique that aims to reduce or eliminate the production of a protein from its corresponding gene. It generally describes the "switching off" of a gene by mechanism other than genetic modification. It occurs when RNA is unable to make a protein during translation. Gene silencing is same as gene knock down but is totally different from gene knock out.

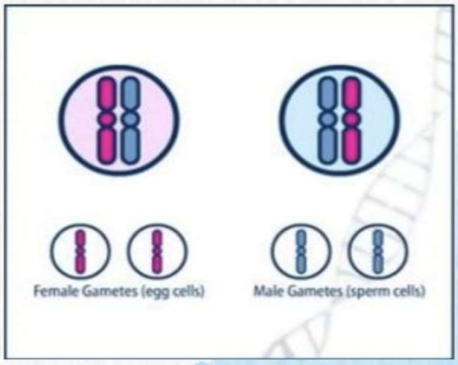
HOW DOES IT WORKS?

This is accomplished by binding a specific strand of RNA to an existing m-RNA strand. The m-RNA creates a copy of DNA strand. By binding the RNA to the m-RNA, m-RNA is prevented from replicating that portion of the DNA. Specific genes can be targeted and prevented from replicating in to new DNA strands.



TYPES OF GENE SILENCING

Genes are regulated at either the transcriptional level.hr post transcriptional level, therefore silencing can be induced either at transcriptional level or post transcriptional level.



There are mainly two types of gene silencing: -

1. Transcriptional gene silencing

2. Post transcriptional gene silencing

TRANSCRIPITION GENE SILENCING.

Is the result of histone modification, creating an environment of heterochromatin around a gene that makes it inaccessible to transcriptional machinery e.g.: RNA polymerase, Genomic imprinting? genomic imprinting is a genetic phenomenon by which certain genes are expressed in a parent-of-origin-specific manner. It is an inheritance process independent of the classical Mendelian inheritance. genomic imprinting has been demonstrated in insects, mammals and flowering plants.

Transcriptional gene silencing	Post transcriptional gene silencing
Promoter silenced	Promoter active
Genes hypermethylated in promoter region	Genes hyper methylated in coding region
Purpose – viral immunity	Purpose - viral immunity

PARAMUTATION

Paramutation is an interaction between two alleles of a single locus, resulting in a heritable change of one allele that is induced by the other allele. Paramutation was first observed by the effect it had on the color of corn kernels in maize plants.

Position effect

Position effect is the effect on the expression of a gene when its location in a chromosome is changed, often by translocation. This has been well described in Drosophila with respect to eye colour and is known as position effect variegation (PEV).

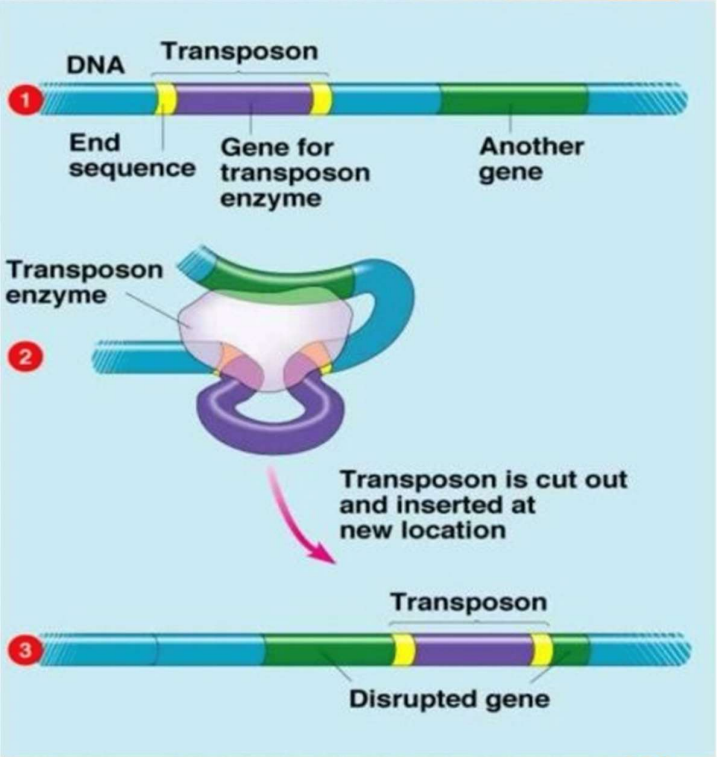
RNA Directed DNA Methylation

RNA-directed DNA methylation is an epigenetic process first elucidated in plants whereby small double-stranded RNAs (ds RNA's) are processed to guide methylation to complementary DNA loci. in the model plant organism Arabidopsis thaliana.

Transposon silencing

Transposon silencing is a form of transcriptional gene silencing targeting transposons. Transcriptional gene silencing is a product of histone modification that prevent the transcription of that area of DNA.

The "jumping" of transposon generates the genomic instability and cause the extremely deleterious mutations. Transposable element insertion has been linked to many disease including haemophilia, SCID and predisposition to cancer



Transgene silencing

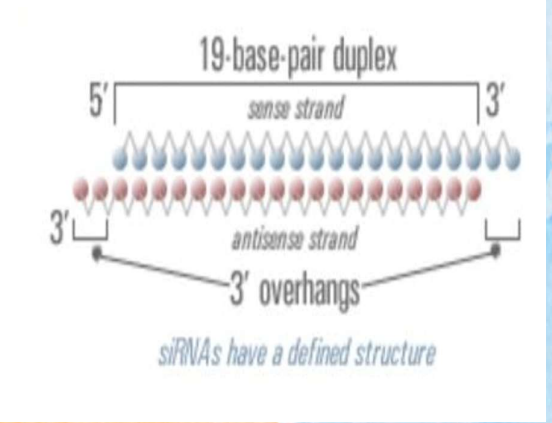
Unfortunate insertion of transgene in to a transcriptionally inactive part of genome. When an insertion of any transgene it does not show activity as per desire and this is because of its instability. The loss of transgene stability is because of gene silencing, E.g. slow fruit softening tomato, by reducing expression of polygalacturonate enzyme.

POST TRANSCRIPTIONAL GENE SILENCING

The ability of exogenous or sometimes endogenous RNA to suppress the expression of the gene which corresponds to the m-RNA sequence. RNAI (RNA interference): It is a post transcriptional process triggered by the introduction of double stranded RNA (ds RNA). which leads to the gene silencing in a sequence specific manner. First evidence came from studies on nematode Caenorhabditis elegans, further analysis in fruit fly drosophila melanogaster. It is also known as post transcriptional gene silencing /co suppression and quelling.

SiRNA (small interfering RNA)

Small interfering RNAs that have an integral role in the phenomenon of RNA interference



(RNAi), a form of post-transcriptional gene silencing. RNAI: 21-25 nt fragments, which bind to the complementary portion of the target mRNA and tag it for degradation. A single base pair difference between the Si RNA template and the target mRNA is enough block the process. Each strand of SiRNA has:

a. 5'-phosphate termini
b. b. 3-hydroxyl termini
c. c. 2/3-nucleotide 3 overhangs

mi RNA (micro RNA)

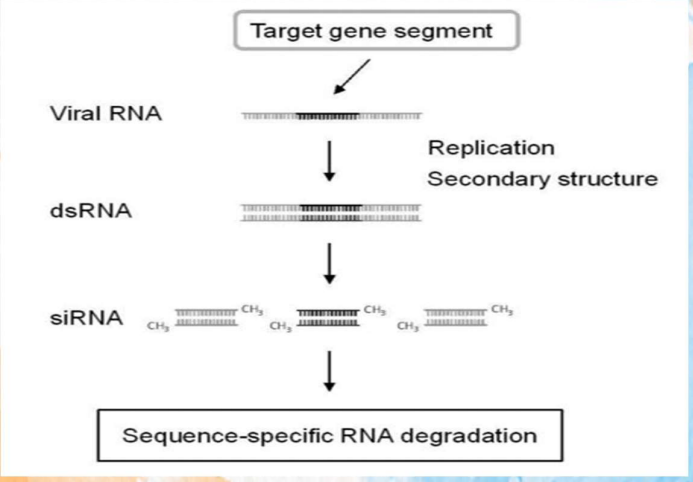
mi RNA Originate from capped & polyadenylated full length precursors (pri-miRNA). Hairpin precursor - 70 nt (pre-mi RNA) Mature miRNA-22 nt (miRNA). mi RNA originates with SSRNA that forms a hairpin secondary structure. Mi RNA regulates post-transcriptional gene expression often not 100% complementary to the target.

Advantages of gene silencing

Downregulation of gene expression simplifies "knockout" analysis. Easier than use of antisense oligonucleotides. Si RNA more effective and sensitive at lower concentration. As Cost effective blocking expression of unwanted genes and undesirable substances. Inducing viral resistance. Powerful tool for analyzing unknown genes in sequenced genomes. Disadvantages of gene silencing are post-transcriptional RNA silencing usually does not result in complete gene silencing. Complete or stable gene knock out is hard and almost impossible to achieve.

Application of Gene silencing

Specific gene silencing using RNAi in cell culture. RNA interference has been used for applications in biotechnology, particularly in the engineering of food plants that produce lower levels of natural plant toxins. Modulation of HIV-I replication by RNAi. Small RNA and its application in andrology and urology. Developing technologies for epigenomic analysis.



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CRISPR
GENE EDITING

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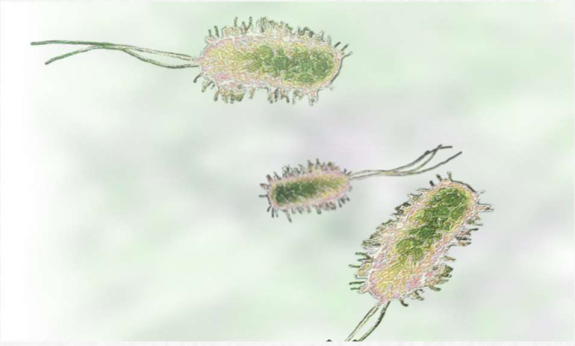
Introduction:

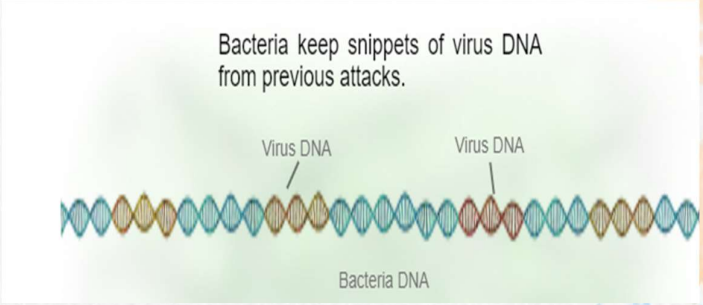
CRISPR gene editing is a genetic engineering technique in molecular biology by which the genomes of living organisms may be modified. It is based on a simplified version of the bacterial CRISPR-Cas9 antiviral defense system. By delivering the Cas9 nuclease complexed with a synthetic guide RNA (gRNA) into a cell, the cell's genome can be cut at a desired location, allowing existing genes to be removed and/or new ones added. The term CRISPR/Cas9 stands for Clustered Regularly Interspaced Short Palindromic Repeats/CRISPR associated protein 9.**Cas9:** a CRISPR-associated protein 9, or enzyme, that acts as "molecular scissors" to cut DNA at a location specified by a guide RNA.

How does it work?

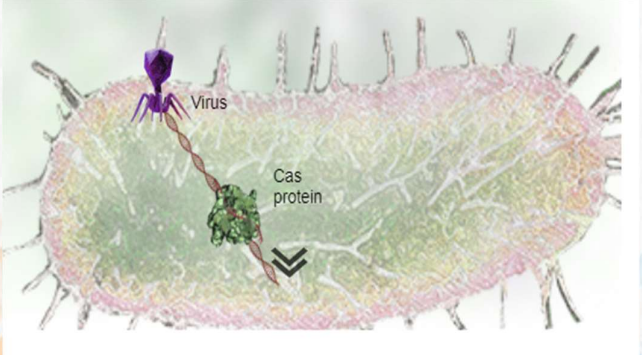
CRISPR/Cas9 (More commonly referred as just CRISPR) is a tool scientist have developed to edit genes by cutting DNA. Genome editing technology is not new, but CRISPR is much better than other methods.

CRISPR was invented after scientists discovered some bacteria had the ability to slice through DNA as a means of self-defense.

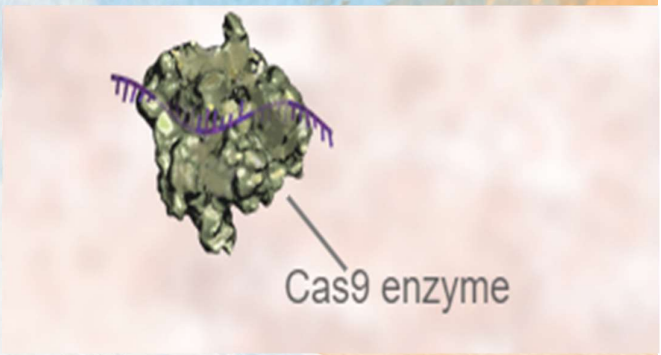




When the bacteria is attacked by a virus it has been infected with before it uses an enzyme (called a CRISPR associated protein, or Cas) to find, and cut, the virus DNA.



Scientists have adapted this self-defense mechanism of bacteria to edit genes from any organism.



The CRISPR/Cas9 system effectively does two things:

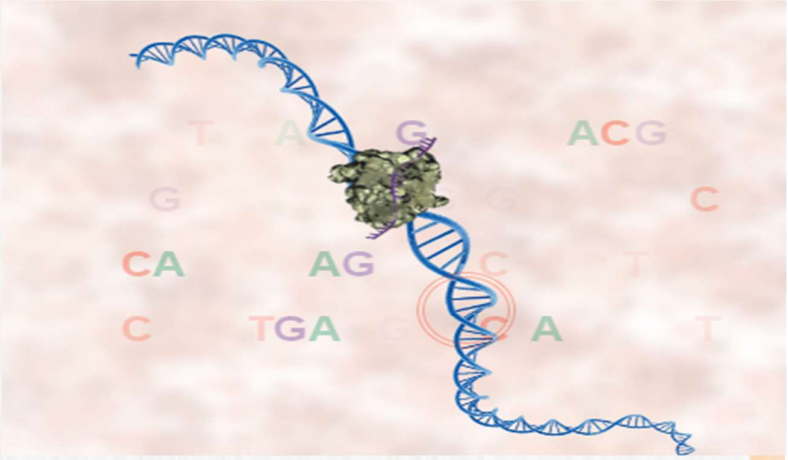
(a) it searches a cell's genetic material looking for a specific DNA sequence

(b) once a match is found, it cuts the target DNA.

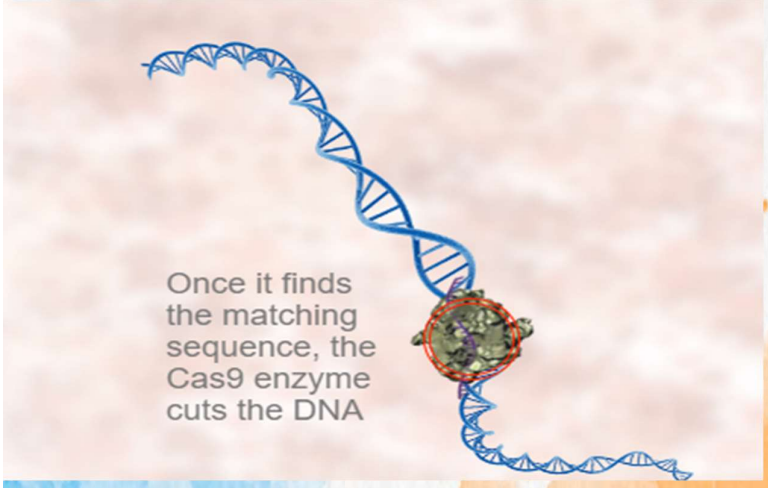
To edit a DNA sequence using CRISPR, you first need to tell it where to cut. This is done by providing a copy of the DNA sequence we're looking for.

This DNA search sequence guides the Cas9 enzyme to the site to edit. Cas9 acts as a tiny pair of molecular scissors to cut the DNA strand.

The Cas9/guide structure combs through the sequence of DNA letters in the target genome looking for a match.



Once it finds the matching sequence, the Cas9 enzyme cuts the DNA.



Once the DNA is cut, the cell will then repair the cut by either:

(a) Joining the ends (with some DNA at the cut side being lost so that a detection is made)

(b) Or by using any available DNA to patch the gap.

If additional DNA material is provided, the cell uses the replacement DNA to repair the cut.

What are we doing with CRISPR/Cas9?

