M. G. SCIENCE INSTITUTE

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DEPARTMENT OF MICROBIOLOGY

presents

THE WORLD OF MICRO BIO & ME

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EDITOR-IN CHIEF

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MEET JOSHI

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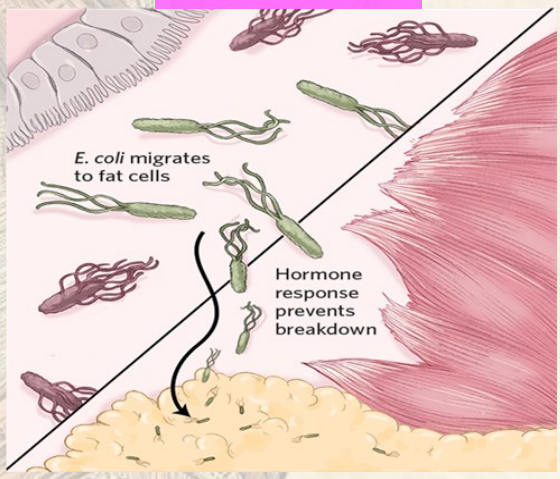
IMMUNITY ISN'T THE BODY'S ONLY DEFENCE SYSTEM

When we are sick, we want to feel better immediately. Our bodies function to accomplish this goal by activating the immune system to vanquish the invader as quickly as possible. Vaccines help prepare the immune system for this fight, while antibiotics or antiviral drugs serve as its support on the battlefield, targeting the pathogens and preventing them from multiplying and spreading in the body.

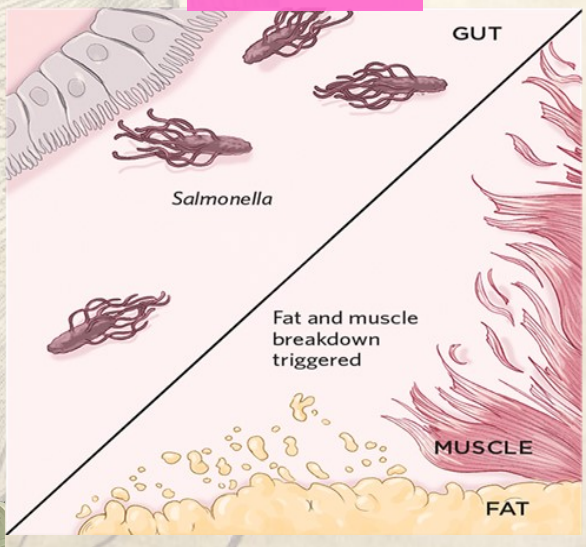
But often what makes us sick is our own immune response. To avoid sickness we take pain or fever-reducing medicine which doesn't affect the illness-causing pathogen at all, but does calm the inflammation and other symptoms. Recently, scientists have come to realize that the body can similarly work to promote health by suppressing an immune response and minimizing the damage from an invading pathogen. And adapting some of the ways where disease tolerance can protect the body from damage during infection. The possible mechanisms involved include symbiotic bacteria in gut, host metabolism and pathogen mutation in host body.

Mammalian guts are loaded with symbiotic bacteria, which might actually help us tolerate pathogenic microbes. Severe infection with *Salmonella typhimurium* can sometimes trigger muscle and fat tissue in a host to damage. But, researchers found, when mice had a symbiotic E. coli in their guts, they didn't suffer much damage to their tissues. Giving E. coli to mice that lacked the symbiotic strain revealed that, upon infection with Salmonella, the resident microbe moves to the adipose tissue. There, it triggers a hormone response that protects against fat and muscle breakdown, easing the animals' recovery

