



# Cancer Cell Scaffold

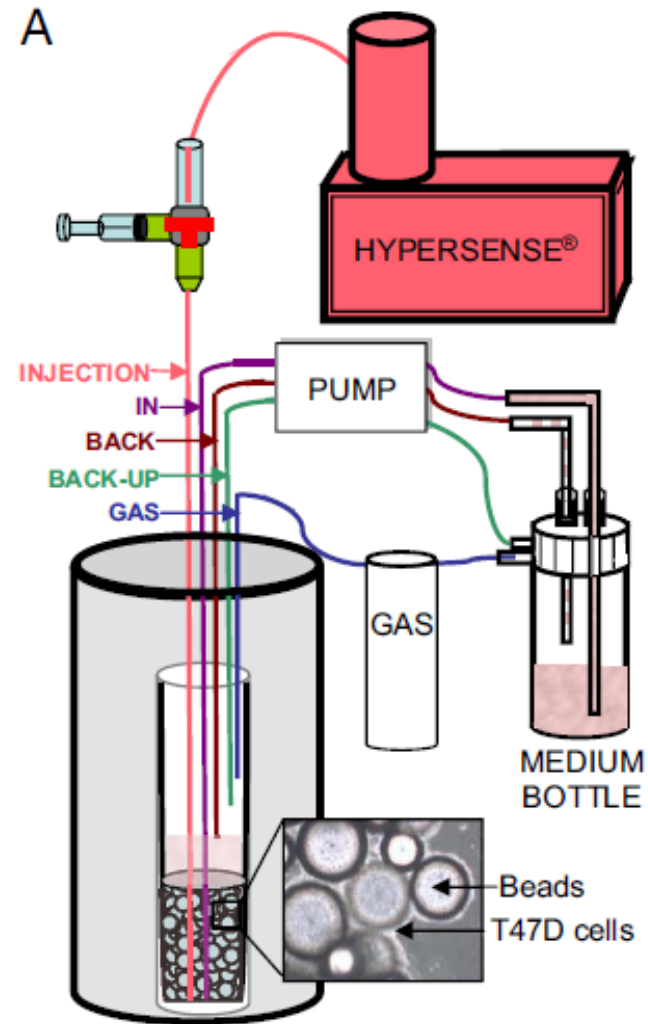
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# Outline

- Background
  - Bioreactor
  - Cell Scaffold
  - MRI
  - Cancer cells
- Motivation
- Design
  - Criteria
  - Alternatives
- Matrix
- Final design
- Future work

# Bioreactor & Scaffold

- System to grow and sustain cells
- Bioreactor encases cell scaffold
- Scaffold provides site for cells to attach



# $^{13}\text{C}$ MRI Hyperpolarization

- Hyperpolarization: nuclear spin polarization of a material ( $^{13}\text{C}$ ,  $^1\text{H}$ ) far beyond thermal equilibrium
- MRI tracks decay of hyperpolarized proton
- Used to assess cancer malignancy and treatment
  - Glycolysis up-regulated in cancer cells
  - $^{13}\text{C}$ -labeled pyruvate used to monitor glycolytic pathway

# Experimental Cell Lines

- Cell Lines
  - Lymphoma K562
  - Leukemia NKL
  - Prostate Cancer: PC3, DU145, LNCap
  - Brain Glioma: U251, U87
  - Breast Cancer: T47D
- Characteristics
  - Self-proliferating
  - Overproduction of ECM
  - Increased ease of culturing

# Project Motivation

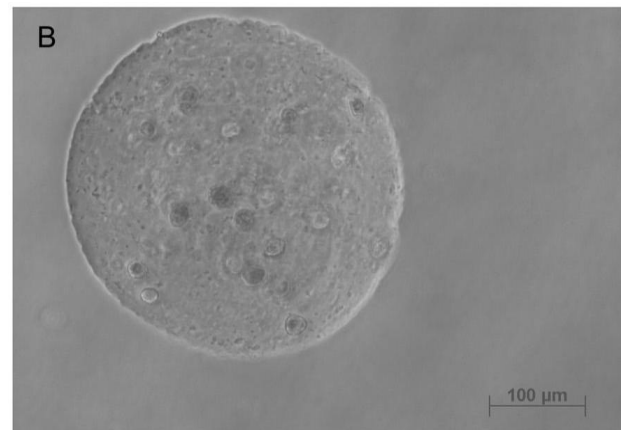
- Controlled cell culture experiments provide superior method of monitoring cancer cell metabolism
- Bioreactor and cell scaffold required
- Scaffold must promote cell growth to a high density to track metabolism