Most experiments use mouse embryos or cells grown in petri dishes in artificial liquid designed to be like blood. Other researchers are modifying stem cells that may then be re-injected into patients to repopulate damaged organs. Only a few labs around the world are actually working with early human embryos. This research is highly regulated and carefully watched.

Advantages of CRISPR are Target design simplicity, Efficient, Cheaper, Multiplexed mutations, Quiker, more accessible for researches and Limitations of CRISPRT target sequence may be limited due to PAM sequences. Off target effects could be possible.

Future of CRISPR

Human gene therapy, Agriculture, crops. Animals, Screens for drug target ID, Viral gene disruption, Ecological vector control, Synthetic biology (pathway engineering), programmable RNA targeting

CLINICAL HUMAN APPLICATIONS OF CRISPR

genetic diseases: remove or add the sequence that is causing the disease, transplantation: gene editing of mismatched human or even non-human mammals as potential, mismatched organs some more applications are drug development – optimize biotech manufacture, disease models, ecological vector control – mosquito sterilization, bio fuels

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BIOSORPTION OF HEAVY METALS

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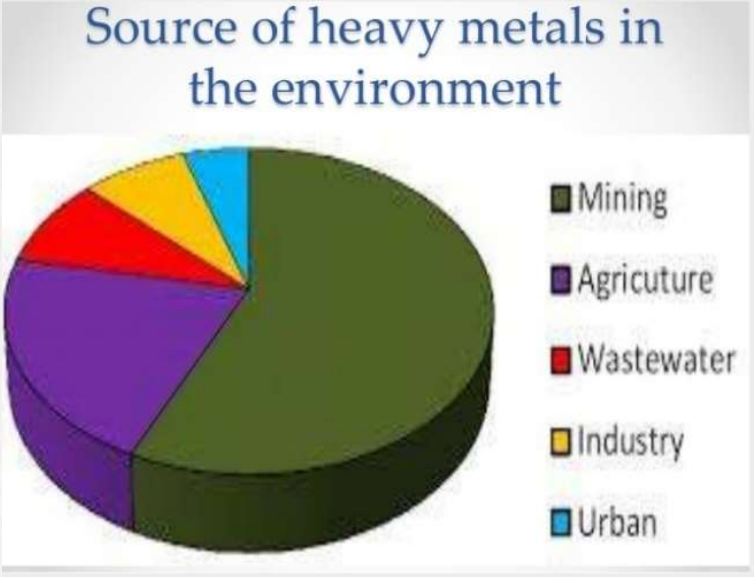
INTRODUCTION:



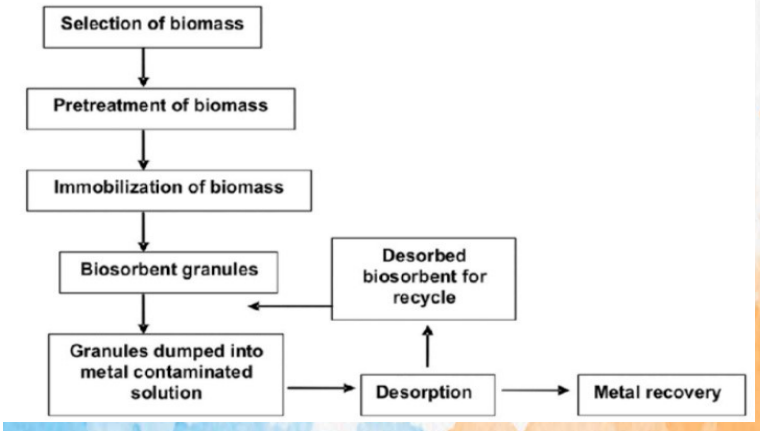
Industrialization has led to introduction of heavy metals in the environment. Heavy metals are known to persist in the environment. Microorganisms are present in industrial effluents. They have adopted different strategies to cope up with the harmful effects of these metals. These strategies can be metabolism dependent or independent. One such strategy is biosorption which is binding of metal ions with metal binding proteins present on the cell wall. Biosorption is exhibited by bacteria, algae, fungi and yeasts. Heavy metals are usually defined as metals having density more than 5 g/cm3. They are classified as essential and non-essential metals. ESSENTIAL METALS- Cu, Ni, Fe, Zn.

- Non-Essential Metals- Pb, Hg, Cd, Sn, As.

METHODS FOR REMOVAL OF HEAVY METALS:

Chemicals methods: Chemical precipitation, electrochemical treatment, oxidation/reduction.

Physical methods: Ion exchange, membrane technology, reverse osmosis, and evaporation recovery, filtration. Biological methods: Microorganisms including bacteria, fungi or algae.



BIOSROPTION:

The ability of biological materials to accumulate heavy metals from wastewater through metabolically mediated (by the use of ATP) or spontaneous physicochemical pathways of uptake of metals. It is a complex process that depends on different factors such as pH, temperature, contact

time, ionic strength, and metal concentration, chemistry of the metal ions, cell wall composition of microorganisms

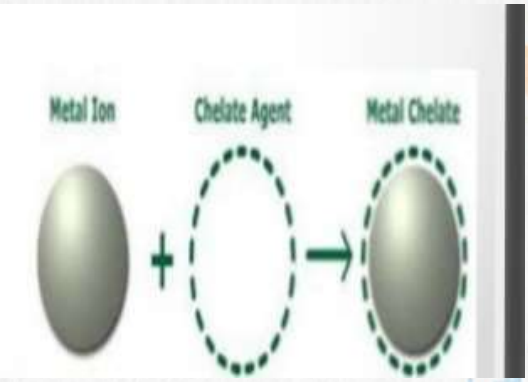
BIOSORPTION MECHANISMS:

1) METABOLISM DEPENDENT BIOSORPTION:

Metabolism dependent biosorption is exhibited by living biological material. It involves various mechanisms like chelation: a specific way in which ions and molecules bind to metal ions and it involves the formation or presence of two or more separate coordinate bonds between a polydentate ligand and a single central atom. Many metal-containing compounds, especially those of transition metals, are coordination complexes). There may involve a single process or combination of these processes. If the metal binding to cell wall is metabolism dependent then it involves energy from ATP.

2) METAL INDEPENDENT BIOSORPTION:

The metabolism independent process mostly occurs in biomass consisting of dead cells . The adsorption process is the main key point behind such physicochemical biosorption mechanism. The adsorption process can be ionic interactions or physiochemical adsorption. Presence of anionic ligands on bacterial cell wall also plays an important role in metal biosorption.



DESORPTION AND RECOVERY OF METALS:

After biosorption of heavy metal from environment, its recovery is another crucial step which involves desorption of metal from biosorbent. According to previous literatures, various agents were used for this purpose which includes complexing agents (thiosulfate, EDTA), mineral acids (HNO_3, H_2SO_4, HCl), organic acids (acetic acid, citric acid). Before choosing the recovery agents, it should be kept in mind that chosen recovery agent should give least harm to physical properties of a biosorbent so that its efficiency of metal binding must remain in its original state to ensure its maximum efficiency for metal binding. By

above stated data we can conclude that, Biosorption is eco-friendly and cheap method of removing metals from the environment. Previous researches conducted during last five decades provided vast amount of information about different types of biosorbents and their mechanism of metal uptake.

Biomass type	Metal studied	pH	T (°C)	C_o (mg/L)	W_t (g/L)	N_s (rpm)	Time (h)	q(mg/g) or % removal	References
Staphylococcus saprophyticus	Cr(VI) Pb Cu	2 4.5 3.5	27	193.6 100-150 105	0.2	150	3 4 2	24.1% 100% 14.5%	[79]
Sulphate-reducing bacteria(SRB)	Zn	6.0	30	10-200	1		24	5.6	[80]
Enterobacter cloacae	Pb Cu Cr(VI) Hg Cd	5 5 4 4 5	25	200 150 100 100 300 (25-350)	0.1	240	2	67.9% 78.9% 55.8% 43.23% 58.9%	[81]
Bacillus sp. Pseudomonas sp. Micrococcus sp.	Cu Cd Pb	5-9	30	25 25 25 (20-100)		100	24	69.34% 90.41% 84.27%	[82]
Pseudomonas sp.	Cr(VI) Cu Cd Ni	5.5	30	1-10 mmol/l	5	200		8.9-238 8.9-238 500 556	[83]
Thiobacillus thiooxidans	Zn Cu	6 5	30	50 25-250	0.25	786	2	95.24 39.84	[84]
Pseudomonas Aeruginosa	Cr(VI) Cu Zn		25	1000 1000 1000 (0-1000)				1.07 0.67 1.33	[85]
Bacillus cereus	Cu Pb	5.5	25	(5-100)	1.0		24	50.32 36.71	[85]
Geobacillus themodenitrificans	Cu Zn Pb	5 5 4	25	0.5 0.5 2.0 (0.5-3.0)		100	12	57 18 53	[86]
Geobacillus themocatenulatus	Cu Zn Pb	5 5 4	25	1.0 1.0 1.0		100	12	65 12.3 54	[86]
Bacillus licheniformis	Cr(VI) Fe Cu	3.5 3.5 2.5	28	1200 1500 1500 (200-1500)		120	48	95% 52% 32%	[87]
Stenotrophomonas maltophilia	Cu Cd Pb	5.0	25	50 10 20 (0-140)	20	140	2	0.57 0.12 0.41	[88]
Actinomycete sp	Cd Ni	6 5	30	(50-400)	5	150	24	32.63 36.55	[88]
Micrococcus sp.	Cr(VI) Ni	5	35	100 50		120	24	92% 90%	[89]

FACTORS AFFECTING BIOSORPTION:

- **Temperature:** For efficient removal of metal ions from environment, the optimum temperature needed to be investigated. It is generally assumed that biosorption is carried out between 20 and 35°C. High temperatures above 45°C may results in damage to proteins which in turn affects metal uptake process.

- **pH:** It is a very important parameter. It affects solubility of metal ions and binding sites of biomass. At lower pH, the biosorption of metals is affected [96, 97]. General range of pH for metal uptake is between 2.5–6. Above this limit, metal uptake ability of biosorbent gets compromised.
- **Nature of biosorbents:** Metal uptake is reported in different forms like biofilms, freely suspended microbial cells or immobilization of microbial cells. It can be altered by physical or chemical treatments. Physical treatments include autoclaving, drying, boiling, sonication, etc. Chemical treatment as the name indicates involves chemicals like acid or alkali to improve biosorption capacity.
- Surface area to volume ratio: This property plays an important role in efficient removal of heavy metal from medium. The surface area property plays a significant role in case of biofilms. The binding of metal ions with microbial cell wall is previously reported.
- **Concentration of biomass:** The concentration of biomass is directly proportional to the metal uptake
- **Initial metal ion concentration:** The initial concentration provides an important driving force to overcome all mass transfer resistance of metal between the aqueous and solid phases.
- **Metal affinity to bio sorbent:** Physical/chemical pretreatment affects permeability and surface charges of the biomass and makes metal binding groups accessible for binding. It can be manipulated by pretreating the biomass with alkalis, acids detergents and heat, which may increase the amount of metal uptake

ADVANTAGES:

Cheaper production of biomass (bacteria or fungi), Use of biomass for removal of heavy metals. No need for chemical additions as highly selective for uptake and removal of specific metals. Functional over wide range of conditions including temperature, pH, presence of other metal ions, etc. Easy and cheaper desorption of metals attached to biomass. Reduced volume of waste or toxic materials production

DISADVANTAGES:

Saturation of active sites of metal binding ligands, Reversible sorption of metals on biomass

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BIO-BATTERY

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111707

Bio-batteries

Introduction:

A battery is an electrical device which is used to alter the chemical energy to electrical energy. Batteries are classified into different types based on the application, and these are used in several electrical as well as electronic devices. An electrical battery includes certain chemicals like compounds of mercury, lead. The lead of a battery is extremely dangerous in nature and not environment-friendly. Apart from these, there is a chance for chemical leakage as well as the explosion of the battery in certain cases. To overcome this problem researchers have invented Bio-battery which reduced the impact of these chemicals and reduces the harm to the environment which gives a great advantage to humans. The mechanism of bio-battery is similar to how plants and animals obtain their energy.

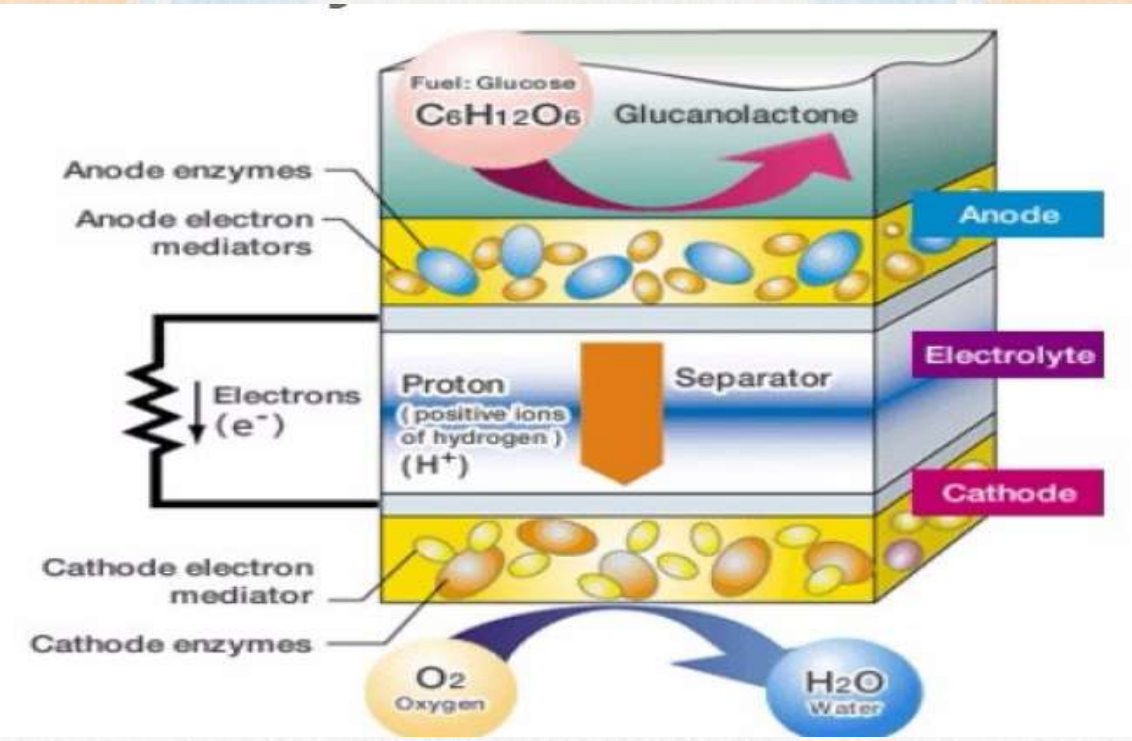
Need of a bio-battery

Electro-chemical batteries may contain compounds like lead and mercury which are highly toxic in nature. These are prone to explosions and leakages. Bio-batteries can reduce the usage of non-renewable resources in construction of batteries. They can be used to power devices in areas which are devoid of electric sockets. There are basically four types of bio-batteries which can be categorized as enzymatic bio-batteries, microbial bio-batteries, Cellulose based bio-batteries, body fluid based bio-batteries.

Construction of a bio-battery

The bio-battery construction can be done by using four components such as anode, cathode, electrolyte, and separator. All these four components are coated on each other so

they stack up jointly. Similar to other batteries, in these batteries, the anode is negatively charged as well as the cathode is charged positively. The main difference between the anode & cathode permits the flow of electrons inside and away from them. In bio- battery construction, the anode terminal is placed at the top of the battery whereas the cathode terminal is placed at the bottom of the battery. In between these two terminals electrolyte is



placed which includes a separator. Here, separator plays a key role by separating the anode and the cathode terminals from one another which can be lead to avoid the short circuit otherwise the entire battery will damage. In this system, the electricity will be generated by the flow of electrons as well as protons. Because the main energy source of Bio-battery is glucose so it requires plenty of glucose for generating the electricity. In the bio-battery, the breakdown of glucose can be done on the same rule while it is broken down into small pieces in the body of humans.

Mechanism of working

The concept of working of an enzymatic bio-battery is similar to process of respiration in living cells. Here glucose gets broken down into electrons and protons.

Reaction occurring at anode:

$$\text{glucose} \rightarrow \text{gluconolactone} + 2H^+ + 2\text{e}$$

Resultant protons are transferred to cathode via separator.

Reaction occurring at cathode:

$$O_2 + 4H^+ + 4e \rightarrow 2H_2O$$

Electricity is generated by continuous flow of electrons from anode to cathode.

