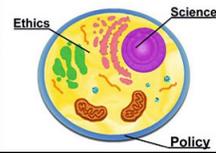


Stem Cells and Regenerative Medicine

Adam J Engler, PhD
Associate Professor of Bioengineering
University of California, San Diego



Stem Cell Education Outreach Program [SCEOP]
"INTEGRATING SCIENCE & ETHICS INTO THE CLASSROOM"



PLAN YOUR ESCAPE

EWAN MCGREGOR SCARLETT JOHANSSON

THE ISLAND

What comes to mind when you hear "stem cell?"

How does your picture relate to stem cell research?

“Glow-in-the-dark” dogs!



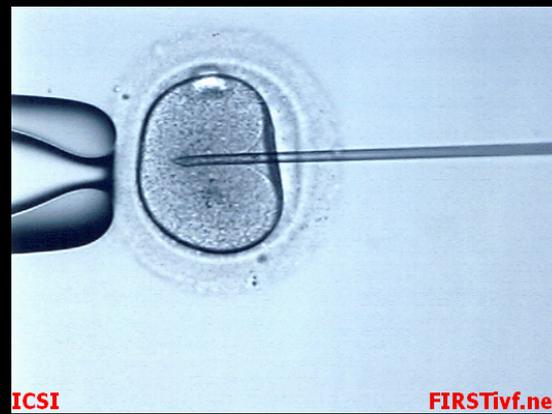
Outline of Presentation

- Introduction to fertilization and embryonic development
- What makes stem cells unique?
- What do stem cells look like?
- What are the different types of stem cells?
- What are examples of stem cell research, therapies, and technologies?
- Conclusion and future directions

Conception in a dish



Conception in a dish





Fertilized Egg

FIRSTivf.net



2-Cell Embryo

FIRSTivf.net



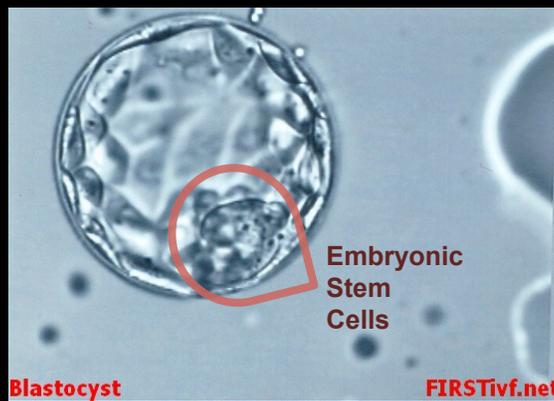
4-Cell Embryo

FIRSTivf.net



8-Cell Embryo

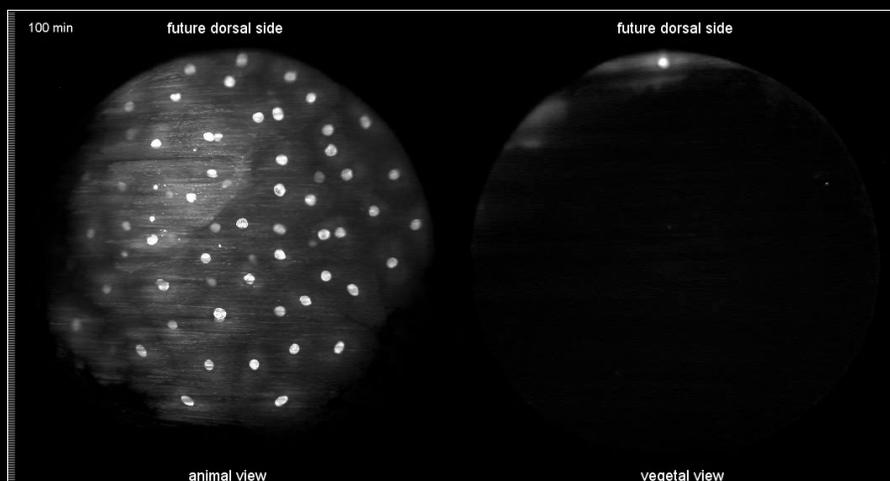
FIRSTivf.net



At what point is this a fetus?