# Design Criteria

- Large surface area : volume ratio
- High cell density ( $50 \times 10^6$  cells/ml)
- Maintain cell viability (~4 days)
- Allow perfusion of fluids
- Ensure proper inoculation
- Non-ferrous material

# Encapsulation

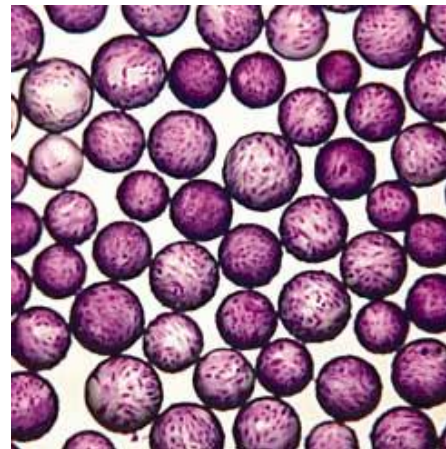
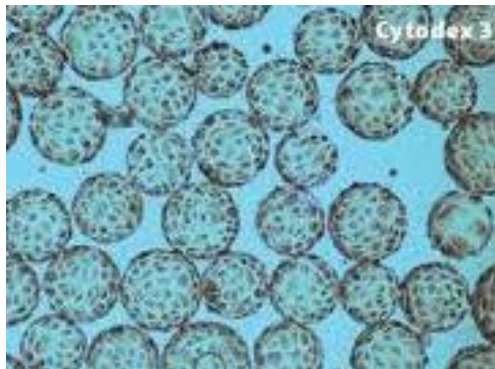
- Calcium alginate bead with cells inside
- Primarily used with tumorous liver cells
- Grow to a desirable density
- Time consuming to construct
- Size, shape, and cell density can vary





# Microcarriers

- Dextran (polysaccharide), glass, polystyrene (polymer)
- 125-300  $\mu\text{m}$
- Often used in bioreactors
- Coated or uncoated (collagen, FACT, ProNectin F)
- Different porosities and surface chemistries

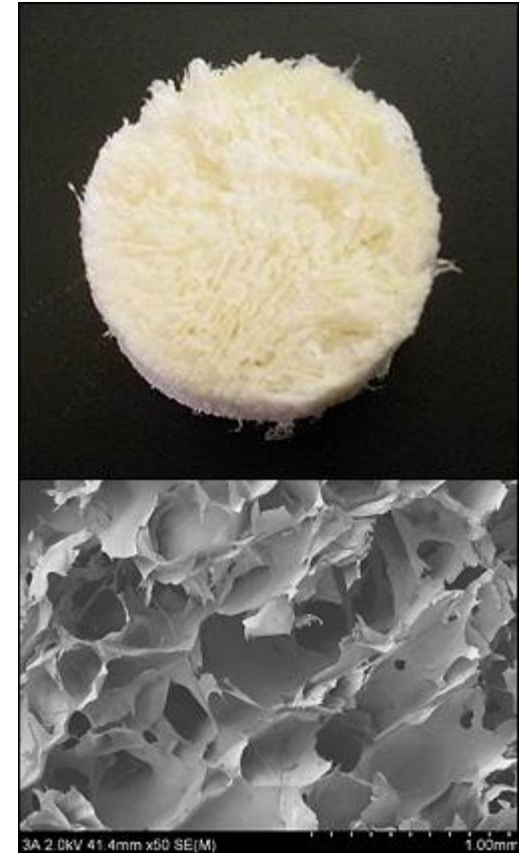


# Microcarriers

- Cytodex 3
  - Cross-linked dextran beads with collagen layer, microporous
- Biosilon Nunclon Delta Microcarriers
  - Polystyrene with surface treatment to promote adhesion, nonporous
- Sigma-Solohill Microcarrier Beads
  - Polystyrene beads coated with collagen, nonporous

