



Universal Business School, Mumbai

Research paper

## A Study on Bioluminescence and its Impact on Medical Science

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March 2022

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**ABSTRACT**

**“Systems evolved naturally that our technology is yet unable to create.”**

**Production and emission of light by any living organisms is called bioluminescence. Bioluminescence comes from a range of reds, greens and blues caused by proteins and majorly studied bioluminescent often found in marine animals, mushrooms, insects, algae and specific types of bacteria. These types of creatures are usually found in ocean habitats, in the season of monsoon, or in the surface of deep-sea floor.**

**As per researchers, bioluminescence can develop various new treatments to - understand the damaged cells of Alzheimer patients, neurological diseases, detection of blood clots, track the spread of HIV and fight Cancer.**

**Before bioluminescence helped H.I.V researchers to track the virus, the same type of work was done with radioactive materials but the technique was expensive and hazardous. Luciferase - the enzyme that cause bioluminescence are more sensitive and amenable, it also requires fewer precautions to use in labs.**

**Many people are yet to be aware that bioluminescence can treat these diseases in a much less hazardous and cost-effective way. So, this paper is going to help the common mass to know about bioluminescence, it's benefit, treatments it can do.**

***Key words:- bioluminescence, luciferin, HIV, Cancer, Alzheimer's, Green, Marine creatures.***

***A. Objective of the study***

- To understand whether people are aware of the term bioluminescence or not
- To understand whether people know that bioluminescence can treat many deadly diseases in a risk-free and cost-effective way or not.
- To inform the common mass about the recent discoveries on biomedicine made out of bioluminescent proteins/cells
- To know how much bioluminescence can actually be helpful in the field of medicine
- To know whether is it sustainable development or not
- To prove that bioluminescent can cure cancer

***B. Hypothesis***

- There is no relation between medical science and bioluminescence
- There is no relation between bioluminescence and cost-effective treatment
- There is no relation between bioluminescence and risk-free and sustainable development in the medical science
- There is no relation between bioluminescence and curing of cancer

## CHAPTER 1

### INTRODUCTION

The term “Bioluminescence”

Bioluminescence is light generated by a chemical process within a living organism. Bioluminescence may be a form of chemiluminescence, that is solely the term for a chemical reaction wherever light is produced. (Bioluminescence is chemiluminescence that takes place inside a living organism.) bioluminescence is a cool and calm light. Cool light means that near less than 20% bioluminescent illumination generates thermal radiant or heat. Most bioluminescent organisms are found within the ocean. These bioluminescent marine species embrace fish, bacteria, and jellies. Some bioluminescent organisms, as well as fireflies and fungi, are found on land. There are nearly no light organisms native to purely water-based habitats.



Impact of bioluminescent in medical science

A huge scope of logical methods has been created in light of bioluminescence. Immunoassays, quality articulation measures, drug screening, bioimaging of live life forms, malignant growth studies and the examination of irresistible infections" are only the start of an account of 1001 enlightenments as the scientists allude to the developing number of bioluminescence and biofluorescence revelations with applications in medication.

For instance, green fluorescent protein, found in the gem jellyfish *Aequorea Victoria*, and other fluorescent proteins have changed research in fields from immunology to neuroscience. Numerous creatures are currently known to produce fluorescent proteins. The light power managed by fluorescent proteins is changing most areas of current biomedicine. In ongoing many years, a rainbow of fluorescent proteins has been created. A few tones were utilized in a neuroscience explore called the brainbow.

According to Pieribone, a class of proteins called Genetically encoded fluorescent voltage indicator (GEVIs) permits researchers to watch nerve cell action in a live creature. These proteins are a promising new apparatus for planning synapse action in numerous creatures and for concentrating on how neurological problems disturb typical synapse flagging. The new protein, called the voltage-actuated neuronal action screen, or VARNAM, and that signifies "shade" in Sanskrit, changes its fluorescence power as an electrical drive travel through a live neuron. Like Arclight, VARNAM is essential for the group of proteins called GEVIs. "VARNAM is a critical development in our capacity to screen the electrical movement of synapses in a not so much intrusive but rather more extensive way.