In microbial bio-battery, micro-organisms are used to break the sugars and release electrons. The micro-organisms involved in functioning of microbial bio-batteries are *cyanobacteria, Escherichia coli and Shewanella oneidensis* etc. These micro-organisms are located at anode and act as anodic catalysts. Glucose is broken down by micro-organisms at the anode and electrons are released. These electrons are delivered to the cathode producing electricity. Electricity has also been produced from sewage eating bacteria such as *Geobacter Sulfurreducens*.

Advantages

Bio-batteries are much faster in charging the devices because of the quick action of the enzymes when we compared to other batteries.

Bio-batteries don't require external power supply. Bio-batteries are totally non-polluting, renewable, and also environmentally friendly.

Bio-batteries are very secure to use due to no leakage and explosions like chemical batteries.

They possess high energy density and work easily at room temperature.

It can be made using readily available fuel.

Disadvantages

The bio batteries preserve less amount of energy as compared to lithium-based electrical batteries.

These batteries cannot be used for the long-term.

However researches are continuing to develop the battery in order to make it more practical replacement for current batteries.

Applications

- Bio-batteries are used in medical implants like pacemakers, insulin pumps, etc.
- It can be used as a charger for electronic devices like cell phones, tabs, power banks, etc.
- Bio-batteries can be used for toys and greeting cards.
- Bio-batteries are used in the defense field in the remote sensing devices, spying devices, as well as surveillance.
- Sony has created a bio-battery that gave a power output of 50milliwatts which is enough to power an MP3 player

The figure shows a bio-battery which runs with the help of blood in the bug. The blood has sugars which are the energy sources of the battery. This model was developed by researchers at Cal Berkley. The goal is to develop an implanted pace maker which works with the help of sugars in the body. This type of batteries can work forever unless there is an interruption in sugar supply.

Sony's bio-battery

Sony has exhibited a bio-battery that generated electricity from glucose .Since the energy density of glucose is high ,it is possible to generate enormous amount of energy. They also predicted that the fuel in the bio-battery could be refilled with juice or coco-cola. It is said that energy produced by one bowl of rice is equivalent to 96 double A batteries.Below figure(i) shows that the phone is being charged by a bio-battery which uses sugar(coco-cola) as the source of energy. Figure(ii) is the demonstration on an experiment.Here the fan runs with the energy produced from bio-battery whose energy source is cardboard.

Future Scope

Research in bio-batteries has been increasing over years. So, bio-batteries can have a very bright future ahead. They can serve as a new form of energy that is eco-friendly. It can act as a great potential energy device for the next generation gadgets. It is predicted that once bio-batteries pick up pace in the market, the global pollution drastically reduces.

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BIOFOULING

AMAN RAO
111706

The Guidelines for the control and management of ships' biofouling to minimize the transfer of invasive aquatic species (Biofouling Guidelines) are intended to provide a globally consistent approach to the management of biofouling, which is the accumulation of various aquatic organisms on ships' hulls. They were adopted by the Marine Environment Protection Committee (MEPC) at its sixty-second session in July 2011 and were the result of three years of consultation between IMO Member States. The Biofouling Guidelines represent a decisive step towards reducing the transfer of invasive aquatic species by ships.

Invasive aquatic species

The introduction of invasive aquatic species to new environments by ships has been identified as a major threat to the world's oceans and to the conservation of biodiversity. A multitude of marine species, carried either in ships' ballast water or on ships' hulls, may survive to establish a reproductive population in the host environment, becoming invasive, out-competing native species and multiplying into pest proportions.

The problem of invasive species carried by ships has intensified over the last few decades due to the expanded trade and traffic volume and, since the volumes of seaborne trade continue to increase, the problem may not yet have reached its peak. The effects in many areas of the world have been devastating. Quantitative data show that the rate of bio-invasions is continuing to increase at an alarming rate and new areas are being invaded all the time.

The spread of invasive species is now recognized as one of the greatest threats to the ecological and the

economic well-being of the planet. These species are causing enormous damage to biodiversity and the valuable natural riches of the earth upon which we depend. Direct and indirect health effects are becoming increasingly serious and the damage to the environment is often irreversible. Moreover, significant economic impact occurs to industries that depend on the coastal and marine environment, such as tourism, aquaculture and fisheries, as well as costly damage to infrastructure.

Biofouling as a vector for the transfer of invasive aquatic species by ships

Invasive aquatic species are introduced to new environments by ships mainly through ballast water or hull fouling.

While ballast water is essential for safe and efficient modern shipping operations, the multitude of marine species carried in it may pose serious ecological, economic and health problems. These include bacteria, microbes, small invertebrates, algae, eggs, cysts and larvae of various species.

Biofouling is also considered one of the main vectors for bioinvasions and is described as the undesirable accumulation of microorganisms, plants, algae and animals on submerged structures (especially ships' hulls). Biofouling on ships entering the waters of States may result in the establishment of invasive aquatic species which may pose threats to human, animal and plant life, economic and cultural activities and the aquatic environment.

Related international regulatory framework

Preventing the transfer of invasive species and coordinating a timely and effective response to invasions requires cooperation and collaboration among governments, economic sectors, non-governmental organizations and international treaty organizations; the UN Convention on the Law of the Sea (UNCLOS) provides the global framework by requiring States to work together "to prevent, reduce and control human caused pollution of the marine environment, including the intentional or accidental introduction of harmful or alien species

to a particular part of the marine environment."

IMO has been at the forefront of the international effort by taking the lead in addressing the transfer of invasive aquatic species through shipping.

With the adoption of the International Convention for the Control and Management of Ships' Ballast Water and Sediments, 2004 (BWM Convention), IMO Member States made a clear commitment to minimizing the transfer of invasive aquatic species by shipping, specifically through **ballast water**.

On the other hand, while the International Convention on the Control of Harmful Anti-Fouling Systems on Ships, 2001 (AFS Convention) addresses anti-fouling systems on ships, its focus is on the prevention of adverse impacts from the use of **anti-fouling systems** and the biocides they may contain, rather than the prevention of the transfer of invasive aquatic species through hull fouling.

The Biofouling Guidelines

The Guidelines were further supplemented by the Guidance for minimizing the transfer of invasive aquatic species as biofouling (hull fouling) for recreational craft, approved by MEPC at its sixty-fourth session in October 2012. This Guidance is for use by all owners and operators of recreational craft less than 24 metres in length, which may constitute an important vector for the transfer of invasive aquatic species due to their large numbers and their operating profile that may make them particularly susceptible to biofouling.

As scientific and technological advances are made, the Biofouling Guidelines may be refined to enable the risk to be more adequately addressed. Port States, flag States, coastal States and other parties that can assist in mitigating the problems associated with biofouling should exercise due diligence to implement the Guidelines to the maximum extent possible, which can play a significant role in reducing

the risk of the transfer of invasive aquatic species.

In support of this review process, IMO has prepared the Guidance for evaluating the 2011 Guidelines for the control and management of ships' biofouling to minimize the transfer of invasive aquatic species. This Guidance is provided to assist Member States and observers who wish to collect information needed to undertake future reviews of the Biofouling Guidelines and to do this in a more consistent way. The Guidance identifies the types of performance measures that could help to assist in evaluating the different recommendations in the Guidelines. At its seventy-second session in April 2018, MEPC agreed to a new output for the Sub-Committee on Pollution Prevention and Response (PPR) to review the Biofouling Guidelines, which will be based on the principles of the Guidance.

Ship fouling and its management

All ships have some degree of biofouling, even those which may have been recently cleaned or had a new application of an anti-fouling system. Studies have shown that the biofouling process begins within the first few hours of a ship's immersion in water. The biofouling that may be found on a ship is influenced by a range of factors, such as:

design and construction, particularly the number, location and design of niche areas (e.g. sea chests, bow thrusters, hull appendages and protrusions, etc.);

specific operating profiles, including parameters such as operating speeds, ratio of time underway compared with time alongside, moored or at anchor, and where the ship is located when not in use (e.g. open anchorage or estuarine port);

places visited and trading routes (e.g. depending on water temperature and salinity, abundance of fouling organisms, etc.); and

maintenance history, including the type, age

and condition of any anti-fouling coating, installation and operation of anti-fouling systems and dry-docking/slipping and hull cleaning practices.

Implementing practices to control and manage biofouling can greatly assist in reducing the risk of the transfer of invasive aquatic species.

Additional benefits from managing biofouling

Such management practices can also improve a ship's hydrodynamic performance, as hull fouling leads to significant increases in ship resistance, which in turn has a severe impact both on fuel costs and on emissions of air pollutants and greenhouse gases. Therefore, biofouling management can be an effective tool in enhancing energy efficiency and reducing air emissions from ships. This has been recognized by the IMO and is reflected in the 2016 Guidelines for the development of a Ship Energy Efficiency Management Plan (SEEMP).

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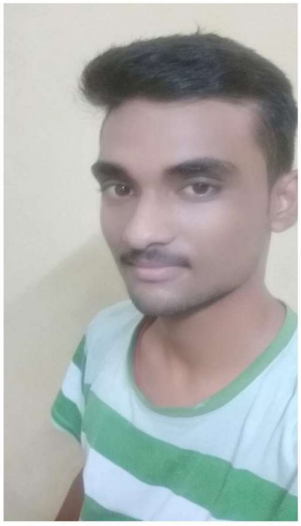
BIOLEACHING



UDAY KIRAN

111717

INTRODUCTION: -

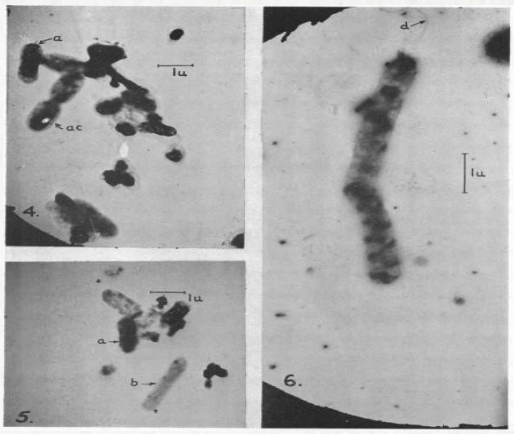
Bioleaching is the process that extracts valuable metals from a low grade ore with the help of living micro-organisms such as bacteria, archaea. Metals extracted from bioleaching process include Copper, Gold, Silver, Cobalt, Uranium, Zinc.

Features of organisms involved

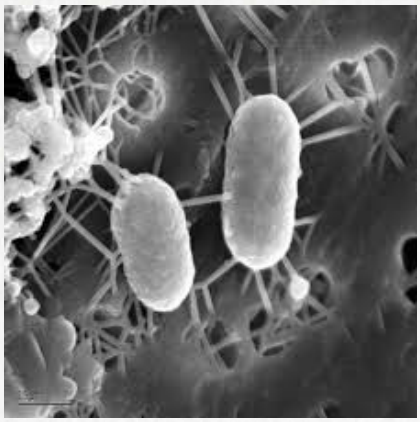
- Single celled organisms
- Derive carbondioxide, oxygen from atmosphere
- Requires Acidic pH

Micro Organisms used in Bioleaching

Some other micro-organisms which may also used are *Bacillus Licheniformis, B Luteus, B Polymyxa.*



Thiobacillus thiooxidants



Thiobacillus ferrooxidants

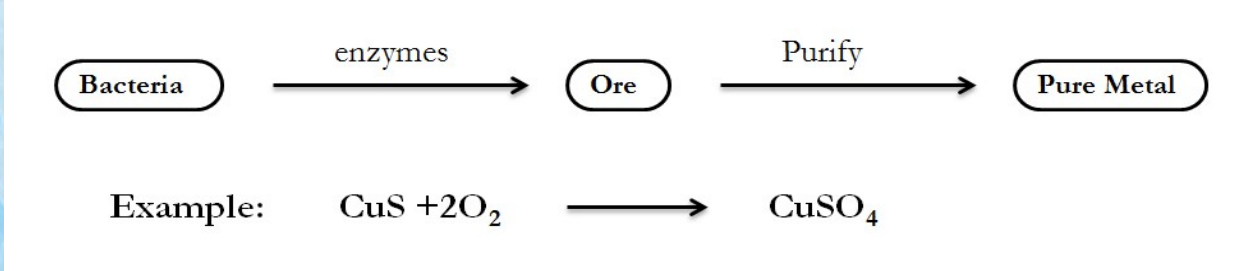
Types of Bioleaching:

The reaction mechanism is of two types

1) Direct bacterial leaching
2) Indirect bacterial leaching

1) Direct bacterial leaching:

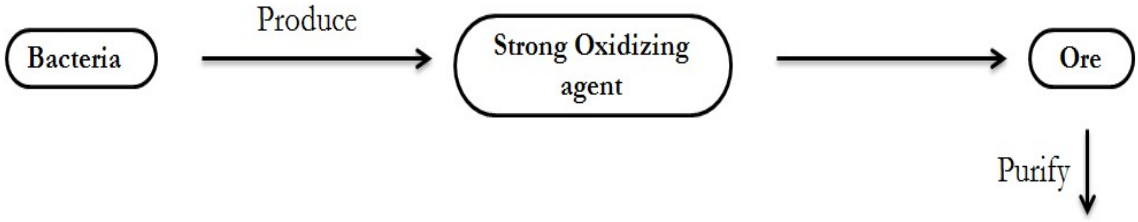
In direct bacterial bioleaching, minerals which are susceptible to oxidation undergoes direct enzymatic attack by the microorganisms.



2)Indirect bacterial leaching:

In Indirect method, bacteria produce strong oxidizing agent which reacts with metals and

Example: $CuS + Fe_2(SO_4)_3 \longrightarrow CuSO_4 + 2FeSO_4 + S$



Direct		Indirect
Low grade ores		Concentrates
Low cost		High cost
Poorly controlled		Good control
Long leaching time		Short leaching time
Large volumes		Small volumes

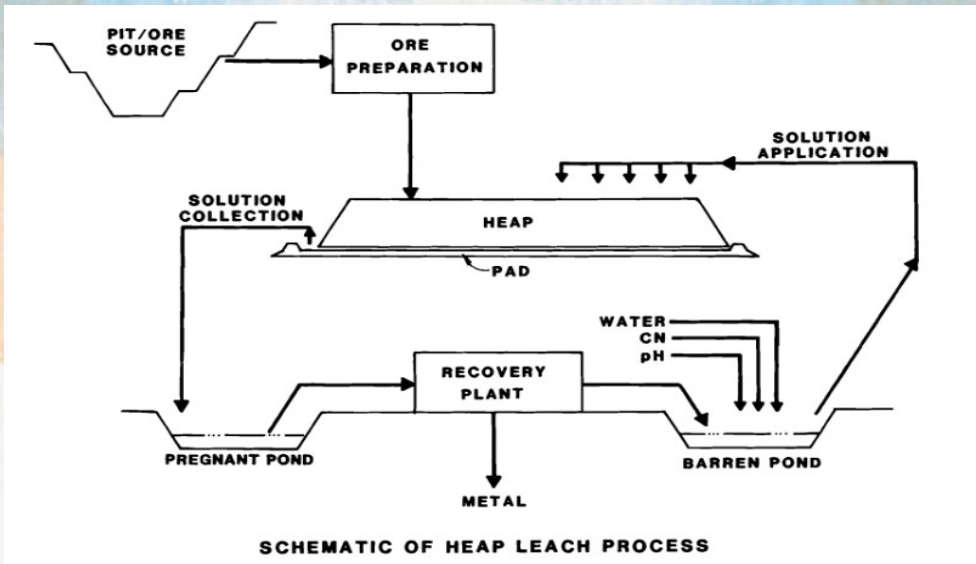
Methods of Bioleaching:

The commercial processes used in bioleaching are

1) Heap leaching
2) In Situ leaching
3) Slope leaching

1) Heap leaching

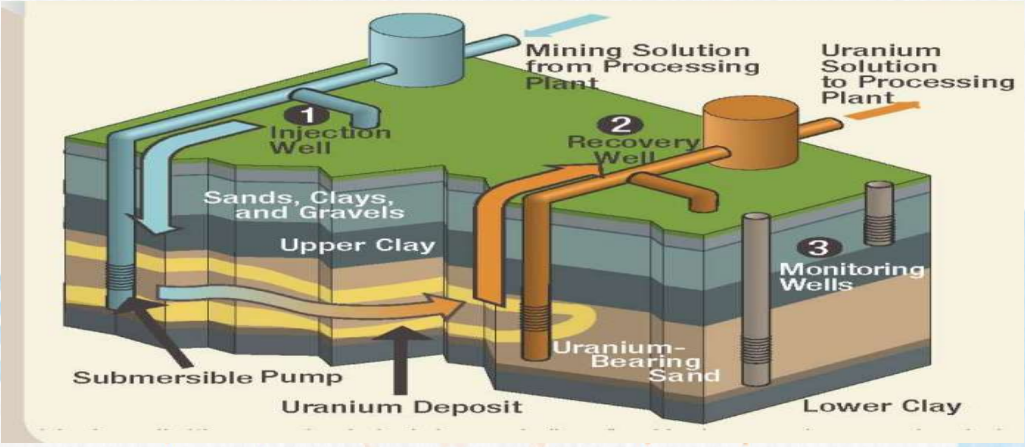
In this process, the ores are dumped into large heaps called leach heaps. Water containing inoculums of *thiobacillus* is continuously sprinkled over the ore. Water is collected from the bottom and used to extract metals and generate bacteria in an oxidation pond.



