




Classroom Bioreactor

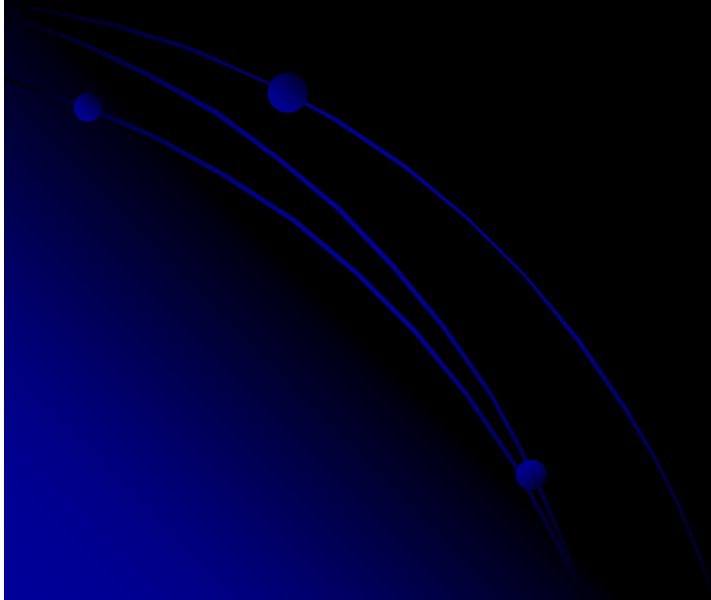
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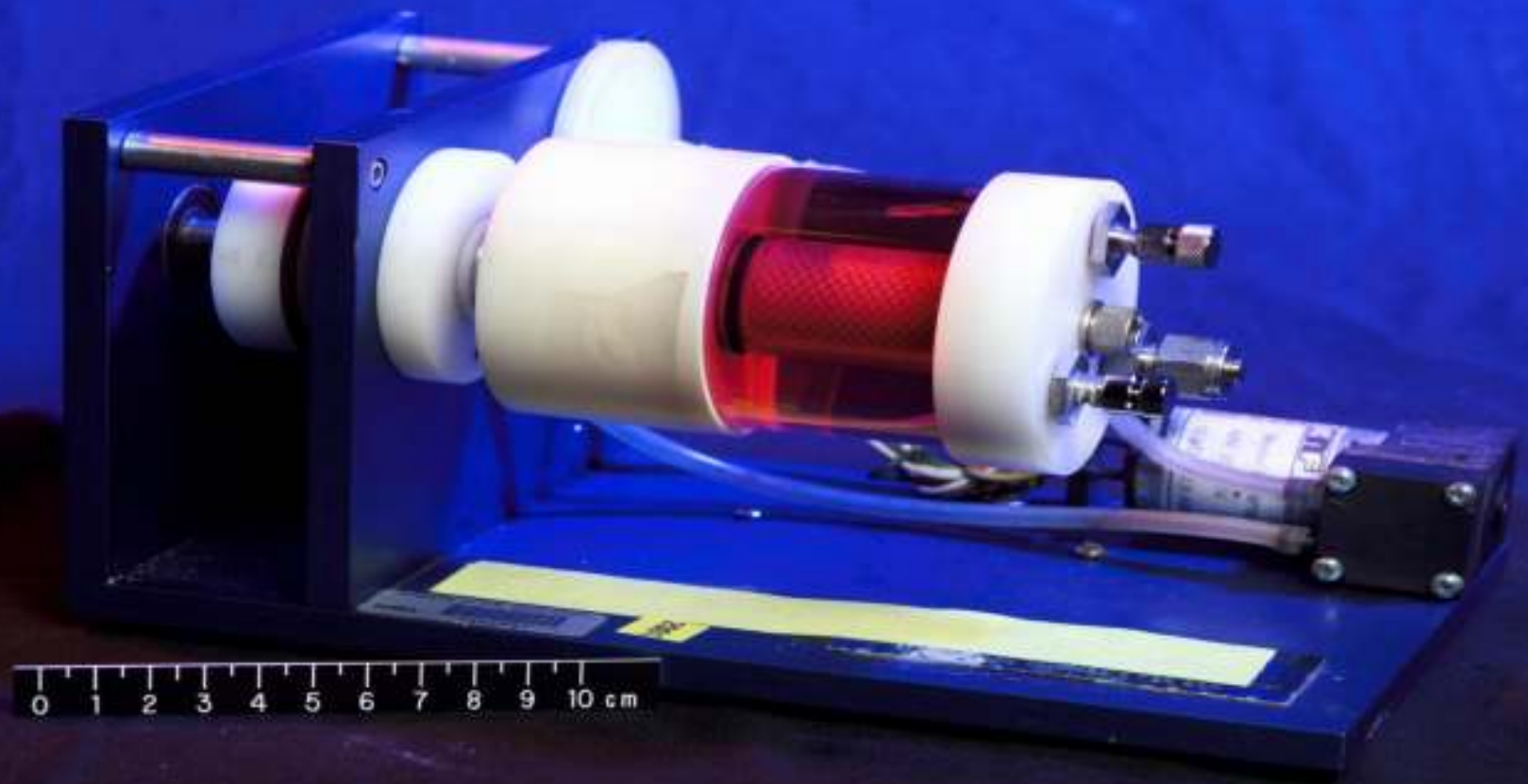
Introduction