- Days 7-14: Uterine implantation
- Day 14: Three distinct layers begin to form (no more embryonic stem cells)
- Days 14-21: Beginning of future nervous system
- Days 21-24: Beginning of future face, neck, mouth, and nose
- Weeks 3-8: Beginning of organ formation
- Week 8: Now it's called a fetus

Embryonic Development: Zebrafish model

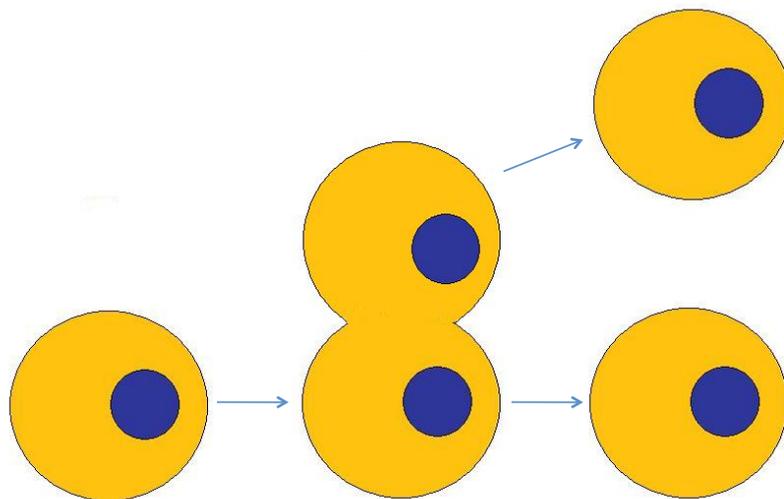


Keller et al. 2008

Outline of Presentation

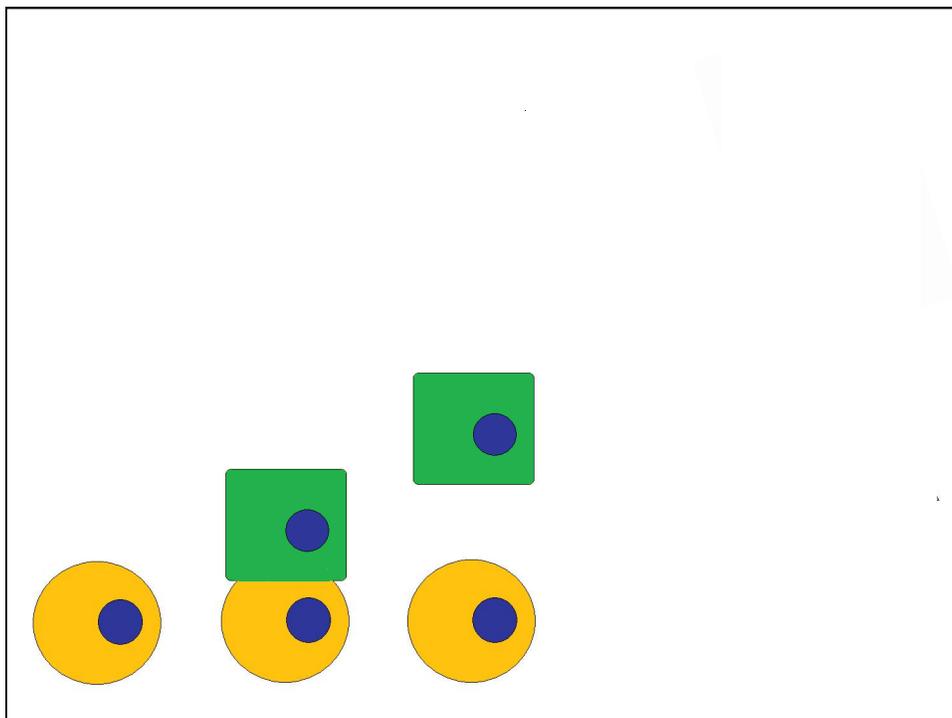
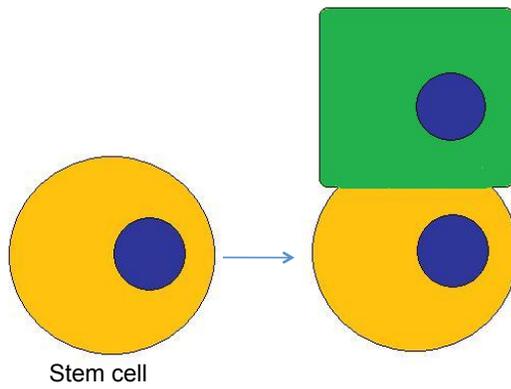
- Introduction to fertilization and embryonic development
- **What makes stem cells unique?**
- What do stem cells look like?
- What are the different types of stem cells?
- What are examples of stem cell research, therapies, and technologies?
- Conclusion and future directions

