

Establishment of Bioengineering Teaching Lab

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Abstract: We have started Research Labs with a good program and continued progress, but we need the Teaching Lab, based on research, in order to continue this educative and research inspiring expansion. This would provide much-needed support for students in Bioengineering Program by enhancing expansion and the potential for future external funding. Therefore, we propose novel technologies which will be beneficial to Bioengineering students from the different Engineering areas and Life Science – including graduate and undergraduate students.

Keywords: Bioengineering, Teaching, Research, Wet lab, equipment

I. INTRODUCTION

The purpose of this proposal is to establish Bioengineering Teaching Lab as extension of our 12 years developing MS Bioengineering program. The FAU Bioengineering program commenced in fall 2003 as a graduate certificate program building upon a collaboration between the College of Engineering and Computer Science (COECS) and the Schmidt College of Science. The certificate program consisted of a small menu of courses, from which students had to choose 3 courses in engineering and 2 in science. During the period of 2003-2008 more than 70 students were admitted to the certificate program, 11 of whom received the certificate. Since its inception in 2008, the FAU MSBE program awarded 35 MS degrees (thesis and non-thesis). All non-thesis students have to take a one semester Directed Independent Study (DIS) doing a “mini research” project. Presently there are 23 actively registered students in the program (four of whom are pursuing MS thesis). The newly formed (2016) Steering Committee is working on extension of the program into Bachelor’s degree and it is a matter of time when the concept will be accepted. However, despite this convincing severity of the Bioengineering program, it still does not have a Bioengineering Teaching Lab which this proposal intends to develop. Therefore, we propose novel technologies which will be beneficial to bioengineering students from the different Engineering areas and Life Science – including graduate and undergraduate students. We are committed in creating more classroom educational opportunities and research for all of them.

Concept

The essential idea of the concept is to connect research and teaching in such a way to facilitate the communication

between one and other opportunities for both students and researchers.

Therefore, the instrumentation was carefully chosen to connect and create liaisons between one and another. The basic outlines of the project that will connect technical approaches are given in Fig.1. Investigation will be focused to the low-frequency, low intensity irradiation effects upon normal adult and cancer stem cells—the fundamental question not solved in science, yet. The equipment is adjusted to that request involving state-of-the art products of integral thinking in its best bioengineering instrumental solutions. This will open the door for fundamental work and understanding of stem cells and novel concepts involved in stem cell bioengineering, as well as for skillful work with cutting edge technical solutions, in bioengineering science. It will also open the way for development of Tissue Engineering which is the highest possible level of the work with cells and have a huge impact upon medical health of humanity.

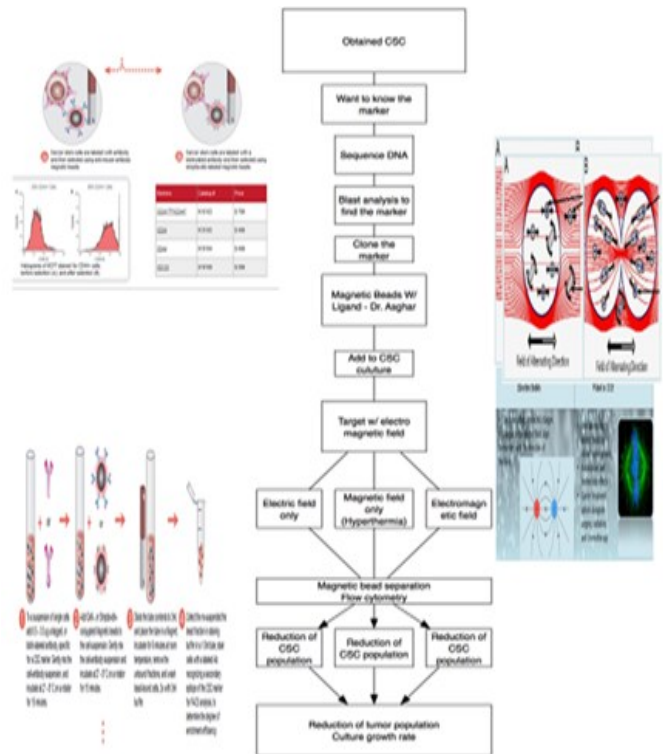


Fig.1. *The use of magnetic separator for isolation of cancer stem cells with magnetic beads, description of the project that underlines the teaching techniques and possible effects of the low-intensity/low-frequent magnetic radiation upon isolated cells.*

Setting up this lab will also reinforce and capture 4 of the 4 research advancement and strategic plans for the period between 2015 – 2025 mentioned by **President Kelly's** during the “State of the Campus” address last year: Healthy ageing (Stem and cancer cell research); Neuroscience (Molecular and Cellular aspect); Ocean Science (Marine drugs testing and effects) and Sensors (wireless versions of spectrum of sensors).