Biofluorescence might be having a biomedical day in the sun, however it is no less the prime of bioluminescence. Bioluminescent proteins definitely stand out as a result of their exceptional applications - says Sana Sharifian, of the University of Hormoz Gan, in Iran; Rodney Luwor, of the Royal Melbourne Hospital, in Australia.

Analysts in Canada and Brazil have created 13 bioluminescence sensors to test the adequacy of new medications. Their outcomes were distributed 8 December 2018, in the diary Science Signalling.

According to Claudio Miguel da Costa-Neto, a natural chemist at the University of Sao Paulo's Ribeirao Preto Medical School, the new biosensors are authentic Frankenstein's created by joining together different primary pieces of various proteins. The biosensors depend on the activity of G-protein-coupled receptors (GPCRs)- proteins engaged with correspondence between cells. More than 33% of meds available are focused on these receptors.

Bioluminescence is additionally prompting better approaches to creating malignant growth immunotherapies. One of the most encouraging regions in disease research is immunotherapy, including CAR-T, as said by senior creator Preet Chaudhary, head of haematology at the USC Department of Medicine. The analysts involved bioluminescent Pacific Ocean shellfish for the test, named the Matador measure after the El Matador State Beach in Malibu, California. Luciferase from the animals is brought into malignant growth cells. The compound breaks out as the cells bite the dust, leaving an apparent shine that can be measured. The researchers tried the Matador examine's viability in a few malignant growths, including constant myelogenous leukaemia, intense myelogenous leukaemia, and Burkitt lymphoma. According to Chaudhary, Academic labs and biotech organizations are creating CAR-T cells coordinated against various diseases, yet a significant test is the absence of a quick, conservative, touchy measure for the discovery of malignant growth battling CARs on the surfaces of safe T cells.

Tubeworm, known for its bioluminescence, ferritin has the quickest execution found, right multiple times quicker than ferritin in people which helps in controlled digestion of iron cells. The mystery might be in the worm's light show, researchers have found. The review was subsidized by the Air Force Office of Scientific Research. Scholars there are keen on diving more deeply into the bioluminescent properties of this surprising worm and the speed of its ferritin.

Tubeworms are normal in sloppy nearshore environments in calm waterfront waters all over the planet. This tubeworm has another one-of-a-kind capacity: It can save its bioluminescent blue light gleaming for quite a long time and now and again days. That is significantly longer than most bioluminescent living beings, which normally light awake for seconds or even milliseconds.

The worm's bioluminescence might depend on the iron broke down in seawater. However, it is more probable, scientists think, that the worm's bodily fluid contains iron that directs its light creation. Chaetopterus kept in seawater with no iron can in any case create bodily fluid with solid glow.

Specialists embedded the quality that actuates fireflies' bioluminescence into malignant growth cells, expecting to set off a chain of occasions that would battle the illness.

The light source, luciferin, made the disease cells shine like fireflies. While a photosensitizing specialist was added, the mix demonstrated lethal to the cancer. The firefly technique, called bioluminescence enacted obliteration of malignant growth, or BLADE is permitting photodynamic treatment to venture further into the body. The treatment utilizes explosions of light to go after cancers close to the skin's surface or on interior organs. Malignant growth cells are treated with a photosensitizer, then presented to a laser or other outer pillar. The light triggers the annihilation of the cells. Outside light sources can go through a modest quantity of tissue, says Theodosius. To treat further malignancies, the BLADE group embedded the light into the actual sickness. Malignant growth cells were adjusted to communicate the firefly luciferase quality and brooded with luciferin in the lab. As said by Theodosius, the cells radiating light that could set off their own obliteration.

tion. Utilizing firefly light to work with photodynamic treatment to kill malignant growth would totally dispose of the requirement for outer light, hence coming to even the most profound lying diseases. The light could likewise be moved to essential growths, and from that point relocate to disease cells that have spread. The luciferase of glow-worm might make significant commitments to biomedicine. More revelations in the forthcoming ten years will add valuable contributions to clinical science and also how these treatments can be served to the common mass.