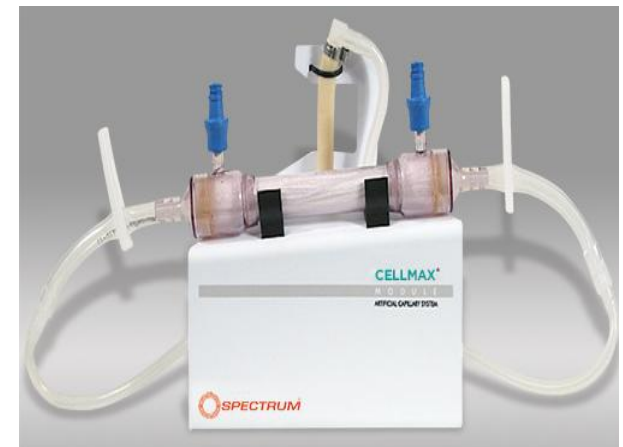
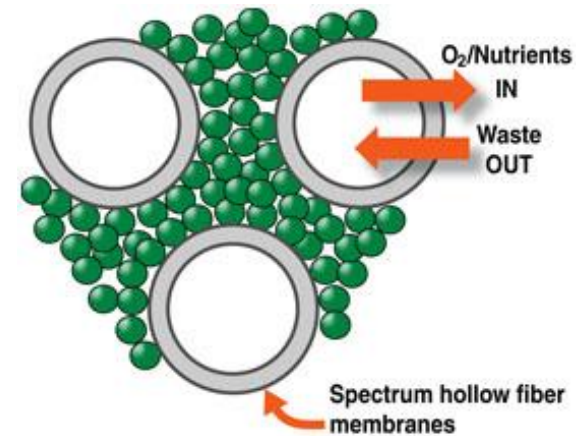
# ECM Scaffolds

- Cancer research commonly utilizes
  - Alginated scaffolds (bought/made)
  - Fibrin scaffolds (bought/made)
  - Collagen
- Lab-made options
  - Cheap
  - High surface area
- Tumor cell specific research
- Not present in bioreactor research



# Hollow Fibers

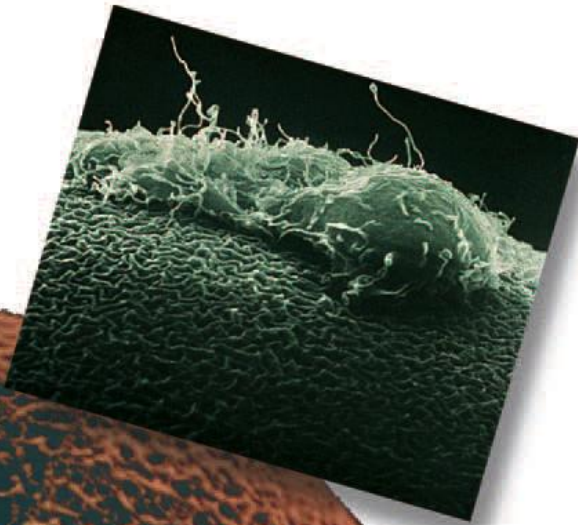
- Tailored for use in a bioreactor
- Cartridge of many tubule membranes
- Large surface area
- Can be coated with ECM proteins
- Precedence with cancer cell lines
- Membranes cause noise in MRI



# Design Matrix

Type of Matrix		Surface Area (Density) 25	Cell Specificity 20	Presence in Bioreactors 15	Cost 10	Change in Phenotype? 5	Viability 15	Ease of Fabrication 10	Total 100
Encapsulation	Calcium Alginate	21	14	12	9	5	15	1	77
Microbeads	<i>Cytodex 3</i>	22	17	15	9	5	15	10	93
	<i>Biosilon Nunclon microcarriers</i>	23	19	15	8	5	15	10	95
	<i>Collagen Coated Polystyrene microcarriers</i>	23	19	15	9	5	15	10	96
Hollow Fibers		24	18	15	6	5	15	8	91
3-D Gel Structures	<i>Algenated Bought/made</i>	15	14	0	1/8	5	15	8/1	58
	<i>Fibrin Bought/made</i>	15	14	0	1/8	5	15	8/1	58
	<i>Collagen</i>	15	14	0	2	5	15	8	59