SCHEMATIC OF HEAP LEACH PROCESS

2) Insitu bioleaching

In this process, the ore remains in its original position in earth. Surface blasting of earth is done to increase the permeability of water. Water containing *thiobacillus* is pumped through drilled passages to the ores. Acidic water seeps through the rock and collects at bottom. Again, water is pumped from bottom. Mineral is extracted and water is reused after generation of bacteria.

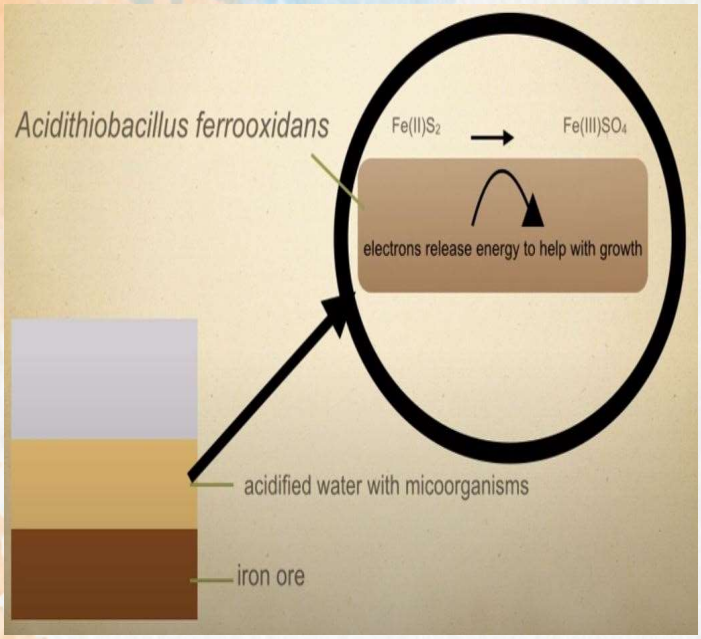


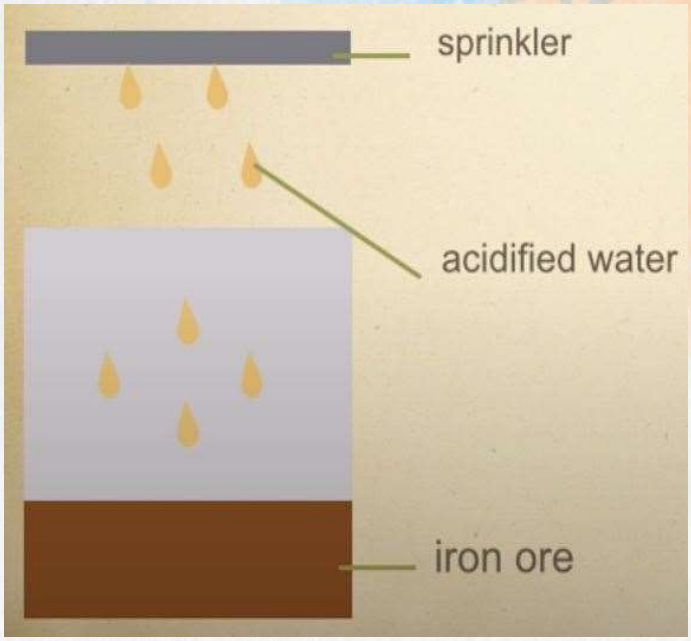
3) Slope leaching

Ore is ground to get fine pieces and then dumped into large leaching dump. Water containing inoculum of *thiobacillus* is continuously sprinkled over the ore. Water is collected from bottom and used to extract metals and generate bacteria in an oxidation pond.

Copper Leaching:

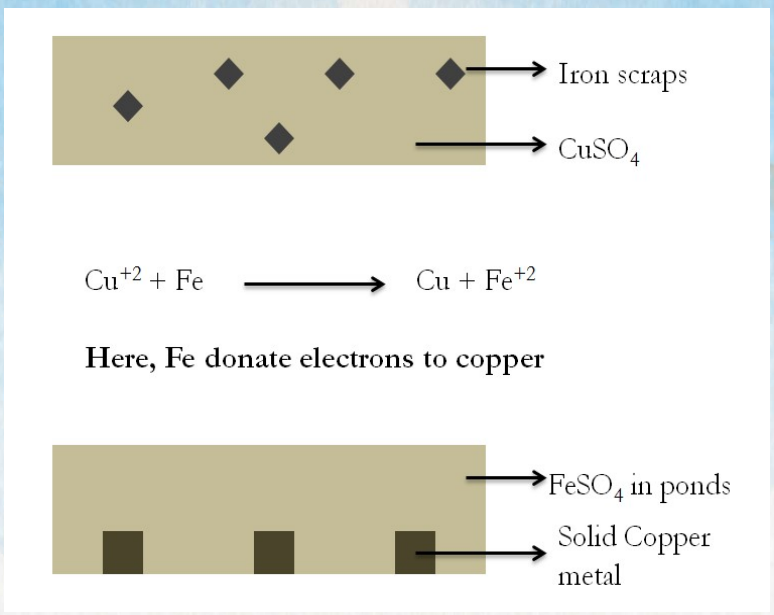
Extraction of copper metal from chalcopyrite ($CuFeS_2$)





Extracting copper metal from copper sulfate:

Leaching Agent	Parameters Evaluated	Cu Ext (%)
NaCl, H_2SO_4, HCl, HNO_3 and Fe^{+3}	Oxygen flow, Stirring speed, Temperature, Sulfuric acid concentration	97
HCl, Cu^{+2} and Fe^{+3}	Potential effect, Chloride concentration, acid concentration, Temperature	98
NaCl and H_2SO_4	Chloride concentration, Percentage of solids and particle size	78



Extracting copper from copper sulfate using Electrolysis

Advantages:

The extraction of metals using mechanical and chemical methods is difficult and expensive but biological methods are most cost effective, use little energy, can function well at low concentration of metals, do not usually produce harmful emissions and reduce the pollution of metal containing wastes.

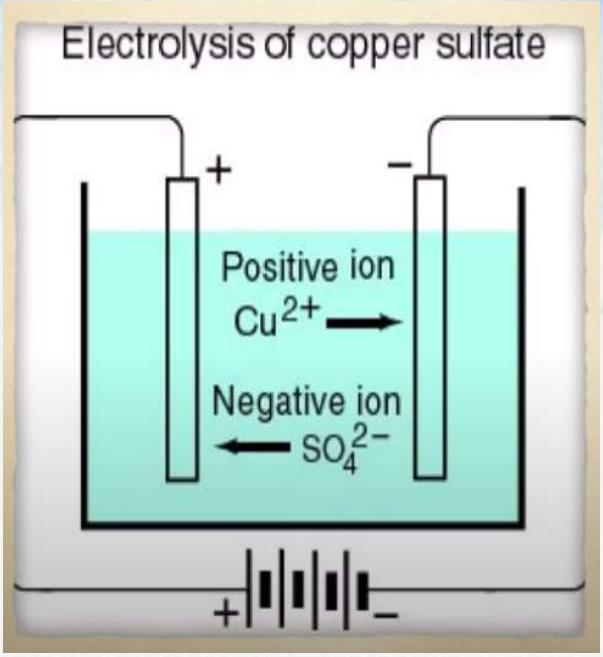
Disadvantages:

Time Consuming – Takes about 6-24 months or longer. Have a very low yield of mineral. Requires a large open area for the treatment. High risk of contamination. Inconsistent yield because bacteria cannot grow uniformly.

Factors affecting Bioleaching:

Temperature, pH	Affects leaching rate, microbial growth
Population density	High population density tends to increase the leaching rate
Metal Tolerance	High metal concentration may be toxic to microbes
Microbial diversity culture	Mixed cultures tend to be more robust and efficient than pure

Oxygen reactions compositions and activity	Needs to be low to obtain the faster leaching rates



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POSOLOGY

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POSOLOGY:

Derived from Greek word posos-how much, logos means science. Posology is a branch of medical science which deals with dose or quantity of drugs which can be administered to a patient to get the desired pharmacological action. The dose of a drug cannot be fixed rigidly because Various factors are responsible for some factors age, sex, severity of the disease etc. The official doses in pharmacopoeia represent the average range of quantity. Suitable for adults which is administered orally within 24 hrs.

TYPES OF DOSAGES:

Depending on the method/route of administration, **dosage forms** come in several **types**: These include many **kinds** of liquid, solid, and semisolid **dosage forms**. Common **dosage forms** include pill, tablet, or capsule, drink or syrup, and natural or herbal form such as plant or food of sorts, among many others.

FACTORS

SEX:

Women do not always respond to the action of drug in the same manner as it done in men. Special care should be uterine smooth muscles e.g. drastic purgative, antimalarial drugs, ergot alkaloids are contra indicated during pregnancy. Alcohol, narcotic drugs acts on fetus through placenta (pregnancy time). During lactation, morphine, tetracycline avoided because its effect on babies.

BODY WEIGHT

The average dose is mentioned either in terms of mg per kg body weight. Another technique used as a total single for an adult weighing between 50-100kg.However, the dose expressed in this fashion may not apply in case of obese patients, children& malnourished It should be calculated according to body weight.

ROUTE OF ADMINISTRATION

Dosages are given in different types, like IM, IV. IM (intramuscular) are used to give in muscle by injections. IV (intravenous therapy) doses of drug are usually smaller than the oral doses, because…Intravenous route this might enhance the chances of drug toxicity. The effectiveness of drug formulation is generally controlled by the route of administration.

TIME OF ADMINSTRATION

The presence of food in the stomach delay the absorption of drug & rapidly absorbed from the empty stomach. But it does not mean that much effective when taken during or after meal. Iron, arsenic & cod-liver oil should be given after meal & antacid drugs taken before meal.

ENVIRONMENTAL:

The personality & behavior of a physician may influence the effect of drug especially the drugs which are intended for use in a psychosomatic disorder. The females are more emotional than male & required less dose of

certain drugs. Inert dosage forms called placebos which resemble the actual medicament in the physical properties are known to produce therapeutic benefit in disease like angina pectoris & bronchial asthma.

PRESENCE OF DISEASE:

Drugs like barbiturates (HELP PEOPLE TO SLEEP) & chlorpromazine (psychotic disorders) may produce unusually prolonged effect in patient having liver cirrhosis (liver diseases). Such as, streptomycin produces toxic effect on these patients their kidney function is not working properly because streptomycin excreted through kidney.

ACCUMULATION:

Some drugs produce the toxic effect if it is repeatedly administered for long time e.g. digitalis, emetine (TO INDUCE VOMTING), heavy metals because these drugs excreted slowly. This occurs due to accumulative effect of the drug.

ADDICTIVE EFFECT:

When two or more drugs administered together is equivalent to sum of their individual pharmacological action, the phenomenon is called as additive effect.

CALUCLATION OF DOSES

The dose of a drug given in the pharmacopoeia represents the average maximum quantity of drugs which can be administered to an adult orally within 24 hrs. The doses are also calculated in proportionate to age, body weight & surface area of the patient.

Dose proportionate to age:

There are number of methods by which the dose for a child can be calculated from the adult dose

1. Young's formula
2. Dilling's Formula
3. Fried's formula
4. Cowling's formula

1. Young's formula: This formula used for calculating the dose for children under 12 years of age.

Dose for the child = Age in years/ Age in years + 12 X Adult dose

2. Dilling's formula: This formula is used for calculating the doses for children in between 4 to 20 years. This formula is considered better because it is easier & quick to calculate the dose. Dose for the child = Age in years/20 x Adult dose

3. Fried's Formula: This formula is used for calculating of dose for infants up to 2 years. Dose for infant's= Age in months /150 x Adult dose

Cowling's formula

Dose for child= Age at next birthday (in years)/24 x Adult dose. Dose proportionate to body weight: Clark's formula used to calculate the dose on body weight. Dose for the child = Childs weight in Kg/ 70x Adult dose. Dose proportionate to surface area: In this method dose is calculated accordingly to surface area it's the more satisfactory & appropriate method than based on age method.

Percentage of adult dose= Surface area of child / Surface area of adult x 100

Catzel's formula:

Dose for patient = Surface area of patient in M2 / Adult dose 1.73 M 2 x Adult dose of 1.73 M 2 where, 1.73 M 2 = Average adult surface area

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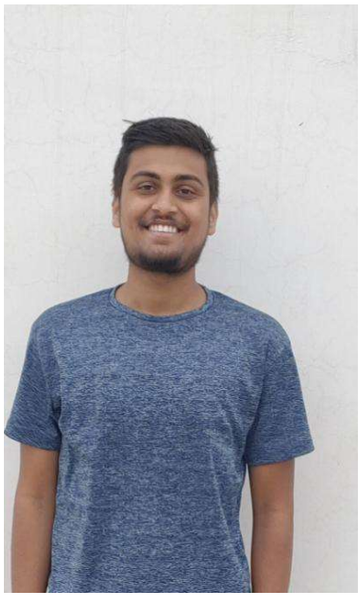
BIOMIMCRY

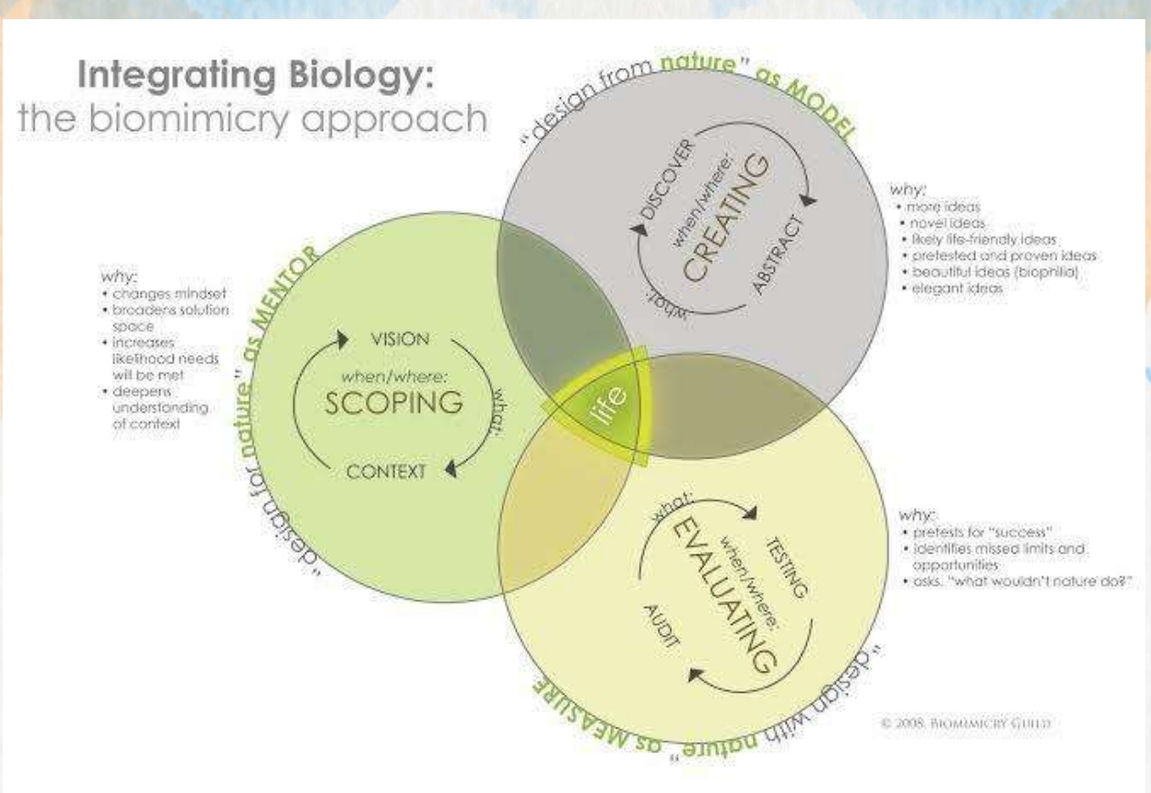


CHAVVI RAJ MEENA
111704

Biomimcry

Biomimicry is the emulation of the models, systems, and elements of nature for the purpose of solving complex human problems. Over the period 3.5 billion years of evolution and natural selection allow these plants and animals to solve complex problems like drag, high temperature tolerance, hydrophobicity etc.