SL. NO	TITLE	AUTHOR	SUMMARY OF FINDINGS	REFERENCE
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2.	Application of bio- luminescence imag- ing to the study of infectious diseases	Martha Hutchens, Gary D. Luker	How viruses can be engineered to encode luciferase and how this helps in Bioluminescence imaging	<a href="https://onlinelibrary.wiley.com/doi/full/10.1111/j.1462-5822.2007.00995.x">https://onlinelibrary.wiley.com/doi/full/10.1111/j.1462-5822.2007.00995.x</a>
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4.	BIOLUMINES- ENCE LIVING LIGHTS, LIGHTS FOR LIVING	Therese Wilson, J. Wood- land Has- tings	Diversity, Functions and Evolution- ary Origins of Bioluminescence along with its application in the medical field	<a href="https://vdoc.pub/documents/bioluminescence-living-lights-lights-for-living-6f7ednn2gk60">https://vdoc.pub/documents/bioluminescence-living-lights-lights-for-living-6f7ednn2gk60</a>
5.	Banglalgachhpala	Gopal Chandra Bhattachar- ya	Study of bioluminescence in mush- rooms and other plants	<a href="http://125.22.75.155:8080/handle/123456789/4372">http://125.22.75.155:8080/handle/123456789/4372</a>

## CHAPTER 2

### LITERATURE REVIEW

(Zimmer, 2015) studied fluorescent proteins. The apparently shining proteins permit analysts to follow the parasite inside a lab mouse to study the transmission of Chagas sickness.

Each year fluorescent proteins are applied in big range of trials, riding researchers of the twenty-first century to remarkable new understandings, medicines, and modern advances. Because of fluorescent proteins, researchers can see whilst character synapses fire, take a look at how the human immunodeficiency infection (HIV) spreads so rapidly, and purpose superinsulation fluorescent magnifying gadgets that to think about noticeably clear, factor through factor, and top-notch symbolism of subcellular life.

Chagas Sickness in excess of ten million individuals, for the most part in Focal America, have Chagas infection. The parasitic sickness at first prompts fever, enlarged lymph hubs, and body throbs. Assuming left untreated, around 30% of individuals with Chagas illness will foster lethal heart issues a very long time after the underlying beginning of the ailment. Chagas is communicated by Triatominae bugs, likewise called kissing bugs. The bugs frequently nibble resting human casualties on the face to take care of off their blood. During their blood feast, the kissing bugs poop close to the nibble wound. In contaminated bugs, the excrement contains a parasite called *Trypanosoma cruzi* (T. cruzi), which causes Chagas infection. The chomps tingle, and scratching the nibbles permits the parasites to enter their new host through the injury. Parasitologists have made red fluorescent proteins that tight spot to the sugar particles that cover the outer layer of T. cruzi parasites. The scientists clone microbes that live in the kissing bug to communicate these fluorescent proteins. Then, utilizing blue light and a fluorescent magnifying instrument, they can see the parasite developing and increasing in the kissing bug's stomach before it passes on the bug by its back exit. Thanks to the fluorescent parasites, researchers can see how the parasite goes through the kissing bug's intestinal system, where it stows away in the bug's body, and the way that it enters the host from the kissing bug's defecation. The main quality of the red fluorescent T. cruzi is that they don't cause Chagas sickness in the creatures that are nibbled by the contaminated kissing bugs. The sugar atoms that cover the parasite are bound up by the fluorescent proteins and can't work with the section of the parasite into a casualty's cells.

