Growth!

Modification of existing techniques in tissue engineering - Ryan Alexander
In-Vitro meat: don't have a cow! – Janice O’Brien
Grow a brain - Anonymous student CE
The Essentials of Tissue Engineering
Importance and Impact

- The focus of tissue engineering is to create three dimensional tissue cultures. These cultures can be used to create functional tissue grafts for transplants, derive proteins from tissues, and further studies in the development of tissues and the diseases that affect them. Basically, this is very important and the impact of improving tissue engineering can affect a wide variety of areas.
The Essentials of Tissue Engineering

Scaffolds: Informational templates for 3-D cultures
Stem cells and cell seeding
Decellularized tissue vs. Electrospun nanofibers

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The Essentials of Tissue Engineering cont'd

Biochemical and mechanical stimulation of tissue cultures.

Bioreactors

Images removed due to copyright restrictions.
Growth factors, microRNA mediated repression
Removal of dead cells: magnetic beads coated with antibodies (existing technology), apoptosis

Knowns and Unknowns

**Knowns**
- Not dealing with hazardous materials
- MiRNA (especially miRNA mimic) is relatively cheap.
- Trying to improve existing techniques that are already known to be cost effective.

**Unknowns**
- Don't know how feasible it is to use miRNA mediated repression in 3-D cell cultures.
- Don't know if engineering damaged cells to undergo apoptosis is comparable to using magnetic beads.
Welcome to the world of meat!
In-Vitro Meat

- The focus of this idea is to develop a method for growing meat in a laboratory environment, using a protein matrix, animal muscle cells, and a nutrient delivery/waste removal system.


Courtesy of the Tissue Culture and Art Project. Used with permission.
In-Vitro Meat: Impact and Importance

- Economic reasons-1/3 of crops produced become “feed crops”
- Environmental reasons-livestock emissions, deforestation for grazing land
- Ethical Reasons: No butchering
- Cleaner meat: grown in clean environment, no unnecessary antibiotics or growth hormones
- Can be engineered to give certain advantages (built-in barbecue flavor!, extra vitamins, etc.)
- Could offer people a chance to try exotic meats without worrying about poaching or endangered animals.
Competition!

- potential competitor—“all-nutrition” plants
- competitor—real meat
- Competitor—plant-based protein products (soy)

Soybeans. Courtesy of Clearly Ambiguous on Flickr.

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Box of “Newkirk Nuggets”
Knowns and Unknowns

- **KNOWNS:**
  - Extremely cost-ineffective compared to current products, but cost could be reduced by use of “bioreactors”
  - Need protein matrix to grow it in-collagen

- **UNKNOWNNS:**
  - Taste – will it taste as good as real meat (no blood or fat)?
  - Consistency – how to grow structured tissue
  - Will certain genes need to be “turned on”?
Growing a Brain
Making Neuron Babies

Photo of neurons removed due to copyright restrictions.
Why?

- Regeneration of damaged neural tissue
- Parkinson's
- Alzheimer's
- Stroke
- Traumatic Brain Injury
- Aging
QUALITY OVER QUANTITY!
Questions/Unknowns

- How do we induce neural cell division?
- Modification of epigenome after division?
- Configuration for desired connections?
- Best pathway to do this?
What we know

- Modifications in cancerous cells lead to uncontrolled cell division
- Stem cells undergo controlled cell division
- Stem cells in the hippocampus can differentiate and integrate themselves
Current Work

- Skin cells turned into embryonic stem cells: Kathrin Plath et. al
First Small Step

Design a simple neural network with neurons that can divide and integrate themselves into the existing network.
Start Here and End There

- Look at normal processes that control cell division
- Work backwards: how does it get stopped?
- Look in nature: existing agents that can induce cell division
Summary

- Modifying existing technology and techniques used in tissue engineering.
- Growing unstructured muscle cells in bioreactors using protein matrixes for support.
- Inducing cell division in differentiated neurons.
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