Biomimcry approaches



Approaches to biomimicry as a design process typically fall into two categories: Defining a human needs or designing problem and looking to the ways other organisms or ecosystems solve this, termed here Design looking to biology (Top-Down approach), or identifying a particular characteristic, behavior or function in an organism or ecosystem and translating that into human designs, referred to as Biology influencing design (Bottom-Up approach)).

Design looking to biology (Top-Down approach)

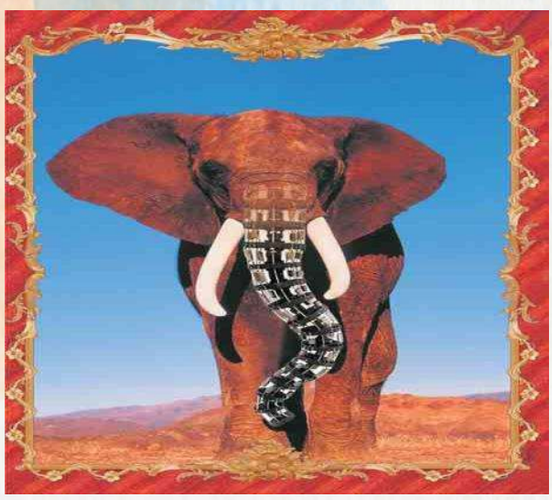
Throughout literature review, this approach has different names as “Design looking to biology”, “Top-down Approach” (Jean and “Problem-Driven Biologically Inspired Design”,, “challenge to biology” (Biomimicry institute).. They all have the same meaning and they also point to the way designers look to nature and organisms for solutions, where designers must recognize exactly their design problems and to match their problems with organisms and creatures that have solved similar problems. This king of approach is as a result of the designers knowledge of the aims and triggers of their design.

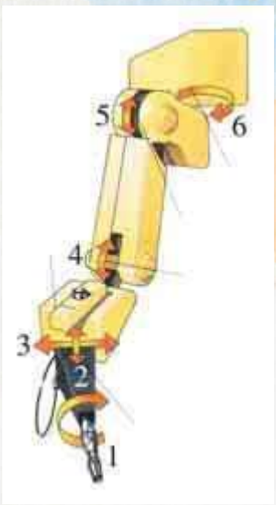
Biology influencing design (Bottom-Up approach)

Just like the previous approach, this approach has different names and expressions such as “Biology Influencing Design”, “Bottom-Up Approach”, “Solution-Driven Biologically Inspired Design”, and “Biology to design”. They all refer to the same meaning, where this approach depends on the previous knowledge of biological research and solutions not to search for a solution in nature, then applying this knowledge on the design problem you already have.

The elephant trunk

The elephant trunk inspired the German company Festo to develop a bionic arm. Called the Bionic Handling Assistant, the free-moving “third hand system,” as Festo calls it, has plenty of uses in situations that require support from machines. That can include medical technology, rehabilitation and as an aid for the handicapped, as well as in agriculture, private homes and educational institutes.





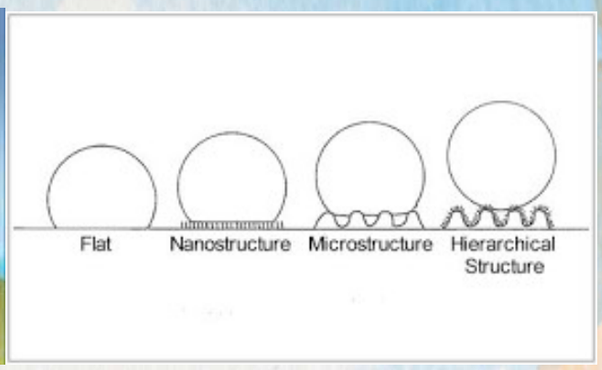
Kingfisher beak and trains

Japan tested trains at 300km/hr causing sonic booms when passing through tunnel (piston effect), passing limits of 70db sound limit in residential areas. Hugely affects wildlife around the bridge/tunnel.

BIOLOGY INFLUENCING DESIGN

The constantly self-cleaning Lotus

Lotus leaves, for example, exhibit extensive folding (i.e., papillose epidermal cells) and epicuticular wax crystals jutting out from the plant’s surface, resulting in a roughened microscale surface. As water and air adhere less well than water and solids, roughened surfaces tend to reduce adhesive force on water droplets, as trapped air in the interstitial spaces of the roughened surface result in a reduced liquid-to-solid contact area. It can be used in paints and in biomedical devices for sterility.

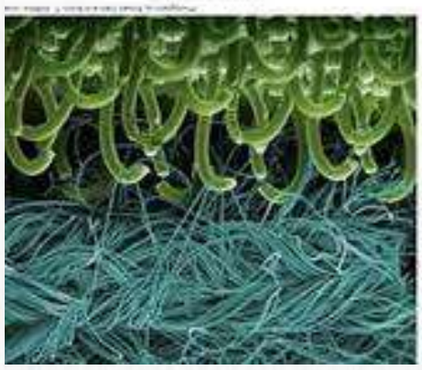


Burr and velcro

Velcro was invented by George de Mestral in 1941 and was inspired by the burrs he found on himself and on his dog. Being an engineer and entrepreneur, Mr. de Mestral examined the burr under a microscope and realized the small hooks of the burr and loops of the fur/fabric allowed the burr to adhere exceedingly well. This sparked his idea to mimic the structure as a potential fastener. The words velours (French for loop) and crochet (French for hook) were combined to start the Velcro company in 1959. Since then, Velcro has become integrated into daily life and has revolutionized the fastener industry

Plant Burrs and Textile

Hook & Loop "Velcro"



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Cell Squeeze technology

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Introduction:

The novel Cell Therapy Platform uses membrane disruption to deliver material into cells. creating high-impact therapies for patients in the fields of oncology, infectious disease, and auto-immunity.

Fig 1: Wide functional molecules can be entered in a cell

Cell Squeeze is the commercial name for a method for deforming a cell as it passes through a small opening, disrupting the cell membrane and allowing material to be inserted into the cell.

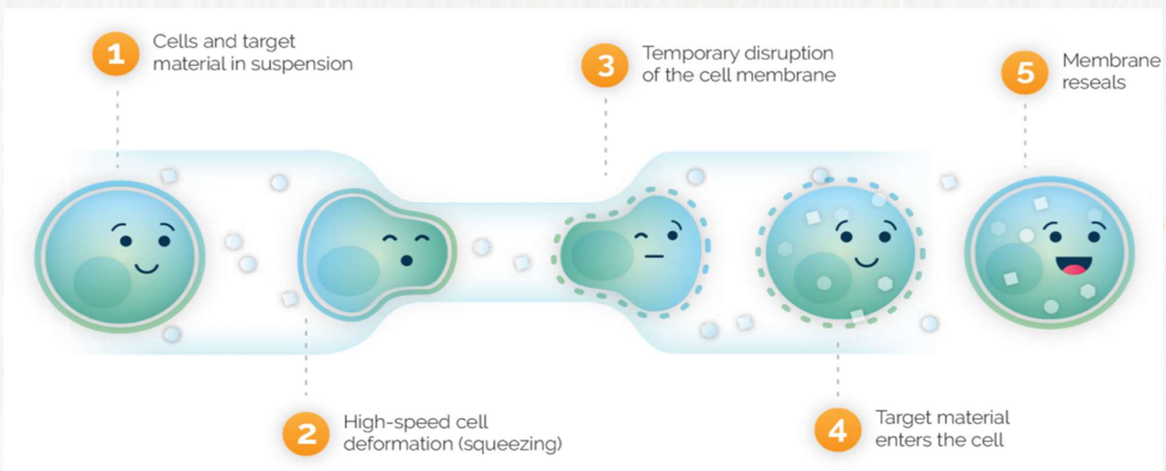

Fig 2: Illustrating cell squeeze platform

It is an alternative method to electroporation or cell-penetrating peptides and operates similarly to a french cell press that temporarily disrupts cells, rather than completely bursting them.

Conventional gene transfer disadvantages for cell therapy

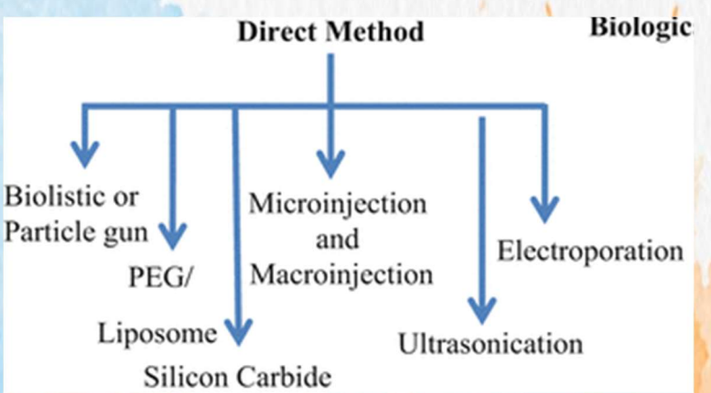

Fig 3: Gene transferring methods

Cell squeeze technology

The cell-disrupting change in pressure is achieved by passing cells through a narrow opening in a microfluidic device. The device is made up of channels etched into a wafer through which cells initially flow freely. As they move through the device, the channel width gradually narrows. The cell's flexible membrane allows it to change shape and become thinner and longer, allowing it to squeeze through. As the cell becomes more and more narrow, it shrinks in width by about 30 to 80 percent its original size and the forced rapid change in cell shape temporarily creates holes in the membrane, without damaging or killing the cell. While the cell membrane is disrupted, target molecules that pass by can enter the cell through the holes in the membrane.

As the cell returns to its normal shape, the holes in the membrane close. Virtually any type of molecule can be delivered into any type of cell. The throughput is approximately one million per second. Mechanical disruption methods can cause fewer gene expression changes than electrical or chemical methods. This can be preferable in studies that require the gene expression to be controlled at all times.

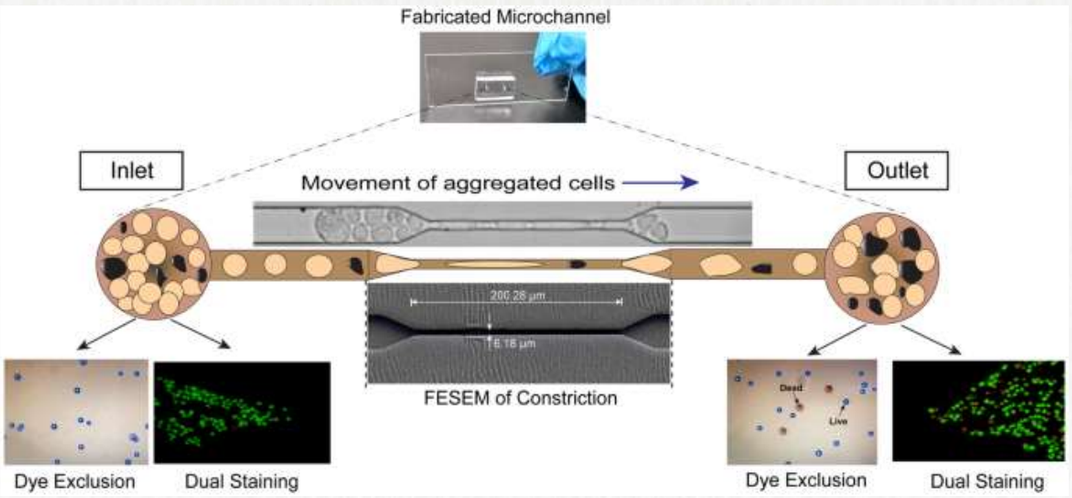

Fig 4: Microfluidic channel assisted cell squeeze technology

Differences and why an alternative

Cells are pushed through these mini tubules with pressure, and get “squeezed,” which opens up pores in the cell membrane Materials are diffused into the cell’s cytoplasm. Once they make it through the constriction, they bounce back to normal, pores sealed up.

- No chemicals used
- No electroporation
- No heat shock treatment
- No functional damage to the cellular components

Applications

Like other cell permeabilization techniques, it enables intracellular delivery materials, such as proteins, siRNA, or carbon nanotubes. The technique has been used for over 20 cell types, including embryonic stem cells and naïve immune cells. Initial applications focused on immune cells, for example delivering: Anti-HIV siRNAs for blocking HIV infection in CD4+ T cells.

Whole protein antigen and enabling MHC class I processing/presentation in polyclonal B cells, facilitating B cell-based vaccine approaches.

Antigen presenting cells (APCs) are analogous to the generals of the immune system. Their interactions with T cells, the soldiers, shape immune responses be they inflammatory (attack) or tolerogenic (protect). By engineering APCs and their interactions with T cells, SQZ could potentially impact numerous immune related diseases, including cancer and autoimmune disorders.

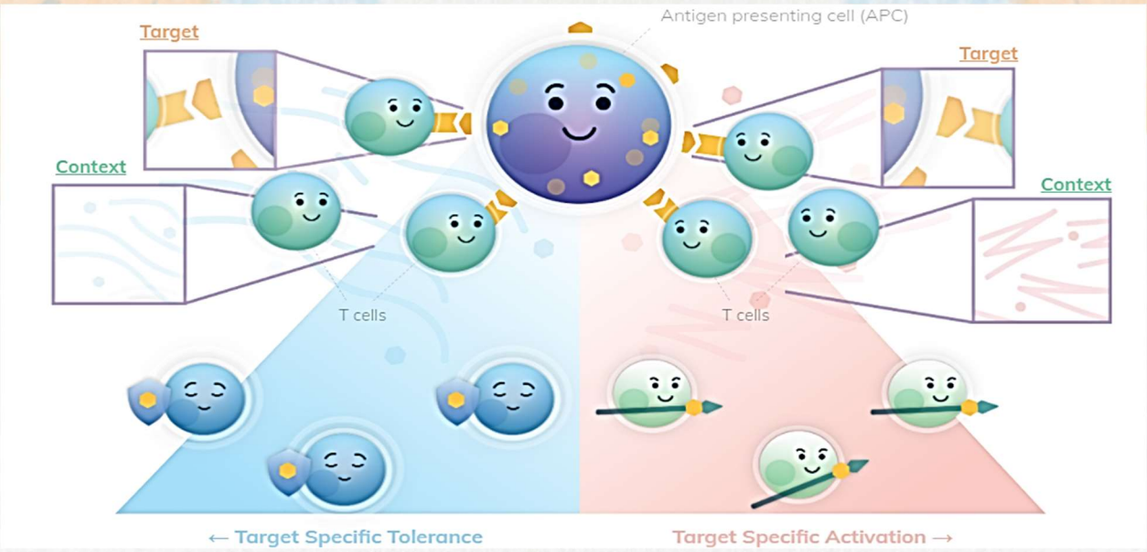

Fig 5: Applications of cell squeeze used in cell therapy

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Bacteriorhodopsin memory

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Introduction:

Silicon-based technologies has been developing since last three decades, and probably might reach its limit in next few decades (improvement in feature, size and device speed. According to Moore's law, semiconductor device size will probably approach the molecular domain around 2030, which is later known molecular electronics. One of such approach in biomolecular electronics (a sub-discipline of molecular electronics) is bacteriorhodopsin based optical memory storage device.

One of the conceivable future directions for memory storage is to make the transition from two to three dimensions. Conventional semiconductor-based technologies face several imposing challenges upon attempting to bridge that gap, including three-dimensional access of data and heat dissipation. There are pseudo-three-dimensional architectures available, but they largely consist of parallel versions of current technologies (i.e., stacked disk architectures with multiple heads that allow parallel access to multiple discs).

The only truly three-dimensional designs are optical, which have the advantage of optically accessing data in a volumetric homogeneous medium. The various active optical elements of these media that have been explored include organics, such as spiropyrans and fulgides, inorganic materials, such as lithium niobate, and finally, the photoactive protein bacteriorhodopsin.

What is Rhodopsin?

Rhodopsin (also known as visual purple) is a light-sensitive receptor protein involved in visual phototransduction. Rhodopsin is a biological pigment found in the rods of the retina and is a G-protein-coupled receptor (GPCR). It belongs to opsins. Rhodopsin is extremely sensitive to light, and thus enables vision in low-light conditions. When rhodopsin is exposed to light, it immediately photobleaches. In humans, it is regenerated fully in about 30 minutes, after which rods are more sensitive. Bacteriorhodopsin is a Microbial rhodopsin. Bacteriorhodopsin is a protein used by Archaea, most notably by haloarchaea, a class of the Euryarchaeota. It acts as a proton pump; that is, it captures light energy and uses it to move protons across the membrane out of the cell.