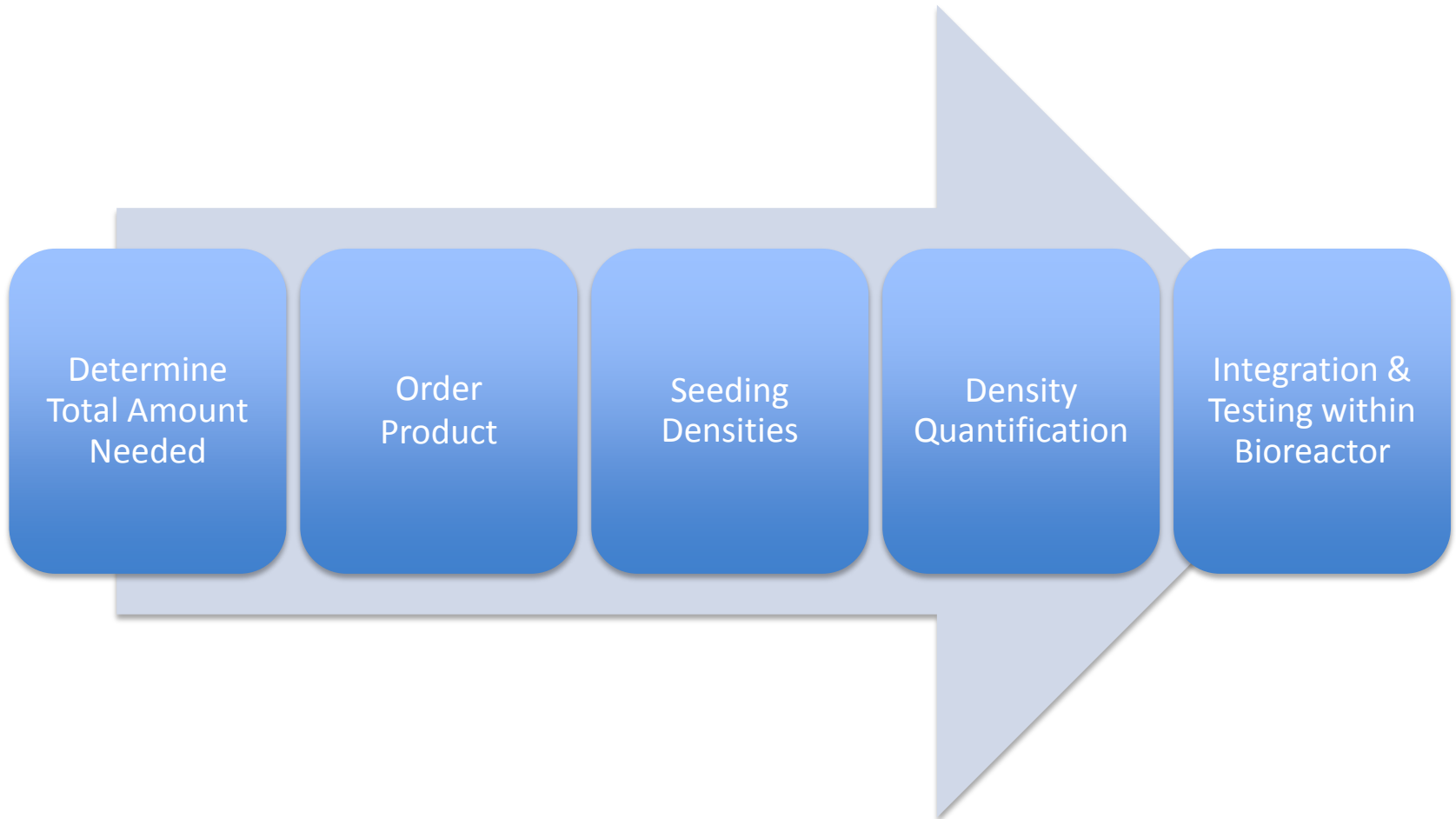
# Final Design



## *Sigma-Solohill*

- Polystyrene microcarrier
- Coated in collagen
- T47D breast cancer cells
- Large surface area  
( $3.6 \times 10^6 \text{ cm}^2/\text{bead}$ )
- \$5 / experiment  
( $\$160.70/20\text{g}$ )

# Future Work



# References

## Text

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## Images

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[http://www.bioprocessintl.com/multimedia/archive/00103/BPI\\_A\\_100807AR30\\_O\\_\\_103800b.jpg](http://www.bioprocessintl.com/multimedia/archive/00103/BPI_A_100807AR30_O__103800b.jpg)

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# Questions?