The bioreactor is an excellent discovery that is used today by scientists'. In this presentation, you will learn about bioreactors and also how to bring this technology into your classroom.



Bioreactor Information





Why Bioreactors?

History:

- Looking for ground-based system that could replicate results as in space
- Upright cylindrical vessel

Incentives:

- Conducting experiments on orbit are very expensive and limited
- Produce a greater number of tissues

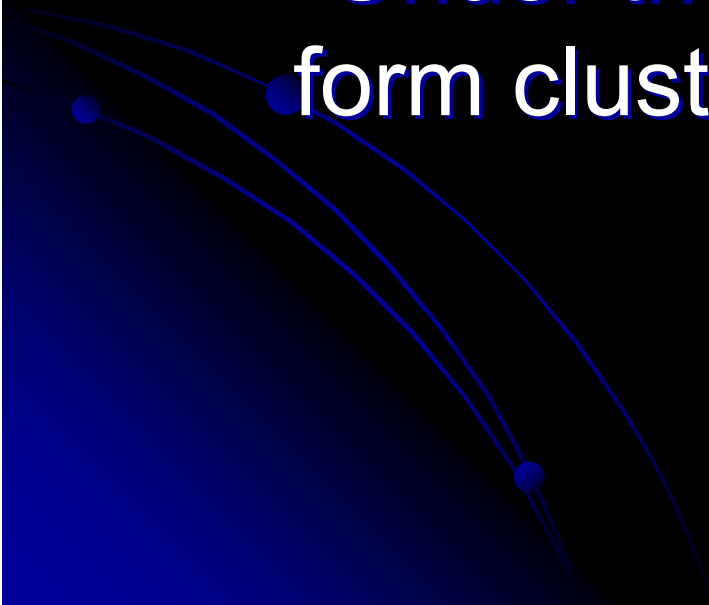


**What was used to culture cells
before bioreactors?**

Petri-dish

A decorative graphic in the bottom-left corner of the slide, consisting of three curved blue lines that sweep upwards and to the right, with three solid blue dots placed at various points along these lines.

How does the bioreactor work?

- Can-like vessel.
 - Balanced speed.
 - Oxygen/carbon dioxide.
 - Under these conditions, the cells form clusters.
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Advantages of Using the Bioreactor

- Cells move with the medium and very low shear
- Improved mass transport of nutrients and gases
- Easier to identify and control variables than on orbit
- Ability to conduct more experiments than on orbit
- Morphology, biochemistry and cell functions are much closer to those exhibited *in vivo* than anything that has been achieved with traditional cell culture methods.

Bioreactor Limitations

- Bioreactor cultures are similar, but not identical to cultures in space.
 - Cartilage grown in bioreactors on Earth is mechanically stronger and less compressible to cartilage grown on orbit which is mechanically weaker. (L. Freed)
 - Gene expression analysis in kidney cells: (T. Hammond)
 - 10,000 genes tested
 - In microgravity, over 1600 genes change expression
 - In bioreactor, approximately 800 genes change expression, which 200 are the same as the gene changes in microgravity
 - In centrifuge experiment (3g), only 70 genes change expression
- LIMITED SIZE!
 - Cell aggregates get larger, increase rotational velocity, but increases shear