Illuminating the Cerebrum In extra of 5,000,000 people withinside the US are residing with Parkinson's and Alzheimer's infections. These are neurodegenerative illnesses wherein synapses damage down and by no means once more paintings appropriately. This reasons quakes, lack of memory, problem with discourse, and muscle solidness. There are as of now no acknowledged answers for one or the opposite illness. As a function of the hunt for therapies, neuroscientists drove via way of means of Karel Svoboda on the Janelia Exploration Grounds of the Howard Hughes Clinical Establishment in Virginia are locating out approximately how stable synapses paintings. They make use of a completely unique accumulating of mice into which they've embedded the GFP fine in all of the nerve cells that move from the mice's stubbles to their cerebrums. These equal mice have moreover long gone thru a gadget to embed a tumbler window withinside the maximum factors in their heads. Researchers installation magnifying units at this window for you to watch the inexperienced fluorescence of the synapses in actual lifestyles withinside the stay mice. A mouse relies upon on its hairs as key tangible apparatuses to discover its contemporary circumstance. Whenever the mouse is stored in an enclosure with little excitement, wherein it may surely look at its water and food, it does not make use of its bristles a lot. Under those circumstances, the mouse has now no longer very many synapses interfacing the hairs to the cerebrum. In any case, assuming a comparable mouse is about in a labyrinth, it wishes to make use of its stubbles notably extra to tune down its route thru the gap and to locate its dinners. In this absolutely hard climate, the mouse's cerebrum calls for extra facts from the hairs to discover the gap. The synapses thusly department out and body severa new institutions from the hairs to the thoughts. In the GFP-modified mice, researchers can surely see what's befalling the synapses associated with the bristles due to the fact that they're the handiest ones withinside the thoughts that gleam green. To watch mice,

regulate to compromised faculties, researchers shave off each one in all a mouse's bristles on one aspect of its face. The mouse ought to determine out a way to scientists can watch the GFP-modified synapses of a lab mouse in actual existence thru a bit glass window embedded withinside the creature's head. Through the GFP sparkle, researchers can observe the comparison among a mouse that does not want to make use of its bristles a superb deal and has more than one synapses prompting its hairs and an invigorated mouse, whose synapses have fanned out and fashioned numerous new institutions tune down its method for buying across the labyrinth with virtually a massive part of its stubbles. By glancing thru the glass window, researchers can watch the GFP-named synapses to peer exactly the manner wherein the mouse overhauls its thoughts to do as such. Researchers believe that via way of means of seeing how a mouse's thoughts adjusts beneathneath compromised circumstances, we might also additionally in the future kind out a few manner to overtake compromised human cerebrums. On the off hazard that we are able to do as such, we would have the choice to absolutely deal with Parkinson's and Alzheimer's.

(D.Luker, 2007)targeting BLI to discover pathogenesis of HSV-1 infection in mice, making use of a recombinant stress KOS contamination that encodes each firefly luciferase and Renilla luciferase looked after an early high-satisfactory advertiser (Luker et al., 2002). Introductory exploration laid out that firefly luciferase movement from the columnist contamination can be identified directly in mice after 4 precise publications of infection. Viral titres evaluated through plaque take a look at associated straightforwardly with mild discharged from firefly luciferase. This deal with moreover proven limits of BLI for pathogenesis studies. On account of the truly low spatial intention of this imaging technique, it's far difficult to apprehend viral contaminations in contiguous tissues. For instance, bioluminescence from the webweb page of sickness withinside the cornea could not be remoted from ensuing unfold of infection to periocular tissues. Also, mild from firefly luciferase turned into outstanding directly withinside the infected cornea after intraperitoneal employer of luciferin, but Renilla luciferase turned into identified simply while coelenterazine turned into carried out straightforwardly to the cornea. The ultimate alternative locating underscores problems with bio-availability of coelenterazine due to carriers, for example, MDR1 P-glycoprotein. Bioluminescence imaging often has been applied to pay attention on infection in mouse models, but this imaging technique may be applied definitely in one-of-a-kind lifestyles forms. For instance, Harmache et al. applied BLI to discover infection with impossible to resist haematopoietic rot contamination (IHNV), a RNA contamination this is massive microorganism in younger trout fish (Harmache et al., 2006). Specifically, the assessment zeroed in at the direction of viral segment into fish. To empower this assessment, the creators constructed a recombinant IHNV that communicated a Renilla luciferase columnist. Not in any respect like Sindbis contamination, the recombinant IHNV contamination turned into now no longer constricted contrasted and the parental stress. Adolescent trout had been tainted with the correspondent contamination and in a while imaged with BLI at one-of-a-kind instances put up sickness. Entire frame luciferase imaging of infected fish exposed the startling predicament of contamination to the stability bases. Disease of blade bases befell earlier than infection of various organs and tissues and persevered after contamination had unfold foundationally. Imaging of an euthanized fish with the pores and skin removed laid out that mild from within the frame can be diagnosed directly thru the pores and skin, featuring the early area of radiance in stability bases isn't always simply due to the slenderness of the tissue at that site. A weakened contamination developing brief on a non-number one protein infected the blade bases with out spreading, which similarly upheld the quit that viral passage befell thru stability bases. This look at laid out the pressure of BLI to pay attention on infection in non-mouse fashions of disease.

