Employing Microfluidics in the Demonstration of Cell Encapsulation

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ABSTRACT

The fusion of concepts derived from physics and biology have produced the fields of biophysics and tissue engineering and have generated many therapeutic applications that are currently undergoing human trials. Innovative techniques that utilize harvested mammalian cells purified to produce a substance of particular medicinal use have been in development since the 1970s. In 1994, bovine cells were harvested to secrete natural painkillers. The cells were encapsulated in a biocompatible plastic tube and then implanted into the spinal column of a patient suffering from chronic pain. The tubular device was engineered to allow the secretions from the bovine cells to escape, while preventing the cells themselves from leaving the confines of the implant and thereby preventing an immune attack by human cells (Lysaght and Aebischer, 1999). Recent advances in these fields have improved the technique of immunoisolation, or biohybrid therapy, and have inspired investigators to focus their attention on chronic and debilitating illnesses such as Parkinson's disease, Huntington's disease, Lou Gehrig's disease, diabetes, and macular degeneration. Proposals to improve the success of cell encapsulation technology by using genetically modified cell lines capable of producing more of a particular chemical have been suggested. Genetic manipulation of mammalian cells may be the key to biohybrid devices of the future. The device presented here can be used by science teachers to form single, water in oil (w/o) emulsions to demonstrate to students a biological application for

PURPOSE OF THE MODULE

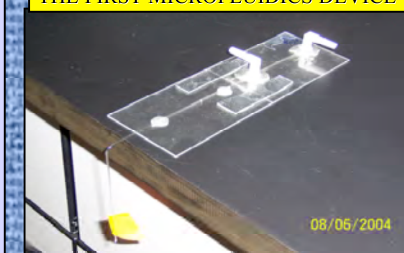
1) To demonstrate to students a practical application for microfluidics;

2) To engage students in real-world science techniques;

3) To present a link between physics and biology; and

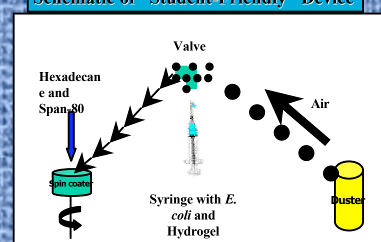
4) To encourage students to participate in the research experience.

THE FIRST MICROFLUIDICS DEVICE

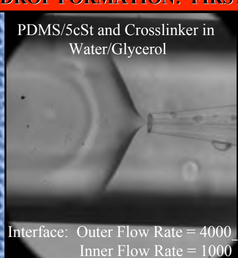


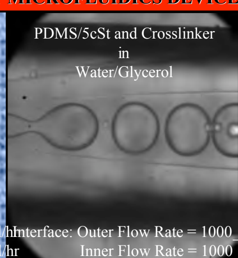
THE "STUDENT-FRIENDLY" VERSION

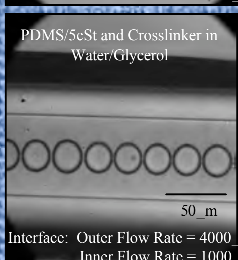
Schematic of "Student-Friendly" Device

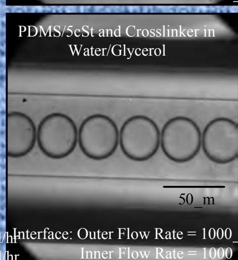


DROP FORMATION: FIRST MICROFLUIDICS DEVICE









OBSTACLES TO OVERCOME WITH THE FIRST DEVICE

1) Clogs easily;

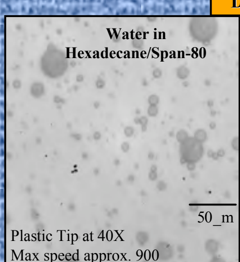
2) Breaks easily;

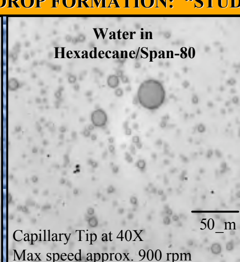
3) Requires use of machinery to construct that is not available at a high school;

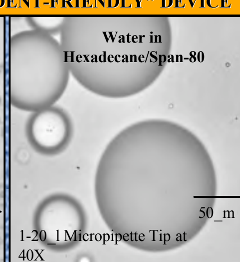
4) Requires the use of a fast camera and syringe pump(s) to operate; therefore

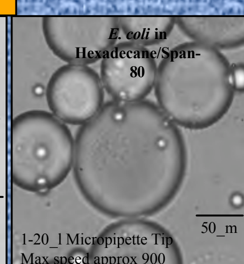
5) A high school requires a more "student-friendly" version.

DROP FORMATION: "STUDENT-FRIENDLY" DEVICE

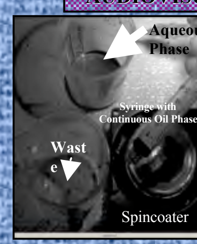




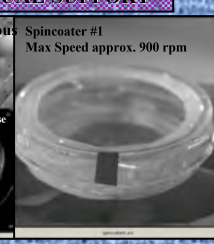




AUDIOVISUAL SUPPORT



Demonstration of Technique



Determining Maximum Rotations per Minute

ANTICIPATED OUTCOMES

IN THE FALL…

Seniors interested in participating in a pilot study will collect data and identify potential changes to the protocol.

IN THE SPRING…

Sophomores
Can Look Forward to…

1) **Bacterial Transformation (a.k.a. pGLO)**
2) **Successful transformants will be used as the subject of encapsulation**

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