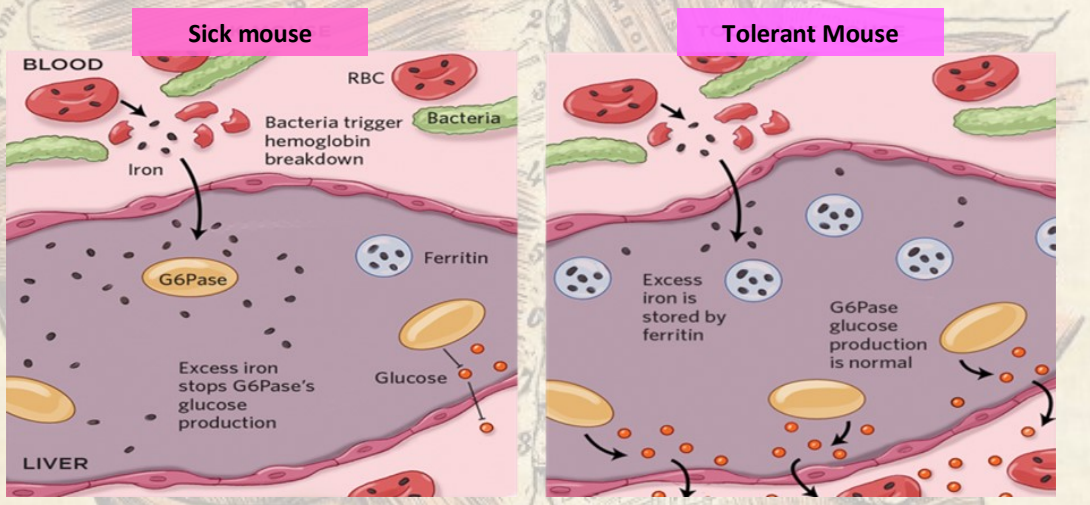
Tolerant Mouse



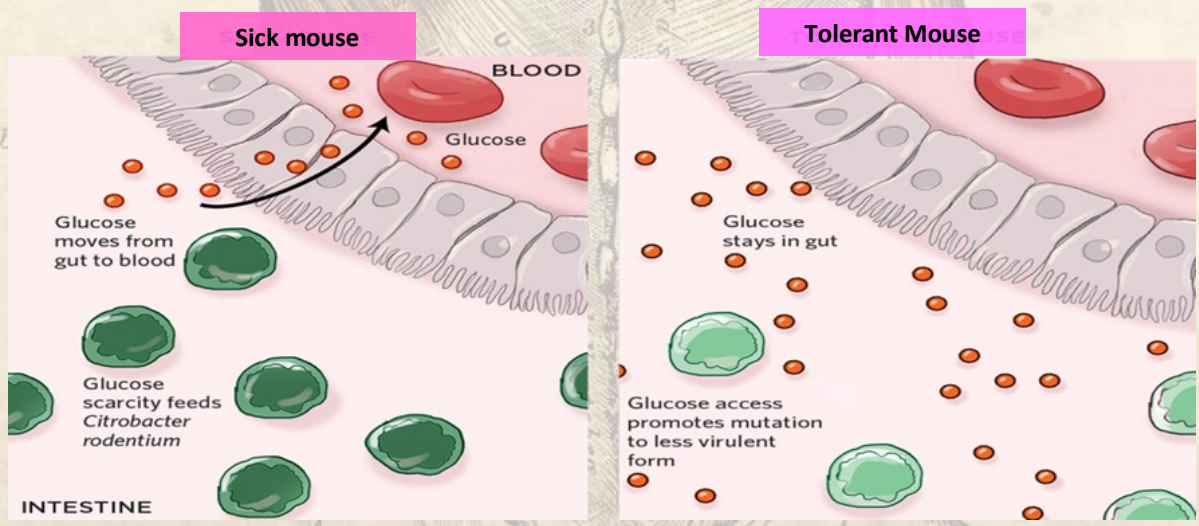
Sick mouse



In second approach when pathogens invade a host, they need sugar along with essential nutrients such as iron to survive. Many pathogens break down the blood protein hemoglobin to get iron, which leads to extra molecules of heme byproduct in the blood. That excess heme reduces the activity of an enzyme called glucose 6-phosphatase (G6Pase) that is essential for producing glucose in the liver. Without glucose production, sugar levels in the blood drop, sometimes so low that the host dies. In mice with high levels of ferritin, an iron-storage protein, glucose production doesn't slow down, allowing the body to tolerate infection by multiple pathogens. Supplementing with a protein that grabs iron to make ferritin saved mice that were fail to resist the infection



Another mechanism involve pathogen mutations when a mouse's small intestine produces glucose during a *Citrobacter rodentium* infection, sugar molecules are absorbed into epithelial cells and then released into the bloodstream. This can feed the pathogen, intensify the immune response to the invader, and lead to the host's death. However, when infected mice were fed an iron-rich diet, glucose was not easily absorbed from the intestine, leaving it available for the pathogen to consume. Having access to the glucose cause mutations in the virulence genes of the bacteria, making them less pathogenic and allowing the bacteria to live without damaging the body.



