Computers and Medicine

A Few Examples

1. CT Scans
   1. Takes multiple 2D x-rays and uses precise computer algorithms to stitch them together to make a 3D image
2. Controlled Robot for Surgery
   1. A remote-controlled robot may be needed to perform a surgery that requires very small, precise movements to be successful

We Will Focus On…

* 3D Bio-Printing

3D Bio-Printing Steps

1. Harvest/Create the Stem Cells
   1. Induced Pluripotent Stem Cells (iPSCs)
      1. Man-made stem cells that can turn into any kind of cell
   2. Made From Adult Cells
      1. Not empryonic cells
   3. Bypasses

Creating the Bio-Ink

* Bio-Ink is a Mix of Stem Cells and Two Polymers
  + Lab Created Synthetic Polymer
    - This causes the bio-ink to change from a liquid to a solid when temperature is raised.

Prink The New Tissue

* Load the Newly Created Bio-Ink Into the Printer

Current Applications

1. Disease and Drug Study
2. Tissue Repair
3. Red Blood Cell Synthesis

Disease and Drug Study

1. iPSCs are Self-Renewing
   1. Scientists have an unlimited supply of disease infected cells
2. iPSCs Have the Ability to Transform
   1. Study the exact effect of a disease on specific cell types
3. Test Drug on iPSC Cultures
   1. Having an unlimited supply means that pharmaceutical companies can test their

Tissue Repair Examples

1. Use Bio-Ink Compound to Print Small Brain Repairs
   1. Created a small cube that secretes serotonin
2. Correct Damaged Eyesight
   1. Inject 3D-printed vascular muscles into the eyes
3. Improve Motor Functions
   1. iPSCs injected into the brain migrate to legions

Red Blood cell Synthesis

* Constantly in Need of Blood
  + iPSCs have unlimited supply and can become anything
* No longer Rely on Public

Future Applications

* One Big Future Application
  + 3D Print an Entire Brain
    - This could

3D Printed Brain Complexities

1. Brains are Made up of Many Parts
   1. Right now 3D printed tissues are uniform
2. Unknown Variables
   1. There is still so much about the brain that we just don’t know

Risk Factors of Bio-Printing

1. Low Efficiency Conversion From Skin Cells to iPSCs
2. Incorrect Transformation of Bio-Printed Tissue

Low Efficiency

* Not only is it complicated to produce iPSCs, but it is also inefficient
* Any guesses for the success rate?
* 100

Incorrect Transformation

* iPSCs, like normal stem cells, have the potential to become anything
* Incorrect Transformation Instances:

Increased Risk of Cancer

* Part of the iPSC creation process includes activation of the genes in the Myc family
* 25% of mice with this brand of iPSCs developed cancer
* New methods

Ethical Issues and Questions

1. Availability and Cost
2. Human Enhancement

Availability and Cost

* Creating Bio-Printed Tissues and Eventually Organs is Naturally Going to be Expensive.
* Should Bio-Printing be Made Accessible to Everyone?
  + If yes, that eliminates money as an incentive, so do you think the technology would progress as fast?
  + If no, do you think that would create a greater rift between the rich and the poor?

Human Enhancement

* Bio-Printing has the Potential to Enhance the Human Body, Such as Stronger Bones, More Resilient Muscles, Higher IQ, etc.
* Should Bio-Printing Solely for Enhancement be Outlawed?
  + If yes, what should the restrictions be?
  + If no, should other performance enhancing tactics, such as steroids, be legal?

Liability

* The First Time a Bio-Print Procedures Fails, a Lawsuit will Naturally Follow
* Which Party Should be Held Responsible?
  + 3D Programmers / Manufacture?
  + Researchers of the technology?
  + Those who performed the bio-print?

How to Test for Safety

* With any new Medical Procedure, Extensive Testing is a Must
* Not all of the Potential Treatments are for Life Threatening Diseases, so who will Want to Test Something That Could Give Them Cancer?

Regulations

* Like any Medical Procedure, Regulations must be put in Place to Protect People
* How can we Prevent This Knowledge From Being Abused, Such as Illegitimate Procedures?

Any Questions?