(Aisha J. Syed, 2021)Studied Coelenterazine is observed in some marine animals along with copepods and the profound water shrimp, and is the opposite maximum often applied luciferin. Coelenterazine is the substrate for round 15 precise usually going on luciferases. From those, the luciferases from Renilla luciferase (Rluc), Gaussia luciferase (Gluc) and Metridia longa luciferase (Mluc) had been one of the earliest to be cloned and feature visible as maximum application in biotechnological applications. The bioluminescent reaction of coelenterazine moreover consists of an enzymatically catalyzed oxidation. Coelenterazine 7 is modified over to an energized nation coelenteramide oxyluciferin 10 thru a dioxetanone moderate. The energized nation oxyluciferin unwinds to its floor nation to supply a photon of blue mild of frequency 454-493



nm, challenge to the compound. This bioluminescent reaction isn't always reliant upon ATP. Coelenterazine is industrially accessible (CAS Number: 55779-48-1) and may be included in up to >two hundred mg scale bunches utilising multi-step synthesis.<sup>85</sup> In any case, coelenterazine is a larger atom than D-luciferin, has unlucky water solvency, greater noteworthy harmfulness and is moreover powerless to auto-oxidation prompting chemiluminescence in association because it would not require enactment as adenylation.<sup>forty</sup> Besides, coelenterazine has likewise been accounted for to be shipped into cells thru exclusive components. For instance, the multidrug obstruction P-glycoprotein (MDR1 Pgp) changed into accounted for to intrude the car of coelenterazine into mobileular lines. This triggered greater distinguished measures of coelenterazine being shipped into sickness cells speaking greater noteworthy quantities of MDR1 Pgp. This may want to spark off a unsuitable portrayal of cancers in little heat blooded animal in vivo imaging as an instance growths that do not speak MDR1 PGp would not be recognized. Coelenterazine offers out blue mild that's unequivocally ate up through blood and tissue, making it an unlucky contender for in vivo imaging while applied by myself with out the red-transferring influences of BRET. To beat those inadequacies, some engineered coelenterazine analogs had been arranged, of which a few are industrially accessible.

Regarding size, each Rluc (~34 kDa), Gluc and Mluc (each ~20 kDa) are extra modest than Fluc (~sixty twokDa). This makes them extra affordable for programs together with little vectors or probably proteins. In the sea pansy, *Renillareformis* the luciferase Rluc is firmly related with a inexperienced fluorescent protein (GFP) and the blue mild discharged through the luciferase is coupled via reverberation electricity circulate to the fluorophore of the GFP allowing it to form an invigorated kingdom species which produces a photon of inexperienced mild ( $\lambda_{max}$  510 nm). This preferred of reverberation electricity circulate brought on the development of bioluminescence resonance electricity (electricity (BRET) and some associated programs wherein the BRET mild outflow has be applied as an movement for the spatial place of proteins<sup>88</sup>