Bacteriorhodopsin:

Bacteriorhodopsin protein extracted from *Halobacterium salinarum* is widely used in many biohybrid electronic devices. The bacteriorhodopsin protein is one of the most promising organic memory materials. Seven helix-shaped polymers form a membrane structure, which contains a molecule known as the retinal chromophor. The chromophor absorbs light of a certain color and is therefore able to switch to another stable state in addition to its original state. Only blue light can change the molecule back to

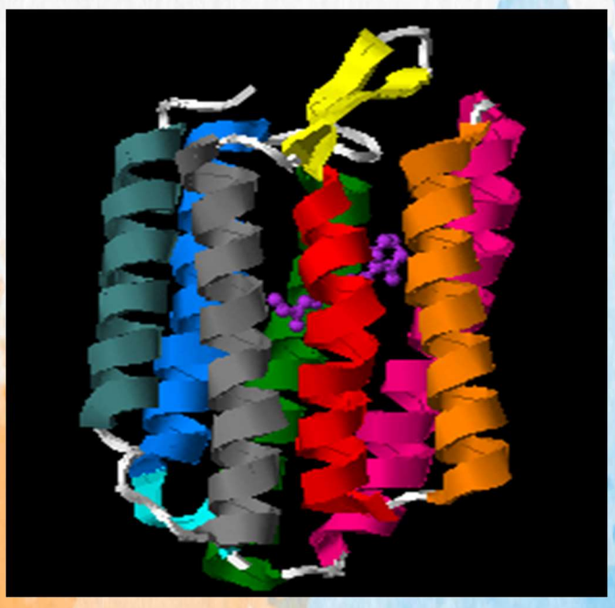

Fig.1. 7 helix structure of Bacteriorhodopsin

its original state. There are several properties that make bacteriorhodopsin an appealing candidate as an active element in device applications. However, two characteristics are of primary importance: the unique manner in which BR responds to light and the protein's remarkable stability.

Photocycle:

Upon the absorption of light, BR undergoes a complex photocycle, which is coupled to proton translocation across the cell membrane, thereby acidifying the extracellular medium. The all-trans retinal chromophore responsible for the absorption of light is bound through a protonated Schiff base to Lys-216. The initial resting state of the molecule is known as 'bR'. Green light transforms the initial 'bR' state to the intermediate state 'K'. Next 'K' relaxes, forms another intermediate state 'M' and then 'O' converts to another intermediate state 'P', which then relaxes to a more stable state 'Q'. Blue light converts 'Q' black to the initial state 'bR'. Here the idea is to assign any two long-lasting states to the binary values of '0' and '1', to store the required information. Upon exposure of the O-state to red light, a small percentage of the excited protein population will be driven into P-state, the first intermediate of the branched photocycle.

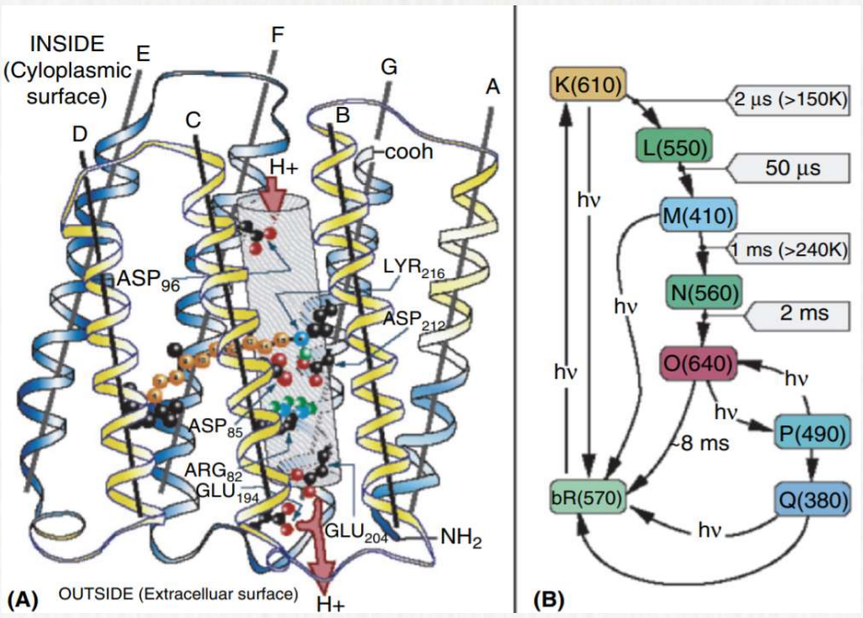

Fig.2. The image (A) Schematic of bacteriorhodopsin illustrating certain key amino acids and the purported path of the proton pump. The all-trans retinal chromophore traverses the binding pocket roughly perpendicular to the membrane normal and the alpha helices. The image (B) The bacteriorhodopsin photocycle, including the branched photocycle originating at the O-state. Absorption maxima in nanometer are shown in parenthesis for each intermediate

Branched-Photocycle:

The P-state is characterized by a 9-cis chromophore, which appears not to be stable in the binding site due to steric interactions between the C9 and C13 methyl groups of the chromophore and nearby amino acid residues. Driven by these steric constraints (i.e., to relieve the strain within the binding site), the Schiff base bond that connects the chromophore to Lys 216 hydrolyzes, resulting in a further blue shifted thermally stable product denoted as the Q-state. The result of this unique combination is a very stable state with an exceptional lifetime, on the order of several years. Exposure to blue light drives it directly back to the bR resting state. To date, a stable long-lived photochromic state

in BR has remained elusive, thereby limiting its viability for device applications. The Q-state, however, has become a particularly valuable candidate for both memory storage and holography.

Branched Photocycle Architecture:

In the branched-photocycle architecture, the resting state (bR) is assigned as a binary 0, and both the P- and Q-states are collectively assigned to a binary 1. A key to the architecture is that writing and reading require two separate photon absorption events: the first for exciting the protein, in effect priming it for binary conversion, and the second for actual binary conversion (after the appropriate temporal separation). Only this combination will result in forcing the protein into the branched photocycle in this way, the protein acts as a latched AND gate. The writing operation is initiated in the memory by a process referred to as paging. A thin slice of the cube is selected optically by a 630 nm laser (paging laser) beam to create the page. Around 2 ms later (depending on temperature), when protein in the paged region has reached the O-state, another laser (690 nm data laser) is fired perpendicularly to the paging laser. Using a spatial light modulator, data is encoded into the beam before it reaches the memory medium and intersects with the previously selected page.

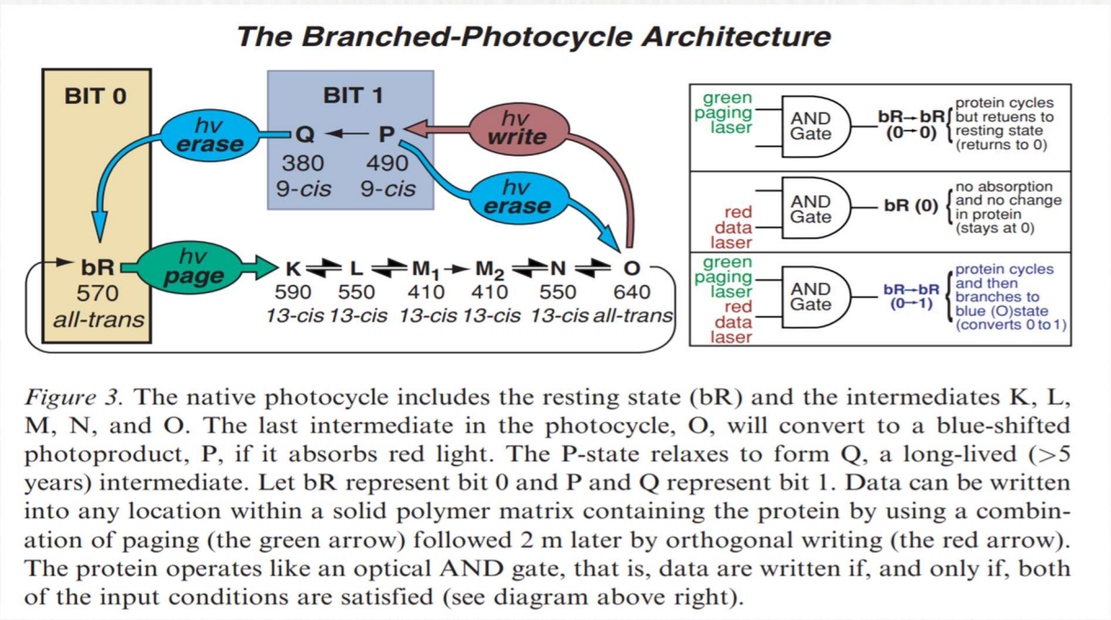

Figure 3. The native photocycle includes the resting state (bR) and the intermediates K, L, M, N, and O. The last intermediate in the photocycle, O, will convert to a blue-shifted photoproduct, P, if it absorbs red light. The P-state relaxes to form Q, a long-lived (>5 years) intermediate. Let bR represent bit 0 and P and Q represent bit 1. Data can be written into any location within a solid polymer matrix containing the protein by using a combination of paging (the green arrow) followed 2 m later by orthogonal writing (the red arrow). The protein operates like an optical AND gate, that is, data are written if, and only if, both of the input conditions are satisfied (see diagram above right).

Upon intersecting the selected page, only the protein in the doubly irradiated regions defined by the spatial light modulator will be driven into the branched photocycle, thereby driving the protein from a binary 0 to a binary 1. All BR outside both the doubly irradiated areas and the paged region will remain unchanged. The reading process is very similar to writing, in that it is also initiated by a paging laser, and after the bulk of the protein reaches the O-state, the data laser is fired.

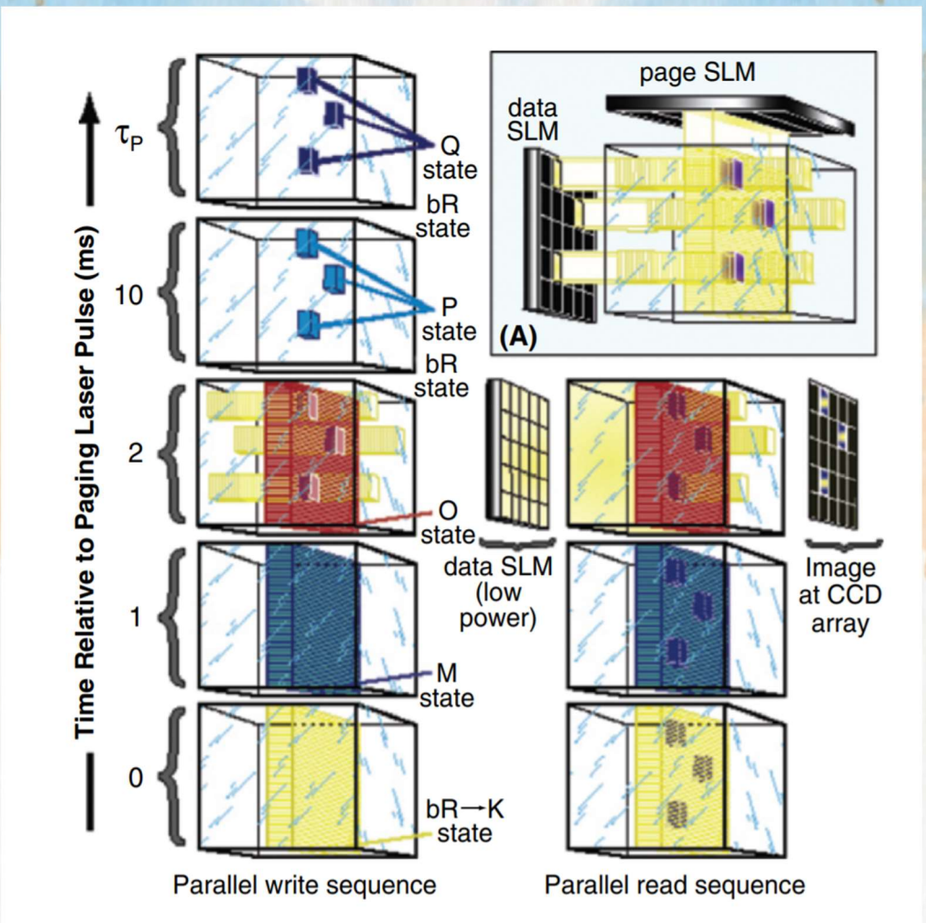

Fig.4. parallel write and read sequence.

The result is that in the reading process, the data laser will ‘‘illuminate’’ the page by introducing contrast between the binary zeros and ones. Because the absorbance maxima of the P and Q-states are blue shifted with respect to the wavelength of the data laser, previously written data will be, in effect, transparent to the data beam. The resulting image is then recorded by a charge-coupled device (CCD)—a differential read is done by comparing to a data image recorded prior to firing the data laser. An erasing operation can be accomplished by driving the 9-cis O-state back to the all-trans resting state with a blue laser (380–480 nm). Lasers in this spectral region are at this point prohibitively expensive, so only global erasures are possible at this time; until such lasers are within reach, the memory system is operated as a write once read many (WORM) devices.

Advantages:

The bR based 3D optical memory has several conceivable advantages, like Substantial increase in the potential storage density (data resolution is limited by the resolution of the SLM, the diffraction limit, and the light scattering potential of the polymer matrix),The ability to operate in parallel, thereby introducing a large gain in data throughput. The resistance to the damaging effects of radiation. The latter is of strong interest to space and satellite applications, where lead is needed to shield semiconductor-based storage media.

Disadvantages:

Memory cubes must be extremely uniform in their composition and must be homogeneous to ensure good results, since excess of defect of molecules in one particular region tends to distort the stored information and render the memory cube useless. It is a single write-in device, as erasing

operation is expensive.

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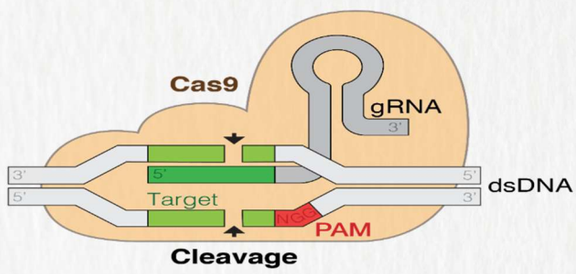
CRISPR/Cas9 genome editing that helps in targeting human hematopoietic stem cells

NIKITA RAMKUCHE
111713

Introduction

In recent days, there has been a high rise in diseases related to blood disorders such as sickle cell anemia, thalassemia, etc., where red blood cells become distorted, rigid and adhesive. They become fatal sometimes. These diseases, is the result of a genetic mutation in a particular type of stem cell. CRISPR-Cas9 Genome Editing is a great way to rectify mutations in the stem cells in the lab. Then these modified cells can be easily placed in the bodies of the affected people. The whole process can help in the treatment of diseases. This is why molecular biologists and biomedicine researchers need to work more on this process.

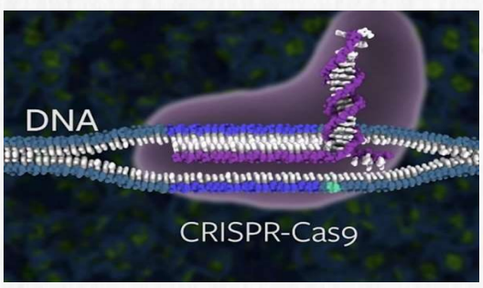
There is a lack of protocol for targeting hematopoietic cells for targeting genes that have influenced Rasmus O Bak et al to develop a protocol for invention, enhancement, in vivo and in vitro genome editing in hematopoietic stem cells (HSC). The study was published in Nature Protocols in January 2018. The protocol includes analyzes by combination of CRISPR/Cas9 process with the use of rAAV6 and flow cytometry, which will take 3 weeks to complete for HSC in vitro and 1 6 weeks for HSC in vivo. The protocol will help researchers to make single nucleotide alteration in the genome, as well as gene editing at any specific location.



CRISPER Cas 9 Technology

(Ref. marius walter)

Ref. Robert snader



- CRISPR gene editing is a genetic engineering technique in molecular biology by which the genomes of living organisms may be modified. It is based on a simplified version of the bacterial CRISPR-Cas9 antiviral defense system.
- By delivering the Cas9 nuclease complexes with a synthetic guide RNA (gRNA) into a cell, the cell's genome can be cut at a desired location, allowing existing genes to be removed and/or new ones added in vivo (in living organisms).
- The technique is considered highly significant in biotechnology and medicine as it allows for the genomes to be edited in vivo with extremely high precision, cheaply and with ease.
- It can be used in the creation of new medicines, agricultural products, and genetically modified organisms, or as a means of controlling pathogens and pests. It also has possibilities in the treatment of inherited genetic diseases as well as diseases arising from somatic mutations such as cancer.