STS-107 Results

GROUND



FLIGHT

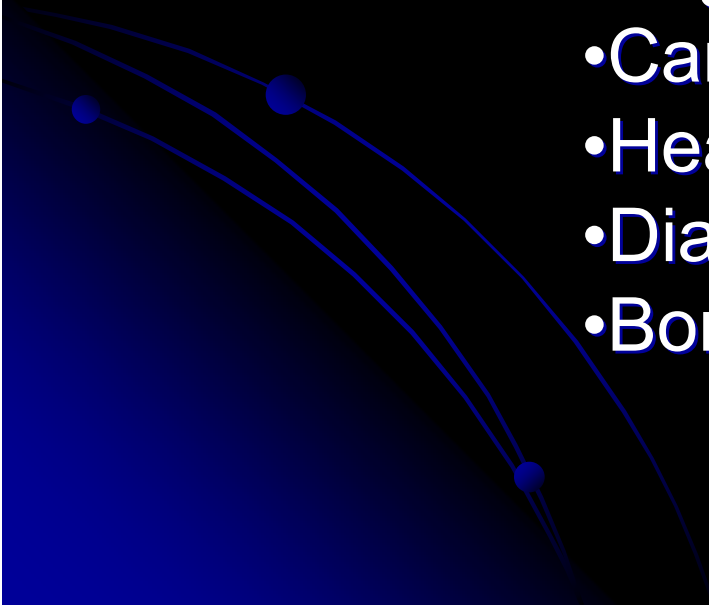


- Bone stromal cells and prostate carcinoma co-culture
- On-orbit tissue aggregates spanned width of bioreactor

From STS-107, BDS-05, PI: Dr. Leland Chung, Emory University

Bioreactor Research

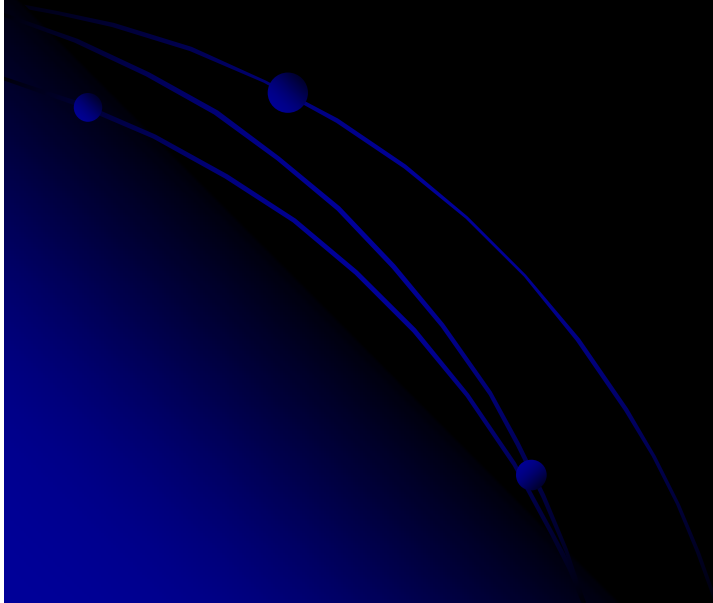
Applications to Human Health on Earth

- Infectious Diseases
 - Drug Efficacy
 - Acute Injury and Reconstructive Surgery
 - Cancer
 - Heart Disease
 - Diabetes
 - Bone Loss
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What Does The Future Hold ?

- To contribute to space exploration by developing countermeasures to the health issues related to space exploration.
- To continue Life Support Systems Research
- To improve ground based and space cell culture technology and applications
- Use bioreactor technology to continue improving health care on Earth and enhance basic and applied research in cell biology

The Demonstration

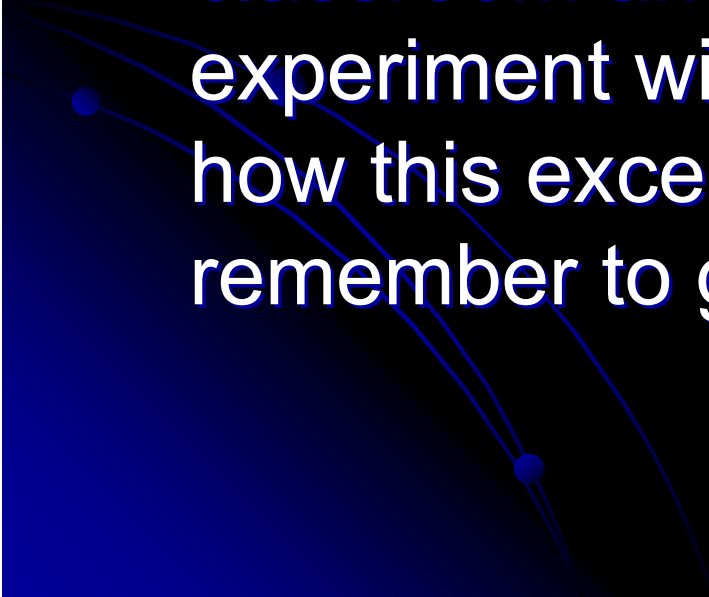


So how can you bring this technology into your classroom?



Conclusion

This presentation has taken you from learning about bioreactors to showing you how to set one up in your classroom. I challenge you to bring this to your classroom and let your students experiment with the bioreactor and see how this excellent technology works. And remember to get your assignments done!



Resources

- NASA Educational Brief. *NASA's bioreactor: Growing cells in a microgravity environment.*

