

Hydrogel Bioprinting: An Interactive Introduction

Dyson Day

Noah Gordon

Introduction

The field of bioprinting, an exciting sub-discipline of biomedical engineering, is revolutionizing the way we approach problems in healthcare and medical research. Bioprinting is a 3D printing technique used to create structures that mimic natural tissues and organs. Hydrogels—water-swollen networks of crosslinked polymer chains, which mimic the extracellular environment of our bodies—are a key material used in this process, often used as scaffolds for tissue engineering.

In this educational outreach event, we aim to introduce children to the concept of bioprinting hydrogels through an interactive 30-minute hands-on activity. Participants will not only gain a basic understanding of bioprinting and the role of hydrogels but also experience the process of preparing hydrogels and using them in a simplified bioprinting setup.

The goal of this activity is to foster scientific curiosity in the younger generation and illustrate the intersection of biology and engineering. In the pages that follow, we outline the organization and execution of the activity, providing a detailed walk-through to ensure it can be successfully replicated in different educational contexts.

Materials

| Material | Quantity |
|------------------------------|---------------|
| Agarose | 250mg/student |
| 20cm x 20cm Plexi-glass base | 1/student |
| 2.5 ml Plastic Syringe | 1/student |
| Paper mixing cups | 2/student |
| Scale | 1/class |
| Vegan food coloring set | 1/class |
| Microwave | 1/class |
| Refrigerator | 1/class |

Activity Overview and Time Allocation

The activity is designed to provide a simple and tangible insight into the world of bioprinting, particularly printing with hydrogels. Participants will be provided with a small piece of plexiglass, agarose hydrogel preparations of varying concentrations, and access to a simplified bioprinting setup. The activity is divided into the following segments:

1. Introduction and Background (5 minutes)
2. Hydrogel Preparation (10 minutes)
3. Introduction to Bioprinting (5 minutes)
4. Hydrogel Bioprinting (10 minutes)

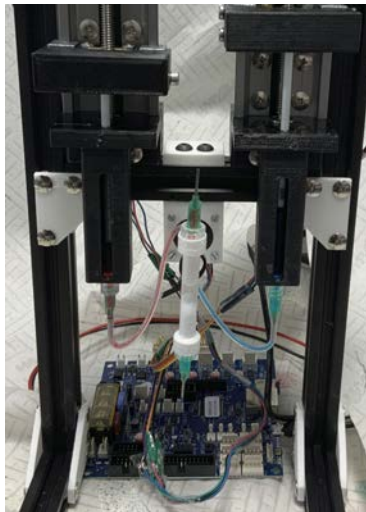
Introduction and Background (5 minutes)

At the beginning of the activity, we will show a few slides and provide a brief background on bioprinting and the importance of hydrogels in this process.

Preparing Hydrogels (10 minutes)

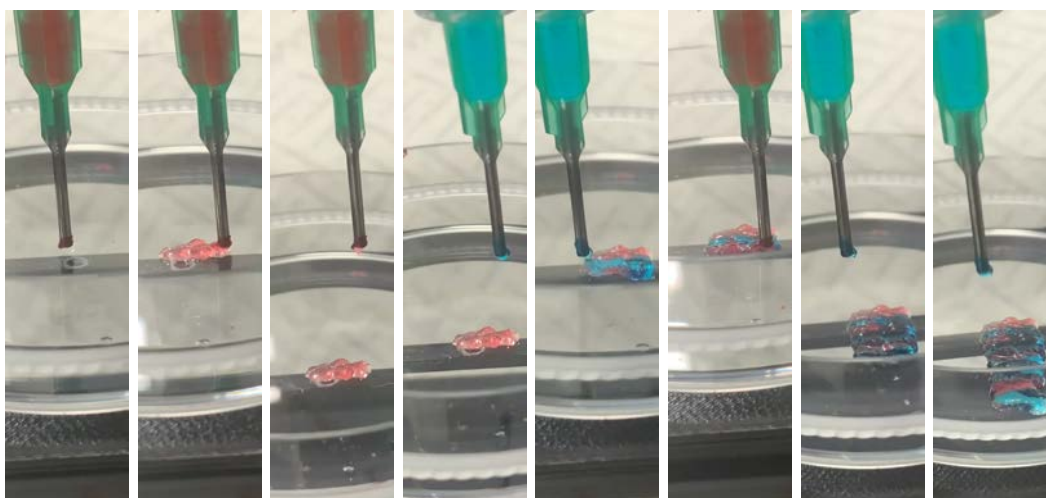
Participants will learn to prepare agarose hydrogels of different concentrations under supervision. The different concentrations will be used to demonstrate the variability in hydrogel properties.

Introduction to Bioprinting (5 minutes)



In this segment, we will introduce the concept of bioprinting, explaining how researchers use similar techniques to create intricate structures, including artificial tissues for medical research. The relevance of hydrogels in this field will be discussed.

Printing the Hydrogels (10 minutes)



Participants will print their hydrogels on the plexiglass substrate using the bioprinting setup. For this activity, we will ask the children to print a design representing a flower, an easily recognizable structure that could be achieved with our simplified setup.

Risk Assessment & Safety

This activity is generally safe but requires constant adult supervision, particularly when participants are using the microwave to heat the agarose and during the operation of the bioprinting setup. It's essential that participants maintain good hygiene practices; washing hands before and after the activity helps prevent the potential spread of germs when handling agarose hydrogel. The agarose solution will be hot immediately after heating in the microwave, so caution should be exercised to avoid burns, and it should be allowed to cool before handing it to participants. As the agarose is a fine powder, care should also be taken to avoid inhalation during handling. We use food coloring in this activity, but it's important to remind children not to ingest it and to avoid eye contact; in case of accidental contact, eyes should be rinsed thoroughly with water. Ultimately, safety measures should be clearly communicated to ensure a secure, fun, and educational experience for all participants.

Conclusion

Through this activity, children would be introduced to the concept of bioprinting, using hydrogels as a medium. By engaging with the process first-hand, participants are likely to gain a deep appreciation for this field of science and its potential applications. This serves as an important step in fostering scientific curiosity in young minds.

This project was supported by the Dyson foundation.