Major components

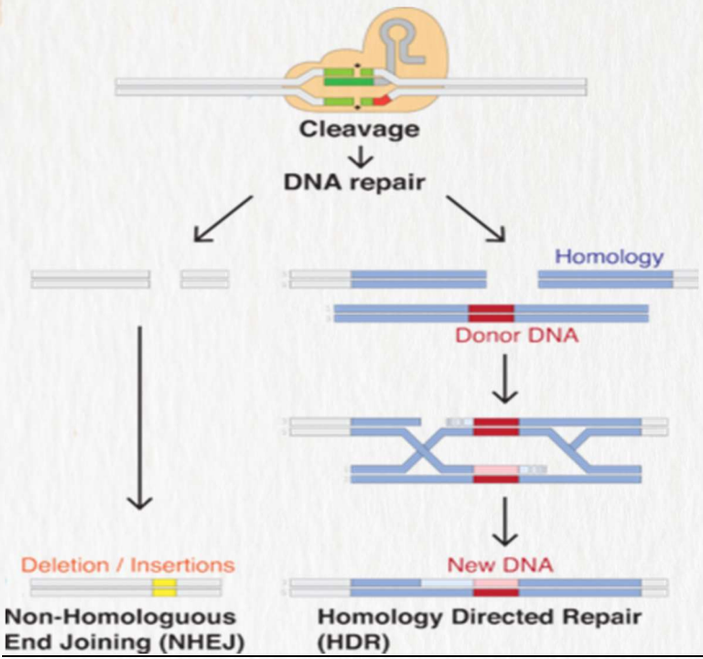
crRNA: Contains the guide RNA that locates the correct segment of host DNA along with a region that binds to tracrRNA (generally in a hairpin loop form), forming an active complex.

tracrRNA: Binds to crRNA and forms an active complex.

sgRNA: Single-guide RNAS are a combined RNA consisting of a tract RNA and at least one crRNA

csa9: An enzyme whose active form is able to modify DNA. Many variants exist with different functions (i.e. single-strand nicking, double-strand breaking, DNA binding) due to each enzyme's DNA site recognition function.

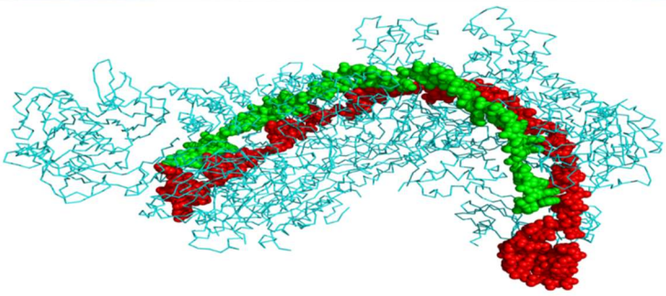
Repair Template: DNA molecule used as a template in the host cell's DNA repair process, allowing insertion of a specific DNA sequence into the most segment broken by Cas9.



DNA repair after double-stranded break (Ref. marius walter)

CRISPR (clustered regularly interspaced short palindromic repeats) is a family of DNA sequences found in the genomes of prokaryotic organisms such as bacteria and archaea. These sequences are derived from DNA fragments of bacteriophages that had previously infected the prokaryote. They are used to detect and destroy DNA from similar bacteriophages during subsequent infections. Hence these sequences play a key role in the antiviral (i.e. anti-phage) defense system of prokaryotes. The CRISPR-Cas system is a prokaryotic immune system that confers resistance to foreign genetic elements such as those present within plasmids and phages and provides a form of acquired immunity. RNA harboring the spacers sequence helps Cas (CRISPR-associated) proteins recognize and cut foreign pathogenic DNA. Other RNA-guided Cas proteins cut foreign RNA.CRISPR are found in approximately 50% of sequenced bacterial genomes and nearly 90% of sequenced archaea. Cas9 (or "CRISPR-associated protein 9") is an enzyme that uses CRISPR sequences as a guide to recognize and cleave specific strands of DNA that are complementary to the CRISPR sequence. Cas9 enzymes together with CRISPR sequences form the basis of a technology known as CRISPR-Cas9 that can be used to edit genes within organisms. This editing process has a wide variety of applications including basic biological research, development of biotechnology products, and treatment of diseases.

CRYSTAL STRUCTURE OF CRYSPER RNA



Application:

CRISPR gene editing

CRISPR technology has been applied in the food and farming industries to engineer probiotic cultures and to immunize industrial cultures (for yogurt, for instance) against infections. It is also being used in crops to enhance yield, drought tolerance and nutritional value. In the future, CRISPR gene editing could potentially be used to create new species or revive extinct species from closely related ones. CRISPR-based re-evaluations of claims for gene-disease relationships have led to the discovery of potentially important anomalies.

CRISPR as diagnostic tool

CRISPR associated nucleases have shown to be useful as a tool for molecular testing due to their ability to specifically target nucleic acid sequences in a high background of non-target sequences. In 2016, the Cas9 nuclease was used to deplete unwanted nucleotide sequences in next-generation sequencing libraries while requiring only 250 picograms of initial RNA input. By coupling CRISPR-based diagnostics to additional enzymatic processes, the detection of molecules beyond nucleic acids is possible. One example of a coupled technology is SHERLOCK-based Profiling of IN vitro Transcription (SPRINT).

SPRINT can be used to detect a variety of substances, such as metabolites in patient samples or contaminants in environmental samples, with high throughput or with portable point-of-care devices. CRISPR/Cas platforms are also being explored for detection and inactivation of the novel corona virus, SARS-CoV-2.

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Mycelium materials

PRAGNA RAJ
11701

NOVEL CLASS OF RENEWABLE BIOMATERIAL

1. Single use packaging materials and environmental impact..?

Pollution from single use plastics has become a major global problem. Recent scientific studies have shown that plastics and/or microplastics has entered all levels of the food chain within our oceans; and is impacting over natural environment, drainage, and waterways. "**single use plastics**" commonly referred as disposable plastics, are plastics intended for one time use before they thrown away or recycling. In many cases, single use plastics are used as packaging materials. Most plastics and Styrofoam are derived from petroleum, meaning that they are a petroleum-based product. For the purposes of the paper: Single Use Plastics refers to both plastics and Styrofoam. Packaging Materials associated with single use plastics are composed of polyethylene, commonly referred to as plastics, and expanded polystyrene, commonly referred to by its most common brand name Styrofoam. Polyethylene or polythene is the most common plastic in packaging and used for making plastic bags, plastic film, plastic bottles, etc. Expanded Polystyrene, locally referred to as Styrofoam or foam, is commonly used for foam food containers, for example, clamshells, soup cups, foam cups, etc.

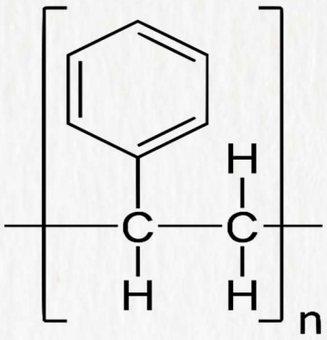


Fig (a) Polystyrene structure

Fig (b) Polystyrene beads

Fig (d) Plastic cups and plates

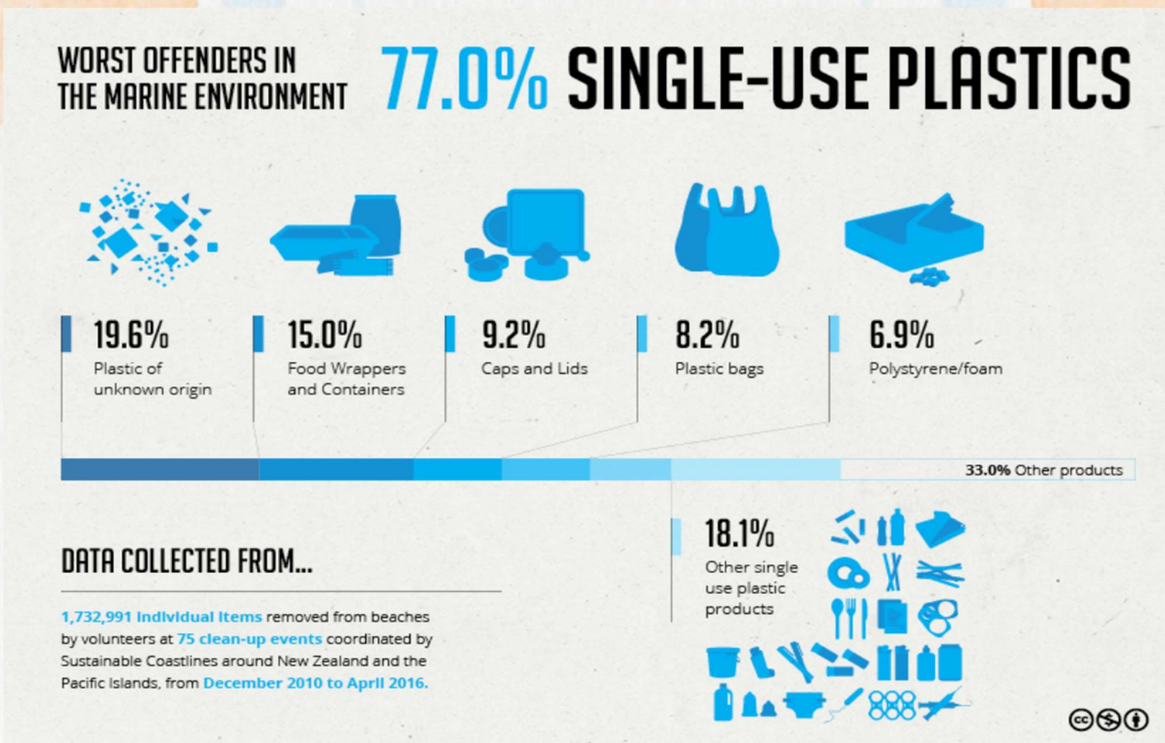
Fig (e) Styrofoam wastage after use

Bird consuming Styrofoam floating.

Single use plastic that we are using in our daily life got alternatives

Why a sustainable replacement required...?

Most Plastics do not biodegrade – meaning they do not breakdown / decompose as a result of natural processes or microorganisms into harmless substances into the natural environment. Instead, plastics slowly breakdown into smaller fragments called “microplastics" and remain in the environment whether on land or in the sea. Plastics and styrofoam pollute the environment and end up in our drains, rivers, coastlines, and oceans. Styrene can leach from polystyrene; this can lead to nervous system damage and cancer. Disposal of plastics costs the tax payer more money for garbage disposal because plastics do not degrade rapidly and fills up a disposal landfill, reducing the lifespan of the disposal site.



Myco-material – An ecological promise

Here is an eco-friendly alternative to Styrofoam which you can actually grow from the earth. The brainchild of Evocative Design, the Mushroom Packaging features a more sustainable form of Styrofoam that has been made entirely from mushrooms.

It grows from mycelium and other agricultural by-products. First of all, these are broken down and bound by the former which acts like a natural glue. After that, the material is compostable and we can use it to create bio composite materials that can easily replace particle boards, plastic foams and other dense materials in the long run.

Wide distribution and diversity of fungal species in the ecosystem, that gives a brief idea about the selection of species in the myco material designing.

Button Mushrooms – regularly used as food.

Some non-edible fungi grown in wild conditions

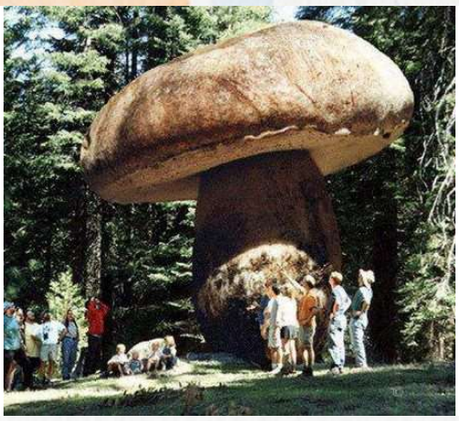
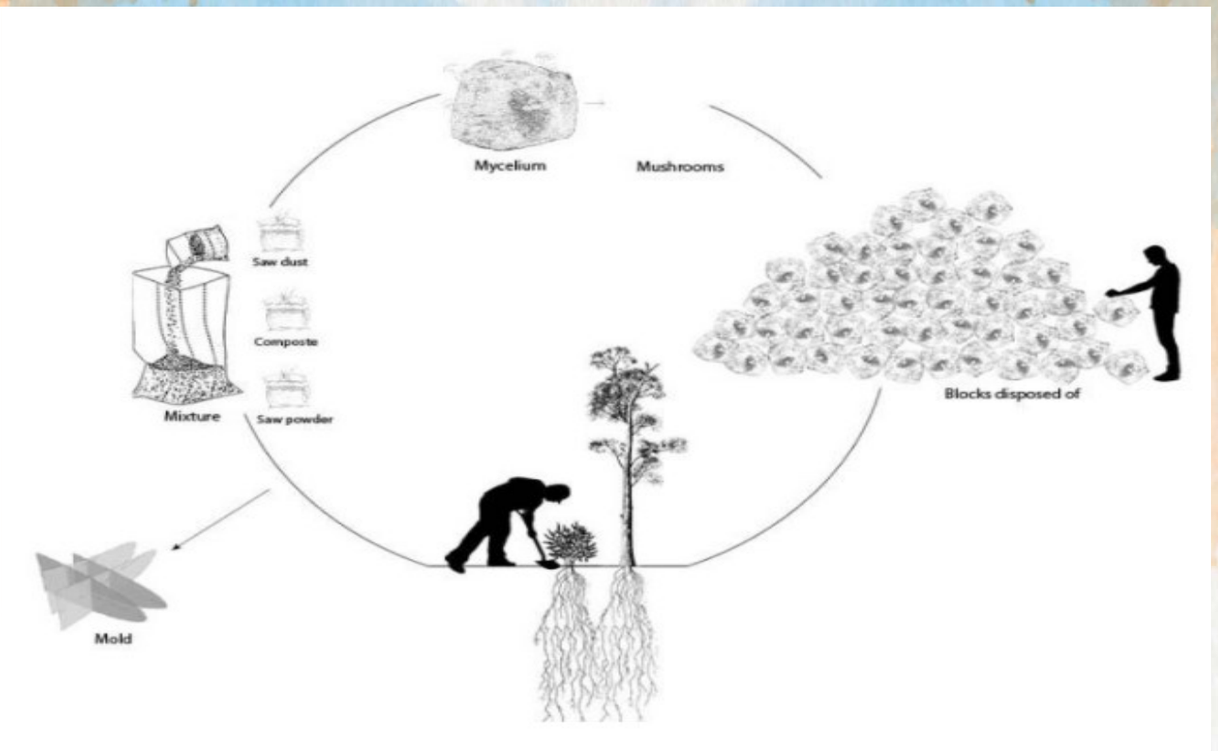


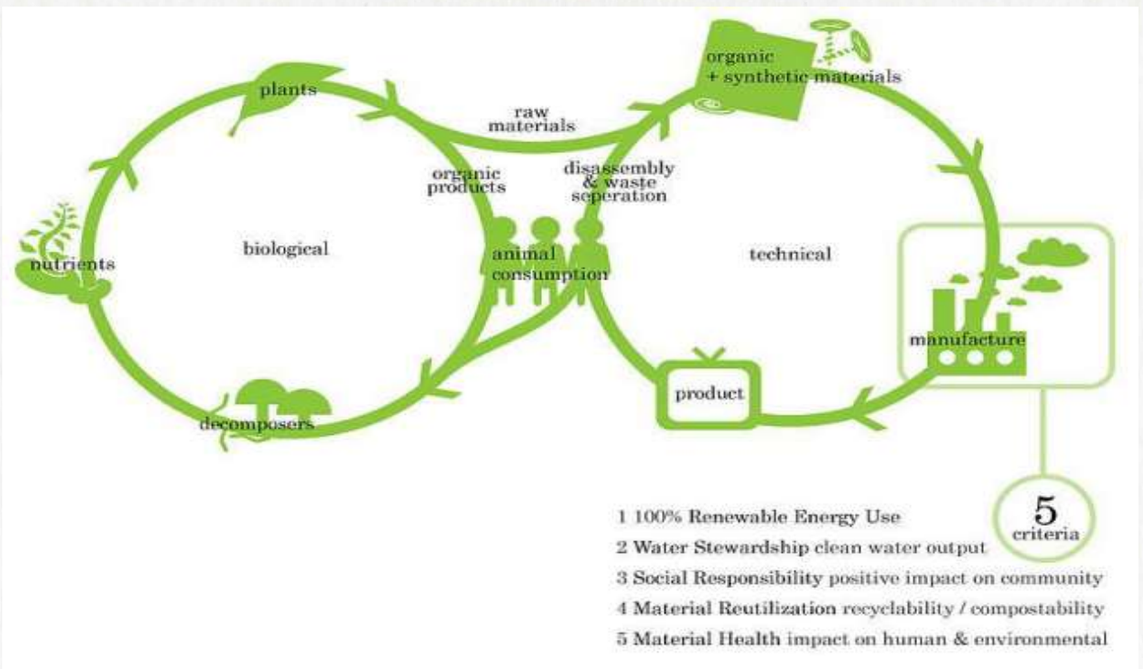
Fig (j) Armillaria ostoyae recorded as biggest mushroom ever.