NOBEL LAUREATES

-ZALAK SOLANKI (B. Sc. SEM 6)

Nobel prize : For discovery of how cells sense and adapt to oxygen availability

Date of nobel prize :October 7 , 2019.

The need for oxygen to sustain life has been understood since the onset of modern biology; but the molecular mechanisms underlying how cells adapt to variations in oxygen supply were unknown until the prize-winning work. They identified molecular machinery that regulates the activity of genes in response to varying levels of oxygen.

Gregg Semenza studied the EPO gene and how it is regulated by varying oxygen levels. By using gene-modified mice, specific DNA segments located next to the EPO gene were shown to mediate the response to hypoxia.

Sir Peter Ratcliffe also studied O2-dependent regulation of the EPO gene, and both research groups found that the oxygen sensing mechanism was present in virtually all tissues, not only in the kidney cells where EPO is normally produced.

Semenza wished to identify the cellular components mediating this response. In cultured liver cells he discovered a protein complex that binds to the identified DNA segment in an oxygen-dependent manner. He called this complex the hypoxia-inducible factor (HIF) . HIF was found to consist of two different DNA-binding proteins, so called transcription factors, now named HIF-1α and ARNT.

At about the same time as Semenza and Ratcliffe were exploring the regulation of the EPO gene, cancer researcher William Kaelin, Jr. was researching an inherited syndrome, von Hippel-Lindau's disease (VHL disease). This genetic disease leads to dramatically increased risk of certain cancers in families with inherited VHL mutations. Kaelin showed that the VHL gene encodes a protein that prevents the onset of cancer. Kaelin also showed that cancer cells lacking a functional VHL gene express abnormally high levels of hypoxia-regulated genes; but that when the VHL gene was reintroduced into cancer cells, normal levels were restored. This was an important clue showing that VHL was somehow involved in controlling responses to hypoxia.

Ratcliffe and his research group then made a key discovery: demonstrating that VHL can physically interact with HIF-1α and is required for its degradation at normal oxygen levels. This conclusively linked VHL to HIF-1α.

Many pieces had fallen into place, but what was still lacking was an understanding of how O2 levels regulate the interaction between VHL and HIF-1α. The search focused on a specific portion of the HIF-1α protein known to be important for VHL-dependent degradation, and both Kaelin and Ratcliffe suspected that the key to O2-sensing resided somewhere in this protein domain. In 2001, in two simultaneously published articles they showed that under normal oxygen levels, hydroxyl groups are added at two specific positions in HIF-1α. This protein modification, called prolyl hydroxylation, allows VHL to recognize and bind to HIF-1α and thus explained how normal oxygen levels control rapid HIF-1α degradation with the help of oxygen-sensitive enzymes (called prolyl hydroxylases). Further research by Ratcliffe and others identified the responsible prolyl hydroxylases. It was also shown that the gene activating function of HIF-1α was regulated by oxygen-dependent hydroxylation.

Through this combined work ,it was thus demonstrated that the response by gene expression to changes in oxygen is directly coupled to oxygen levels in the animal cell, allowing immediate cellular responses to occur to oxygenation through the action of the HIF transcription factor.The discovery of the proline hydroxylases that regulate HIF-1α stability enabled a search for hydroxylase inhibitors to increase HIF levels; and this has now opened up new pathways for pharmacologic discovery. In fact, a number of potential drugs that increase HIF function by inhibiting the PHD enzymes are already far along in clinical trials, in treatment of anemia.

A HEADPHONE:LIVING AND DEAD CONCURENTLY

Meet Joshi (B. Sc. SEM4)

The first thing anybody in the world imagines if you say music it is headphones, right? Comforting, loud with high bass and a bit costly. But costly to whom?? To both of us -to humans and to nature. Headphones are a boon that makes people escape their consciousness and turns reality to their fantasized world. Besides this headphone has a good advantage of limiting the sound pollution to one's own ear canal instead of playing out loud!

