# BioGlow Tile: A Sustainable Approach Using Bioluminescent Mushrooms for Eco-Friendly Illumination

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***Abstract*—This study explores the concept of developing BioGlow Tiles — a sustainable, electricity-free lighting system using bioluminescent fungi. The idea is inspired by the natural phenomenon of bioluminescence, where organisms produce light through biochemical reactions involving luciferin and luciferase. The proposed tiles can provide gentle illumination in dark environments such as pathways, gardens, or rural areas without power supply. The paper aims to present a theoretical framework and proposed methodology for designing and developing such tiles using bioluminescent mushrooms, thereby promoting eco-friendly alternatives to electric lighting systems.**

***Index Terms*—Bioluminescence, Fungi, Sustainable lighting, Eco-friendly innovation, Renewable energy alternative.**

## I. INTRODUCTION

Lighting plays a vital role in modern life, but it also contributes significantly to energy consumption and environmental degradation. According to global energy reports, lighting accounts for nearly 15% of electricity use worldwide. To reduce this dependency, researchers are exploring natural light-emitting biological systems.

Bioluminescent organisms like fireflies, jellyfish, and certain fungi emit light through chemical reactions involving luciferin and luciferase enzymes. Among these, bioluminescent mushrooms offer a promising eco-friendly solution for low-intensity illumination. This study proposes the concept of a BioGlow Tile — a tile embedded with bioluminescent fungi that naturally emit light in dark surroundings.

Review of Literature

Earlier studies have documented the light-emitting properties of various fungi such as Armillaria mellea, Panellus stipticus, and Neonothopanus gardneri.

Research by Airth and McElroy (1959) described the enzyme systems responsible for fungal luminescence. Recent advancements in biotechnology have even allowed the transfer of bioluminescent genes to plants for decorative or ecological use. However, practical applications of fungal bioluminescence for architectural or lighting purposes remain limited. The BioGlow Tile concept bridges this gap by proposing a sustainable, naturally powered lighting model suitable for green infrastructure and rural applications.

## II. RESEARCH METHODOLOGY

This is a conceptual research study based on literature review, biological analysis, and design innovation. The research focuses on understanding the mechanism of fungal bioluminescence and designing a suitable environment to sustain living light-emitting fungi in a tile form.

Procedure for Making BioGlow Tile (Proposed Experimental Method)

1. Selection of Bioluminescent Fungi

Choose naturally glowing fungi such as Panellus stipticus or Neonothopanus gardneri, which emit a steady greenish light through enzymatic reaction.

2. Preparation of Growth Medium

Prepare a nutrient-rich substrate using sawdust, rice bran, and moisture. Sterilize the mixture to prevent contamination and provide it as a growth base for the fungus.

3. Inoculation and Culturing

Transfer the fungal culture into the substrate under sterile conditions. Maintain at 25–28°C and 80–90% humidity to ensure healthy mycelial growth.

4. Tile Base Formation

Create a biodegradable or ceramic base tile with shallow grooves. The base must allow air exchange while preventing excessive water loss.

5. Embedding Fungal Layer

Place the fully grown mycelial mat within the grooves and cover it with a transparent, breathable biofilm such as cellulose or biodegradable resin to protect it while allowing light emission.

6. Curing and Observation

Keep the tiles in a humid environment for 48–72 hours to stabilize fungal growth. Then, observe the glowing intensity and color in dark conditions.

7. Testing and Maintenance

Measure the brightness using a lux meter. Keep the tiles slightly moist to sustain the fungi. Replace or refresh the fungal layer periodically for long-term glow performance.

## III. RESULTS AND DISCUSSION

Theoretically, the BioGlow Tile can produce soft illumination without any electrical input. Though the brightness level is lower than artificial light, it can be effectively used for garden pathways, decorative lighting, emergency exit markings, and eco-architecture.

The proposed system aligns with green building concepts and can reduce electricity costs, carbon emissions, and dependence on non-renewable energy. However, challenges such as fungal lifespan, moisture maintenance, and large-scale production need further investigation.

Sustainable Development Goal (SDG) Alignment

SDG 7: Affordable and Clean Energy — reduces dependency on electric lighting.

SDG 11: Sustainable Cities and Communities — promotes green design and natural illumination.

SDG 12: Responsible Consumption and Production — uses biodegradable and renewable materials.

SDG 13: Climate Action — decreases carbon emissions through energy conservation.

SDG 15: Life on Land — encourages use of natural organisms in human innovation.

## IV. CONCLUSION

The BioGlow Tile presents a novel, sustainable idea that merges biology and technology for eco-friendly lighting. It demonstrates how living organisms can be used to meet modern energy needs in harmony with nature. While the concept requires experimental validation and optimization, it opens new pathways for future research in bio-design and renewable energy applications.

## REFERENCES

[1] Airth, R. L., & McElroy, W. D. (1959). Light emission from extracts of luminous fungi. Journal of Bascteriology, 77(2), 249–258.

[2] Oliveira, A. G., Desjardin, D. E., Perry, B. A., & Stevani, C. V. (2012). The enigmatic bioluminescence of mushrooms. Photochemical & Photobiological Sciences, 11(5), 848–852.

[3] Kotlobay, A. A., et al. (2018). Genetically encodable bioluminescence from fungi. Proceedings of the National Academy of Sciences, 115(50), 12728–12732.

[4] World Energy Report, IEA (2023). Energy Use in Lighting and Sustainable Alternatives.