Most coelenterazine the use of luciferases have some disulphide bonds withinside the protein shape which regularly assist in protein-collapsing and meet those catalysts with extra noteworthy heat solidness than firefly luciferases. Notwithstanding, those disulphide bonds likewise make the chemical compounds sensitive to any reducing experts in aid preparations because the cysteine build-ups in reality have to be withinside the proper oxidation kingdom for nearby protein collapsing. Also, the perfect situations for motion of those luciferases often reflect their regular marine climate. In this way, the extensive majority of those luciferases are halophilic mirroring the pungency of seawater and some structures - for example the Mluc2 isoform of *Metridia longa* luciferase - is psychrophilic for instance has a very low perfect temperature mirroring the low temperatures on the decrease a part of the ocean.<sup>89</sup> Copepod luciferases Gluc and Mluc are the simply recognized luciferases which can be usually discharged from eukaryotic cells.<sup>ninety</sup> These first rate homes cause them to likely useful for an exciting association of utilizations, for instance, excessive throughput research as cell-lysis isn't always needed

(Wilson & Hastings, 2013) While sure fishes make use of a cypridinid form of bioluminescence science, others co-pick out coelenterazine-primarily based totally bioluminescence. The polarity is via way of means of all debts that seaside the front fishes use cypridinid luciferin, aleven though coelenterazine is surely found, now after which in extensive sums, in far off ocean fishes. The liver of 1 animal categories, *Nesostoma lusmacrolepidotus* is brimming with coelenterazine. Whether it profits it in its weight loss program or includes it's far an open inquiry. The equal is going for the luciferase. Regardless, whether or not a fish embraces a bioluminescent framework in mild of cypridinid luciferin or on coelenterazine, it is some thing however an affiliation or then again useful interplay among the fish and a bioluminescent accomplice; the fish wishes debris of coelenterazine for bioluminescence, the manner mammals want nutrition A for vision

(Bhattacharya, 1986) studied how lights were emitted from mushrooms. The duration of this emission was much longer compared to some animals. This emission of light could last for months also. The light helped in attracting insects and when the insects sat on the mushroom and fly to other places this helped in pollination of the mushrooms

## CHAPTER 3

### RESEARCH METHODOLOGY

The research study is based on both Secondary and Primary data and virtual questionnaire was circulated among students, scholars, servicepersons and homemakers as well. The questionnaire contained survey-based questions to know whether the common mass from all age group and professional field are aware of the term “bioluminescence” or not and also it is generated within a protein names “luciferin” and whether they know that bioluminescent can cure cancer or not and also that what they believe that bioluminescent will be an accepted norm in medical science in near future or not. The survey got almost mixed results for every question.

## CHAPTER 4

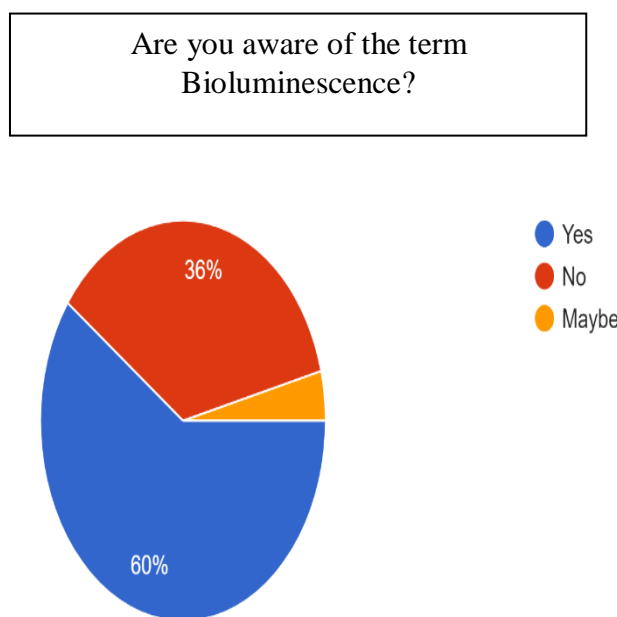
### DATA ANALYSIS AND INTERPRETATION

**•Introduction:** This section represents our findings of the study based on the data collected from the respondents in accordance with the main objectives. The objective was to make aware consumers about bioluminescence and its impact in the medical field. The research was conducted on 100 respondents.