But with all these goods comes the evil - Plastic. Since the main material used in its manufacturing is plastic and leather. Our already polluted oceans full of plastic erode nature everyday even if we ignore. Thus to change the world of designing and material science, scientists at Finland made a thought and started to execute it by making headphones of nothing but a staggering mixture of fungus and bacteria.

Korvaa is a collaboration between Synbio (Synthetic Biology) scientists, industrial designers, artists and filmmakers creating a headset made with microbial materials. Each part of it uses microbial materials with different properties. Microbial bio plastic (Mainly PLA - Polyhydroxy Lactic Acid) for the hard parts which are 3D printed.

The project is an experimental collaboration which explores the design and functionalities of novel bio based, microbially grown materials.

Currently Korvaa is being operated in Aivan, Finland. Fungal and Yeast bio plastics are predominantly used in such project.

There is a species of bacteria so resistant to radiation that scientists have nicknamed it “Conan the Bacterium”.

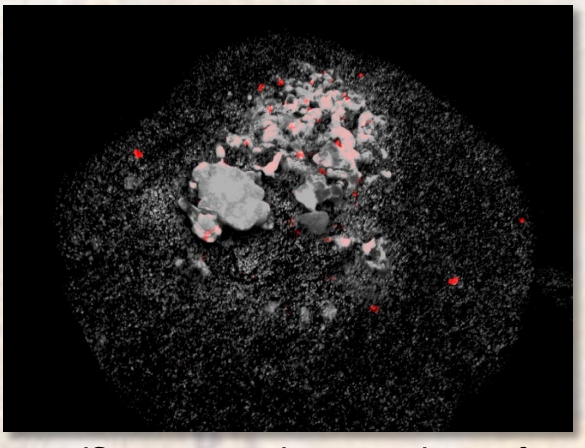
Methanoliparia

Microbes that Degrades oil to gas

Saurav Pargi (B.sc. Sem 4)

The crude oil as well as gas naturally escape from the seabed in many places known as "seeps." These hydrocarbons then move up from source rocks through fractures and sediments towards the surface. Here is where they leak out of the ground and then sustain a diversity of densely populated habitats in the deep dark ocean. A large part of these hydrocarbons, especially alkanes, which is already degraded before it reaches the sediment surface. This provides an important energy source for subsurface microorganisms, even deep down in the sediment, where no oxygen exists!

Recently, a study led by researchers from the Max Planck Institute for Marine Microbiology in Bremen, Germany and the MARUM, Centre for Marine Environmental Sciences, provides environmental information, genomes as well as the first images of a microbe that has the potential to degrade forms of oil to gas or in other words transform long-chain hydrocarbons to methane. Their study results are published in the journal mBio