Rhodotus palmatus are one of the sps Exhibits wide colors in their outer structure.

Mycelium

- **Mycelium** is the vegetative part of a fungus.
- Mycelium can act as a binder, holding new soil in place and preventing washouts until woody plants can be established.
- Ideal conditions to encourage growth is an environment that is warm (75-80°F or 24-27°C), dark (in a closet, under a bed, etc.), and damp. it is also important to have a little bit of airflow.[5]
- Can grow easily on decomposing wood, rice straw, plants, moisture, partial oxygen supply.
- Capable to adopt for the harsh conditions





The manufacturing process of the "mushroom-based plastic", called Myco Foam, is as follows: agricultural waste such as straw, corn husks or lentil pods is collected from local producers. The waste is sterilized and introduced into the mycelium and the mixture is placed in molds in the dark. For five days, the mycelium grows. Feeding on the agricultural waste, it forms a network of tiny white fibers entangled in and around the substrate, filling all the available space and forming a solid structure. The resulting material is removed from the mold and dried to stop the mycelium growing and producing mushrooms or spores.

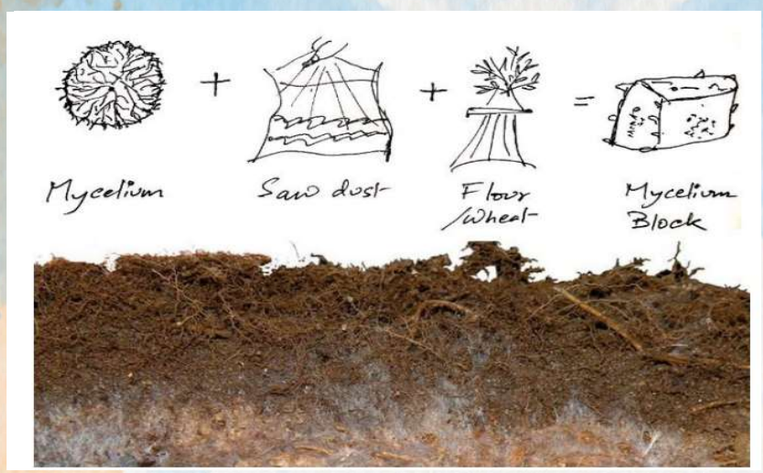


Fig (p) Process of mixing of Mycelium with substrates, after 6 to 12 days mycelium growth was observed

Fig (q) Mycelium growing in specially designed mould to give it a particular shape

Application



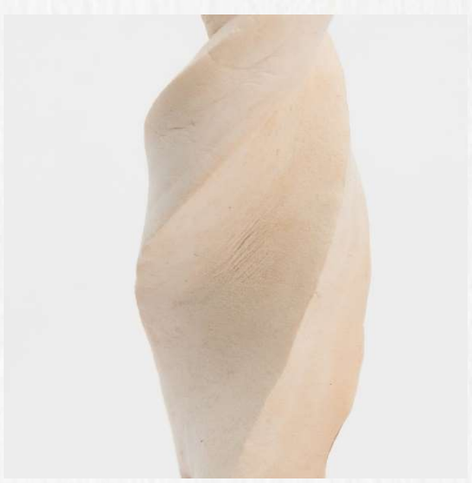




Fig (t) Mycelium materials used as bottle packaging, decorative, structures, Flexible materials, chair as a whole, abstract, bricks

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CONFERENCES ATTENDED

1. E Aman Rao, M Rajesh, V Rakesh, poster presentation in "**International Conference on Advances in Biosciences and Biotechnology**" 2020 (January 30th to February 1st, 2020), Japyee Institute of Information and Technology, Noida, India.

2. Jadala Varshini, M.C.H.Veera Manikanta & Ch.V. Sree Raj Akhil. Oral presentation in "**Two - Day online national conference on Biological, Biochemical, Biomedical, Bioenergy and Environmental Biotechnology**" 2021 (January 29-30th, 2021), National Institute of Technology Warangal, India.

3. E Aman Rao, M Rajesh, V Rakesh. Oral presentation in "**Two -Day online national conference on Biological, Biochemical, Biomedical, Bioenergy and Environmental Biotechnology**" 2021 (January 29-30th, 2021), National Institute of Technology Warangal, India.

PLACEMENT SECURIED BY STUDENTS

1.

STUDENTS: - UDAY

Company: TCS

Off Campus Drive

Package: 3.5 LPA

CGPA: 7.71

I wrote the TCS NQT exam have syllabus of Aptitude, Verbal, Reasoning and Programming

After that I had an interview.

2.

STUDENT: - POOJA

Company: Accenture

Package: 9 LPA

Type : On campus

Cgpa. : 7.9

Accenture solutions is a software company which recruits students from our campus every year. It is one those companies which extends eligibility criteria to all the branches.

- NAME: AZARDUDDIN

Company: TCS

Off Campus Drive

Package: 3.5 LPA

CGPA: 7.71

I wrote the TCS NQT exam have syllabus of Aptitude, Verbal, Reasoning and Programming

After that I had an interview.

Student Achievement (2017-2021)

GATE qualified candidates

S. No	Name	All India Rank
1	Sribhasyam Akhil	184
2	Thota Uday Kiran	1631
3	Siva Udayan	1803
4	Nikita Ramkuche	2239
5	Pragna Raj	2330
6	P. Ramakrishna Reddy (Alumini)	55

NAME : SRI BHASHYAM AKHIL

HAVE BEEN SELECTED FOR THE COLLEGE **IIT MADRAS** OCCUPYING THE BRANCH **BIOPROCESSING**

NAME : Jahanvi

Acquired her admission in University of California, San diego (Master of Science in Bioengineering) Department of Bioengineering.

OUR FACULTY

Dr. JAGAN MOHAN RAO

Dr. V. SUDARSAHANA DEEPA

Dr. RAJESWARA REDDY ERVA

Dr. A. SEENIVASAN

Dr. MANASA P

Dr. M. R. D. S. NITISH V

Dr. NITHYA M

Dr. DESHAVATH NARENDRA NAIK

kruthi Doriya

OUR STAFF

Ms. HARITHA V

Ms. UMA POLINA

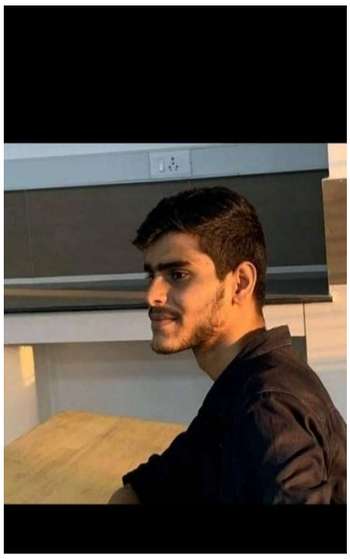
BIOTS 2019-2023

SOWJANYA

SANDEEP

DEEPAK

SAIPRADEEP



ABHISHEK

SUBHASH

YASHWANT

HEMASRI

AKASH

SAI VENKAT

WAZIR HASAN

SAIKUMAR

AJAY

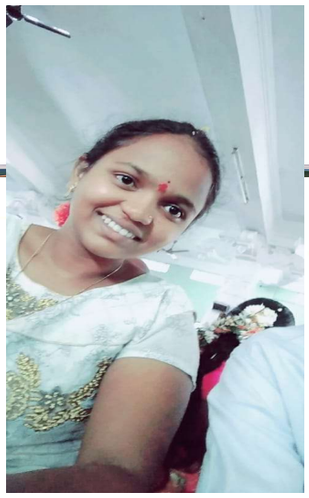
SAI SINDHU

DIVYA

BIOTS 2018-2022

DHANA SAGAR

SAI SRIKARI



VINODINI

SURAKSHITH

SHASHIDHAR

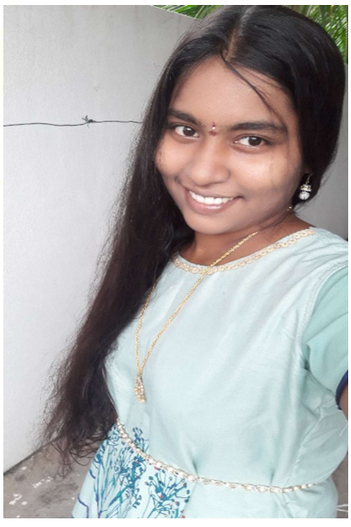
SIVA

NAVYA SREE

SAIVINAY

DHEERAJ

REETHIKA



HEMA LATHA NAGA LAKSHMI

GEETHA SRI

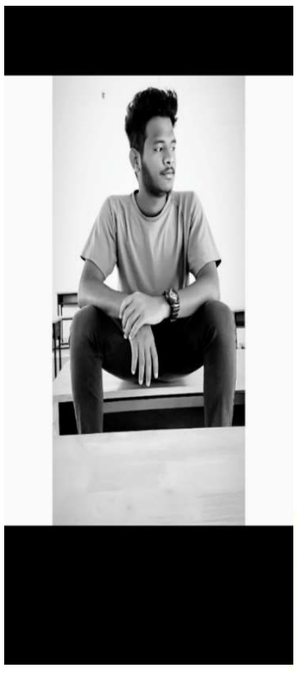
PRAVEEN

HANNAH

VENKATESH

BHUMIKA

AMAN



UJWAL

LAHARI

MAHESHWARI

BIOTS 2017-2021

PRAGNA RAJ

VARSHINI JADALA

G.POOJA

G.VEERAKUMAR

VANI BAI

CHAVVI RAJ MEENA

RAKESH.V

SHREE RAJ AKHIL

AMAN RAO

NIKITA RAMKUCHE

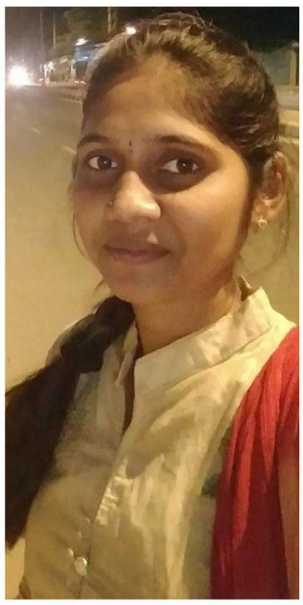
STANNY SHEKAR

VEERA MANIKANTA

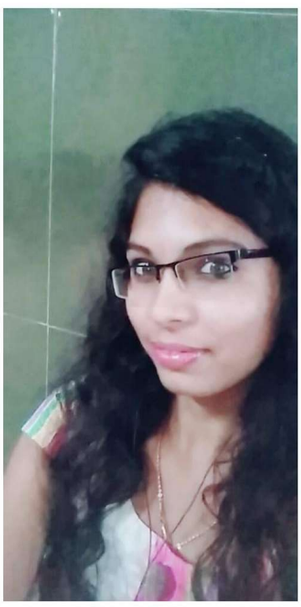
D.D.S. SAMPREETH

AZARUDHIN.M

JAHANVI KUMAR.A



RACHANA.U



MOUNIKA.B

RAJESH.M

VASA ANUSHA

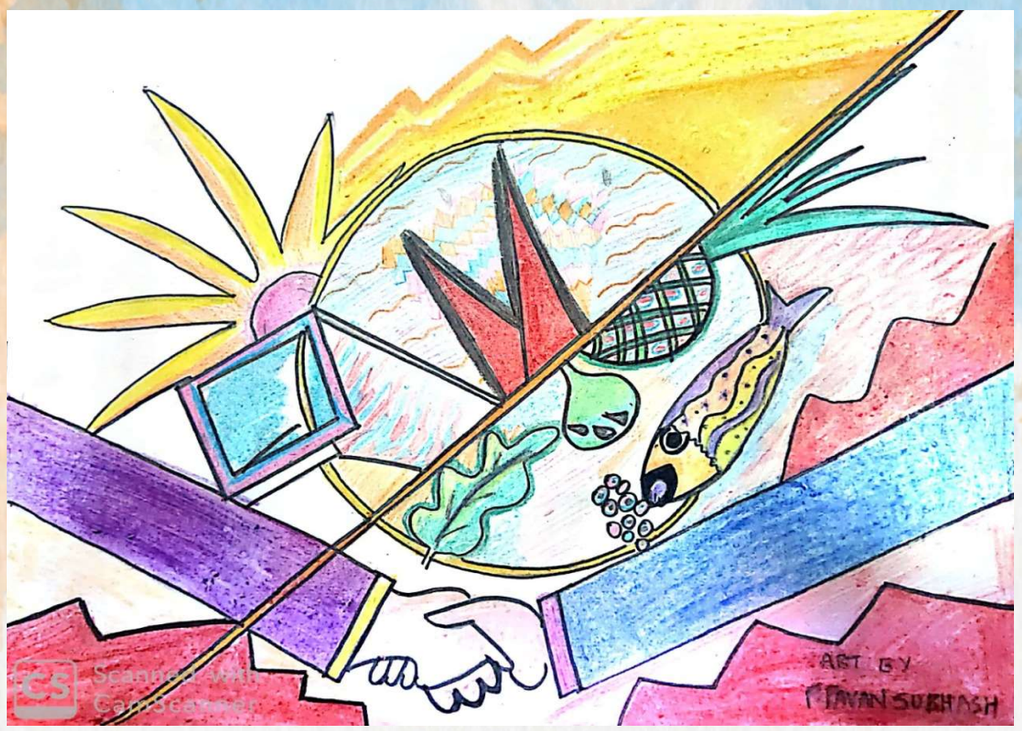
UDAY KIRAN.T

SRI BHASHYAM AKHIL

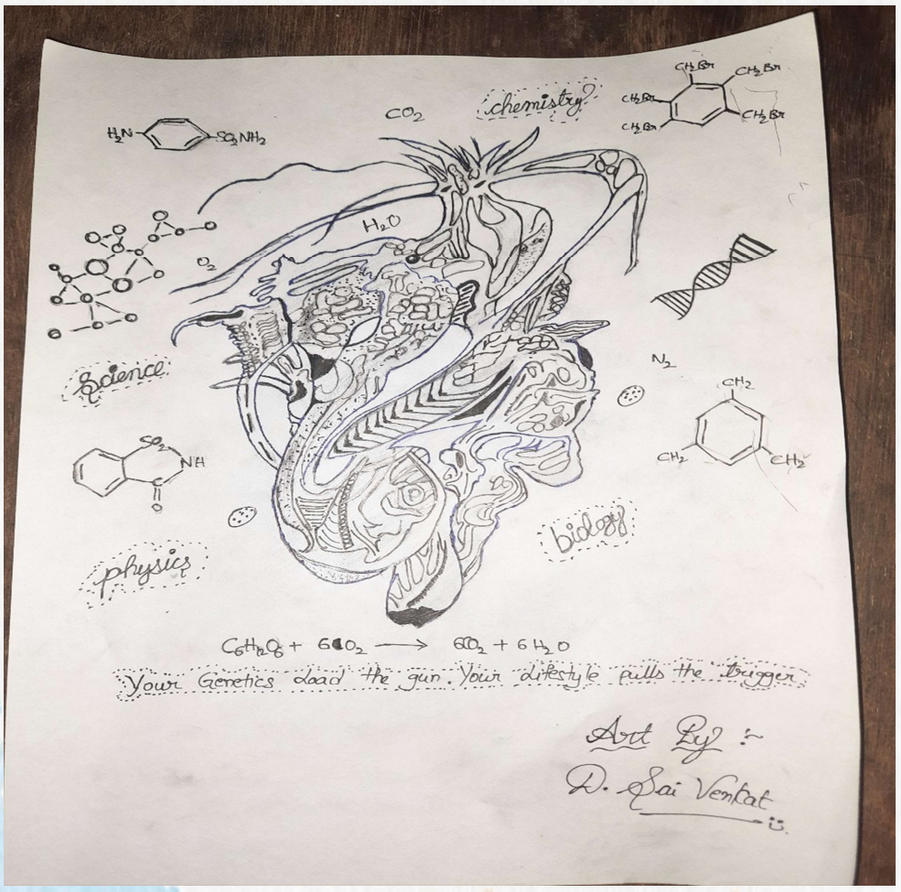
NIVEDITA

ACTIVITIES

- **Drawing competition**



1st prize



Humans have destroyed more than 30% of the natural world since 1970.

This has led to animals migrating to new and unnatural habits to live in. Conservation of the world's biodiversity is vital to help maintain the natural balances disrupted by recent human activity. If we don't act now this will have a devastating effect on our ecosystems and the world's biodiversity.