Sl. NO	Answer	Percentage
1	Yes	60%
2	No	36%
3	Maybe	4%

Table 2: Awareness of the term bioluminescence

In Table 2, the respondents were divided into 3 groups based on the respondent’s knowledge of term bioluminescence. The percentage is shown in the table above. Out of 100 respondents 60 of them were aware of the term,36 were not aware of the term and 4 of them were not sure of the term. This has been explained in the graph below

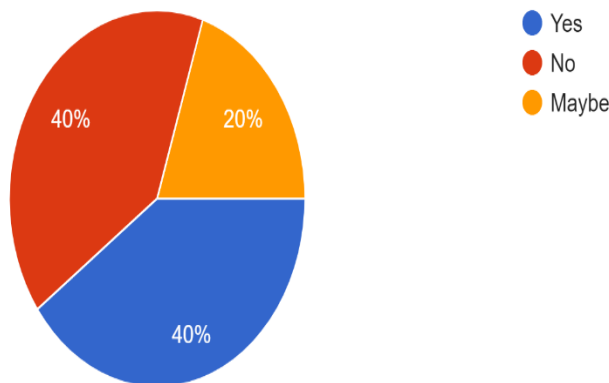


Sl. NO	Answer	Percentage
1	Yes	40%
2	No	40%
3	Maybe	20%

Table 3: Knowledge of luciferin in marine organism causing bioluminescence

In Table 2, the respondents were divided into 3 groups based on the respondent’s knowledge that luciferin in marine organism cause bioluminescence. The percentage is shown in the table above. Out of 100 respondents 40of them were aware of it, 40 were not aware of it and 20 of them were not sure of this. This has been explained in the graph below

Do you know luciferin in marine organism causes bioluminescence?

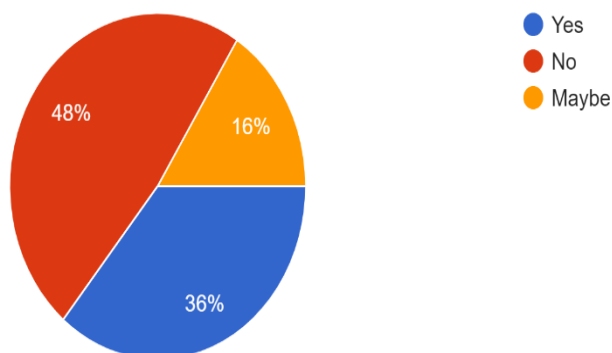


Sl. NO	Answer	Percentage
1	Yes	36%
2	No	48%
3	Maybe	16%

Table 4: Awareness that bioluminescence is used to treat various diseases in much hazard free and cost-effective way

In Table 4, the respondents were divided into 3 groups based on the respondent’s knowledge that bioluminescence can be used to treat various diseases in much hazard free and cost effective way. The percentage is shown in the table above. Out of 100 respondents 36 of them knew about this process, 48 of them were not aware of it and 16 of them were not sure of this. This has been explained in the graph below