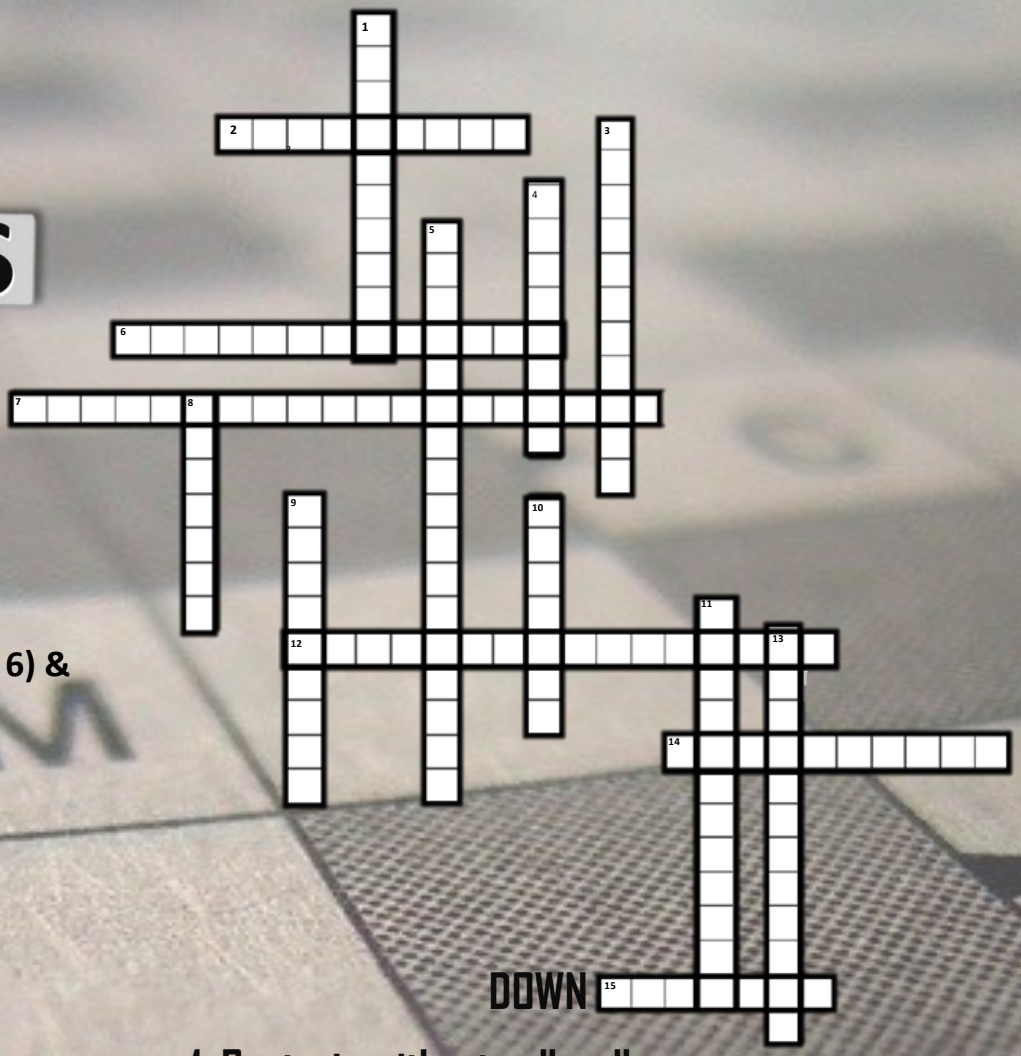
Epifluorescence microscopy picture of *Methanoliparia* cells attached to oil

Splitting oil into methane and carbon dioxide :

This *Methanoliparia* microbe, an archaea, degrades oils to gases by transforming the hydrocarbons by a process called Alkane disproportionation: This is a process where it splits the oil into methane (CH_4) gas and carbon dioxide (CO_2). Formerly, this hydrocarbon transformation by alkaline disproportionation was thought to require a complex partnership between two kinds of microbes, i.e., archaea, and bacteria. Herewith the study by the research team from Max Planck Institute for Marine Microbiology and MARUM presents evidence for a different solution. Rafael Laso-Pérez, first author, explains that this is the first-time researchers get to see an organism that has the potential to degrade oil to methane gas all by itself. During a cruise in the Gulf of Mexico, the researchers collected sediment samples from the Carpospore Knoll. This is an oil and gas seep which is 3000 m deep in the ocean. Back in the lab in Bremen, research team carried out genomic analysis. This analysis that revealed that *Methanoliparia* microbe is equipped with certain novel enzymes to use the quite unreactive oil without having oxygen. Gunter Wegener, the initiator of the study and senior author, said that the new microbe, *Methanoliparia*, is kind of a composite being and some of its microbe relatives are multi-carbon hydrocarbon-degrading archaea, others are the long-known own methanogens that form methane as their metabolic product, he added. With the help of combined enzymatic tools of both its relatives, *Methanoliparia* microbe activates and degrades the oil but forms methane gas as its final product. The visualization of these microbes supports the proposed mechanism. Wegner explained that microscopic results show that *Methanoliparia* microbe cells attach to oil droplets and researchers did not find any hints that it requires bacteria or other archaea as partners for this process of oil degradation to form methane gas.

Your office desk contains 400 times more viruses than a toilet.