Equipment

1. *Countess II FL Cell Counter:*

The Countess II makes it very easy to count cells accurately and quickly—the fact that it tells you the dead cell and live cell count is icing on the cake. Applications are possible in: Detection of Stem and Cancer Cell Viability, Apoptosis (Programmed Cell death), and Transfection [1, 2].

2. *Zoe Fluorescent Cell Imager:*

The ZOE Fluorescent Cell Imager eliminates the complexities of cell imaging associated with traditional microscopes. This fluorescence imaging system combines the ease of use of a personal tablet with the power of an inverted microscope. An Android-based platform, the ZOE Cell Imager uses an intuitive touch-screen interface to control the bright field, three fluorescence channels, and the integrated digital camera. With its bright field and three fluorescent channels, the ZOE Cell Imager has all the features needed for daily cell culture work as well as fluorescent applications: Visual estimation of cell confluency, Observation of general cell health and morphology, Cell growth and proliferation monitoring; Capturing cell images (with or without fluorescent labels); Visualization of expressed fluorescent proteins; Immunofluorescent protein localization; and Estimation of transfection efficiency [3, 4].

3. *XFp Metabolism Analyzer:*

Living cells use one or both major energy producing pathways - mitochondrial respiration and glycolysis - to meet metabolic demands. Agilent Seahorse XF technology measures cellular metabolism in live cells in real time, via the measurement of extracellular flux (oxygen consumption rate and extracellular acidification rate) to provide insight into mitochondrial function and glycolytic activity, under multiple conditions [5].

4. *Microbeads Cell Sorter (MACS):*

MACS Microbeads are 50-nm superparamagnetic particles that are conjugated to highly specific antibodies against a particular antigen on the cell surface. Due to the small size, they do not activate cells and they will not saturate cell surface epitopes. Their application is: for isolation and separation of cells, stem cells, cancer cells and immune cells via cell marker labelling of microbeads and magnetic isolation [6].

5. *Pharmacia Phast-gel system:*

with 9 different computer programs for prepared mini-gels (2 µl sample) with possible detection of proteins, RNA, DNA and their staining. Western Blot of proteins is also possible. The saving on time and material is incomparable [7]. Staining sensitivity is in the range of 1-100 ng of silver.

6. *Wireless SPEC and sensors*

These cutting age, state-of the art devices from PASCO company, as the newest technical solution with the program that can be downloaded through blue tooth so that students can get their own quantitative measurements of Oxygen, CO₂ concentration of the environment, pH, pressure, temperature, etc. graphically presented and precisely calculated [8]

Conclusion: Research and teaching in Bioengineering and in general could be connected through carefully organized collaborative programs. The essence in advanced research today is in ingenious integrated solutions within highly developed equipment and supplies.

References:

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Zoe™ Fluorescent Cell Imager

Website Link:

<http://www.bio-rad.com/en-us/product/zoe-fluorescent-cell-imager>

Video Link:

<https://www.youtube.com/watch?v=KwVBgUgSX7c>



Countess II FL Automated Cell Counter

Website Link:

<https://www.thermofisher.com/us/en/home/life-science/cell-analysis/cell-analysis-instruments/automated-cell-counters/countess-ii-fl-automated-cell-counter.html>

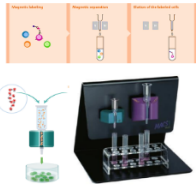
Video Link:

<https://www.youtube.com/watch?v=kLmL1172zgY>



Magnetic Bead Cell Sorter (MACS)

Website:
http://www.miltenyibiotec.com/en/products-and-services/macs-cell-separation/macstechnology/microbeads_dp.aspx?exportPF=1 Video Link:
<https://www.youtube.com/watch?v=JQIXL004uw>



XFp Extracellular Flux Analyzer

Website Link:
[http://www.agilent.com/en-us/products/cell-analysis-\(seahorse\)/seahorse-analyzers/seahorse-xfp-analyzer](http://www.agilent.com/en-us/products/cell-analysis-(seahorse)/seahorse-analyzers/seahorse-xfp-analyzer)
Video Link:
[http://www.agilent.com/en-us/products/cell-analysis-\(seahorse\)/energy-pathways](http://www.agilent.com/en-us/products/cell-analysis-(seahorse)/energy-pathways)



Pharmacia PhastSystem Electrophoresis System

Manufacturer:

Pharmacia

SKU#:

8289-30-0003

Separation-Control unit for system control and electrophoresis



Development Unit for gel staining

Maintains accurate temperatures from 0 +70°C

Multi-step programming allows automatic gel loading and running

Use up to nine different reagents in a single program!