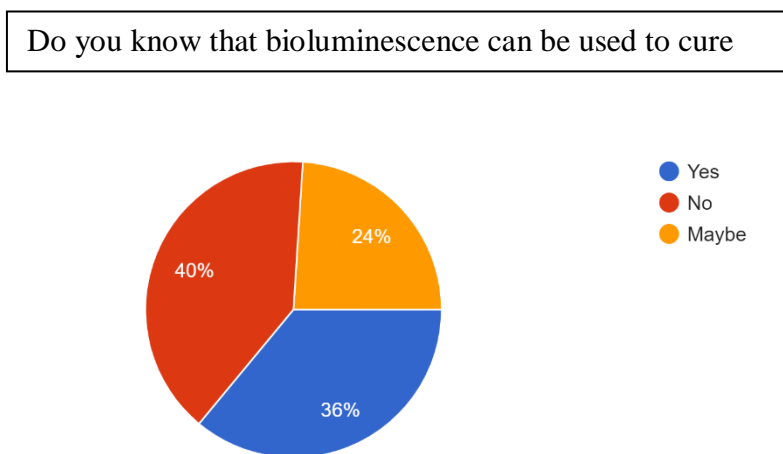
Are you aware that that bioluminescence is used to treat various diseases in much hazard free and cost effective way



Sl. NO	Answer	Percentage
1	Yes	36%
2	No	40%
3	Maybe	24%

Table 4: Awareness that bioluminescence can be used to treat cancer

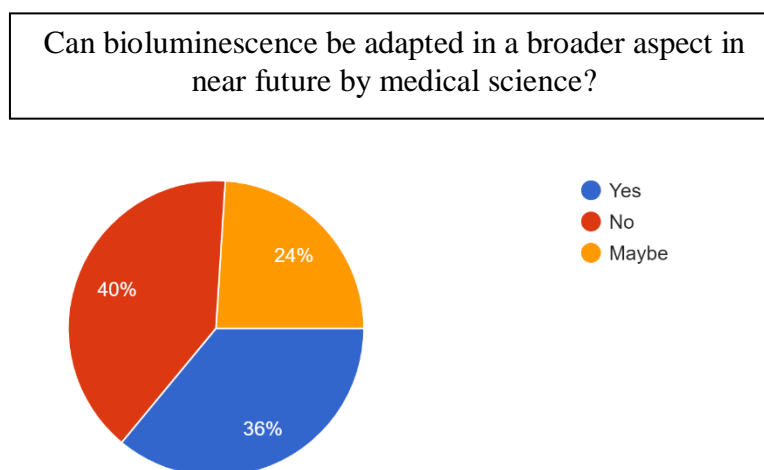
In Table 4, the respondents were divided into 3 groups based on the respondent’s knowledge that bioluminescence can be used to treat cancer. The percentage is shown in the table above. Out of 100 respondents 36 of them knew about this treatment, 40 did not know of it and 24 of them were not sure of this. This has been explained in the graph below:



Sl. NO	Answer	Percentage
1	Yes	40%
2	No	28%
3	Maybe	32%

Table 5: whether bioluminescence can be adapted in a broader aspect in near future by medical science

In Table 5, the respondents were divided into 3 groups based on the respondent’s knowledge that whether bioluminescence can be adopted by medical science. The percentage is shown in the table above. Out of 100 respondents 40 of them are hopeful about it, 28 of them don’t agree to it and 32 of them were not sure of this. This has been explained in the graph below



## **CHAPTER 5**

### **CONCLUSION**

Bioluminescence has various usage in the medical industry as well as fashion industry. It can be used in curing cancer, Parkinson's disease and various other diseases in much cost-effective way. With the advancement of medical science this will lead to new paths to research in biotechnology and medical science. However even in 2022 many people are not aware of the term bioluminescence and its usage. With proper marketing this concept will reach many people and many of them will get treatment in a cost-effective way.

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## Annexure

1. Name?
2. Are you aware of the term Bioluminescence?  
Yes  
No  
Maybe
3. Do you know luciferin in marine organism causes bioluminescence?  
Yes  
No  
Maybe
4. Are you aware that bioluminescence can be used to treat various diseases in a much hazard free and cost-effective way? \*  
Yes  
No  
Maybe
5. Do you think that bioluminescence can be adapted in a broader aspect in the near future by medical science? \*  
Yes  
No  
Maybe
6. Do you know that bioluminescence can be used to cure Cancer? \*  
Yes  
No  
Maybe