CROSS WORD



BY GOHIL DIMPAL A. (B. Sc. SEM 6) &

RATHOD TEJAL (B. Sc. SEM 4)

ACROSS

2. Study of Algae
6. Pigment found in Chlorobium
7. Whooping cough caused by
12. Mold used for genetic study
14. Father of cell theory
15. A pigmented inclusion bodies found in Algae

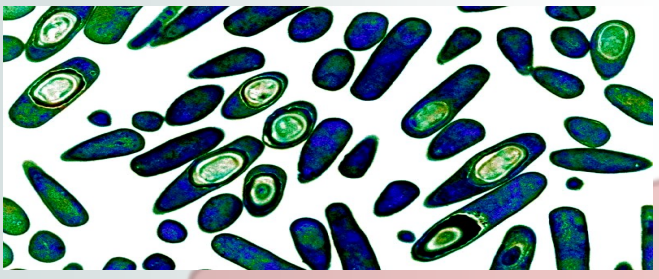
DOWN

1. Bacteria without cell wall
3. A reduction in virulence
4. Lac Y codes for
5. Pigment by which Halophytic Archea carry out photophosphorylation
8. *Clostridium tetani causes*
9. Who coined the term bacteria?
10. Widal test used for
11. Virus containing largest viral genome
13. Antibiotic used in MRBA

A Unique Cure to *Clostridium difficile* infections

- NIRMAL KACHHADIYA (B.Sc .SEM 4)

***C**lostridium difficile* is a Gram-positive, endospore-forming, obligate anaerobe, and nasty bacterium that can cause havoc in gut. In US only, 14,000 people die every year due to colitis caused by *Cl. difficile*. It has developed antibiotic resistance. The infection by this pathogen can easily spread to others. Symptoms include diarrhea, stomach pain and fever.



Clostridium difficile

POOP PILLS

Cl. difficile is found in the digestive system of about 1 in every 30 adults. It often lives as a harmless organism because other intestinal bacteria keep it in control. These strains produce multiple toxins. The best-characterized are enterotoxin (*Cl. difficile* toxin A) and cytotoxin (*Cl. difficile* toxin B) both of which may produce diarrhea and inflammation in infected patients. Symptoms of infection usually develop during therapy with antibiotics, or after then within the last few weeks. It can interfere with the balance of good bacterial flora in the bowel. The antibiotics that most often lead to increased infection by this organism include Clindamycin, Ampicillin, Amoxicillin, Cephalosporins, Fluoroquinolones and in a rare case even Penicillin, Vancomycin and Metronidazole. Proton pump inhibitors, a type of medicine used to reduce stomach acid, also may increase your risk of *Cl. difficile* infection. Old age is also a risk factor. In one study, the risk of becoming infected with this organism was 10 times greater for people aged 65 and older compared to younger people. Women are more likely to develop infection compared to men.

Treatment of *Cl. difficile* colitis includes 10 to 14 days course of antibiotics that in turn can lead to more resistance towards antibiotics. One effective but off-beat treatment is a fecal transplant. Fecal transplant is taking a stool sample from healthy person and transplanting it into the patient. Researchers developed a less cringe inducing alternative of fecal transplant. They created odorless frozen capsule that contains bacteria isolated from healthy stool sample, they called it poop pills.

The poop pills have successfully treated 18 of 20 patients having antibiotic-resistant *Cl. difficile* infections. Next, the scientists are working on the development of pills with bacteria grown in the lab rather than extracted from feces of humans.

Human bites are one of the most dangerous animal bites in the world due to the bacteria in our mouths.

ATAL INCUBATION CENTER

- KRISHNAA PANDYAA (B.Sc. SEM-VI)

The aim of ATAL incubation center is a flagship initiative to promote culture of innovation and entrepreneurship in India. It develops new policies and programs for fostering innovation in different sectors of the economy and provide platform and collaboration opportunities. It is located in various parts of India one of which is in Ahmedabad just behind the L.M.College of Pharmacy supported. AIC - LMCP foundation is non profit incubator hosted by L.M.College of Pharmacy , governed by Ahmedabad Education Society supported by Atal innovation Mission, NITI aayog and Government of India.

These centers support person having considerable idea of new start up providing mentors, infrastructure, equipment and operating facilities. The incubation center of Ahmedabad predominantly contains equipment to cater to most of the requirements of product development, characterization and analysis with qualification. Some of the key instruments include : HPLC-PDA, Flash Chromatograph, LC-MS (Liquid Chromatography - Mass Spectroscopy), UV-VIS spectrophotometer, Incubator shaker, Electrophoresis with Gel-documentation, Lyophilizer, Rotary Evaporator, Freezer, CO_2 incubator and Vacuum oven. It also has a library with rich resources of various scientific journals, reference books, e-journals and SciFinder database. The institute conducts several workshop and training programs i.e. Application of Stability and Photostability chambers, training on flash chromatography, hands on operations on HPLC, Lyophilizer etc. and session on SciFinder. There are many events arranged too that one can see on their sites and yet more to be held.

So if you have any innovative idea regarding drug delivery systems, phytopharmaceuticals and neutraceuticals, medical devices and testing tools for diagnosis of specific disease and related sector then can definitely apply and go for the center support.

Penellus pusillus also known as luminescent panellus, it is a fungi which emits light through their mycelia and fruit bodies.

QUIZ!

- HARSH PRAJAPATI (B. Sc. SEM 4) & UMANG PRAJAPATI (B. Sc. SEM 4)

1. Which among the following come under Gram negative eubacteria?

a) Clostridium
b) S. aureus
c) Neisseria

2. In Gram staining iodine is used as ...

a) Fixative
b) Mordent
c) Stain

3. Oil immersion objective lens has a NA value of ...

a) 1.25
b) 0.85
c) 0.65

4. Negative staining is used for examining ...

a) Bacterial flagella
b) Virus
c) Cell size and arrangement

5. Another name for transposable elements..

a) Insertion sequences
b) Transposons
c) Both a and b

6. Following is the metabolic plasmid..

a) R100
b) Ti
c) TOL

7. *Vibrio cholerae* can grow in a medium with a pH of ...

a) 5.5
b) 8.5
c) 2.0

8. The generation time of E. coli is ...

a) 20 min
b) 35min
c) 60min

9. Scientist that awarded Nobel prize for discovery of Radioimmunoassay..

a) P. Ehrlich
b) R. Yallow
c) E. Metchnikoff

10. The phase in antibiotics are produced is called..

a) Idiophase
b) Trophophase
c) log phase

SUSHEZTOOZ

By Zalak Solanki (B.Sc. SEM 6)
& Sonali Meghani (B. Sc. SEM 6)

DEPARTMENT ACHIEVEMENTS

Research paper publications:

- Varjani Sunita, Vivek Upasani (Nov, 2019) . Fingerprinting hydrocarbons in a crude oil contaminated agricultural soil and its bioremediation employing bacterial consortium. NISCAIR-CSIR, India. ISSN:0975-1009
- Chandranil H. Gharekhan, Vivek N. Upasani (2019). Diatoms from Saline Ecosystems and Biotechnological Applications: An Overview . International Journal of Pharmacy and Biological Sciences-IJPBS . ISSN: 2230-7605

Competitions:

- Krishna R. Pandya (T. Y. B. Sc) and Zalak M. Solanki (T. Y. B. Sc) achieved Third position in poster presentation (ENGAGE) held at Gujarat University on 14th September, 2019.

Faculty achievements:

- Dr. Noopur Goyal and Dr. Payal Patel have became Ph. D guides at Gujarat University.

Young Scientist Award:

- Dr. Sunita Varjani (Alumni of department) has awarded Young Scientist Award in November, 2019 by The Biotech Research Society, India(BRSI) for her outstanding contribution in Environmental Biotechnology.

OTHER CONTRIBUTERS (MAGAZINE):

FACTS	MAKWANA KHUSHALI (T. Y. B. Sc.) NIVA N. PRAJAPATI (S. Y. B. Sc.)
PROOF READING	RIYA SHETH (S. Y. B. Sc.)

Students celebrated Teacher's Day at 5th september, 2019

Group of students from T. Y. B. Sc visited National Conference at Bhavnagar regarding new start-ups

Workshop in Bioinformatics was conducted where students learned molecular docking

Students visited ATAL INCUBATION CENTER under MSMG activities

- Guru Purnima was celebrated as well.
- Students visited Cytel and learned about SAS programming.

EVENTS AT DEPARTMENT