Symmetric cell division



Asymmetric cell division

1. Self-renews
2. Differentiates

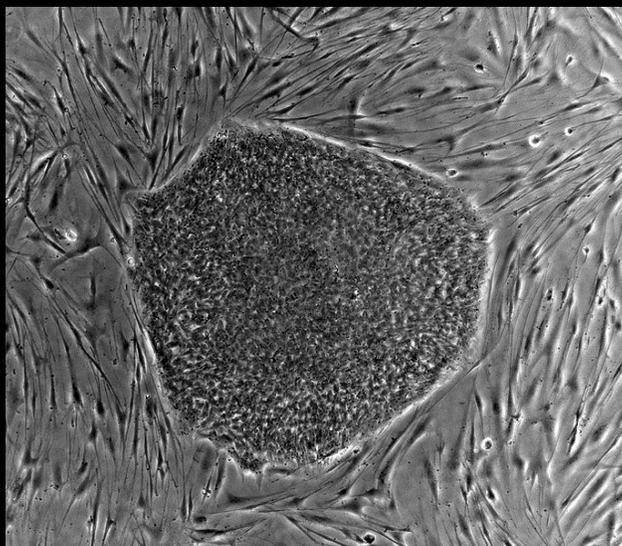


Outline of Presentation

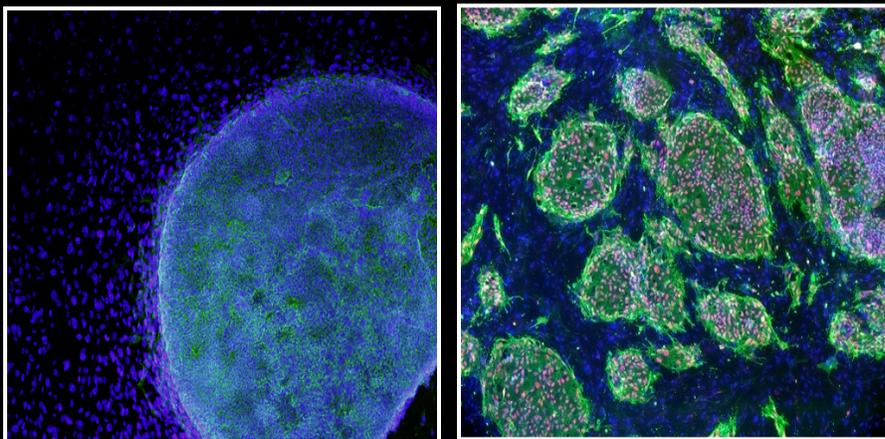
- Introduction to fertilization and embryonic development
- What makes stem cells unique?
- **What do stem cells look like?**
- What are the different types of stem cells?
- What are examples of stem cell research, therapies, and technologies?
- Conclusion and future directions

Embryonic stem cells in the dish:

What do cultured ES cells look like?

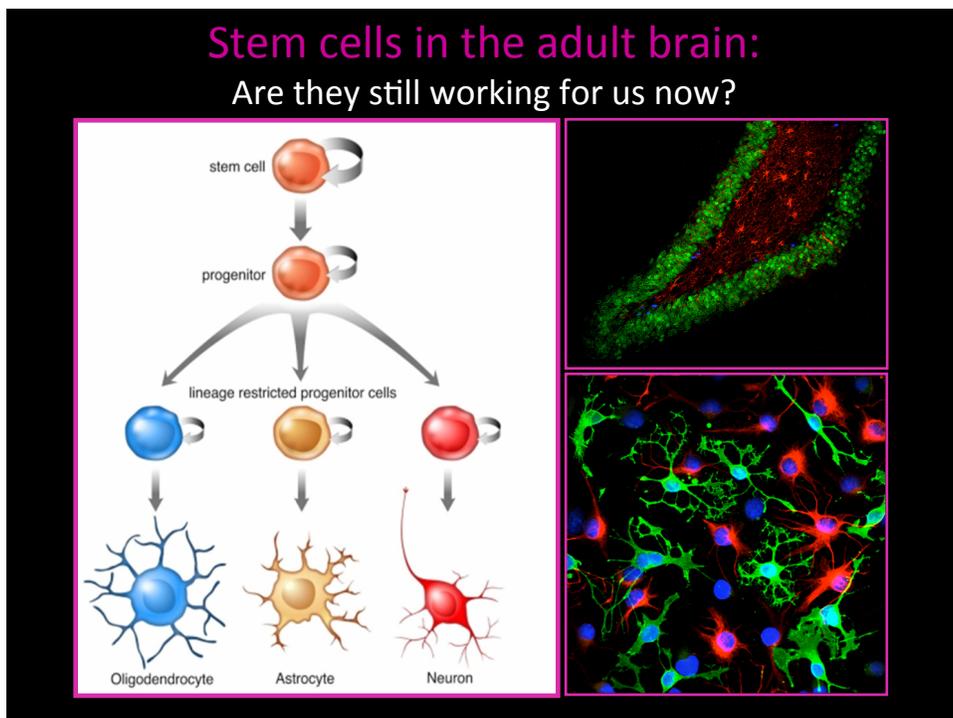
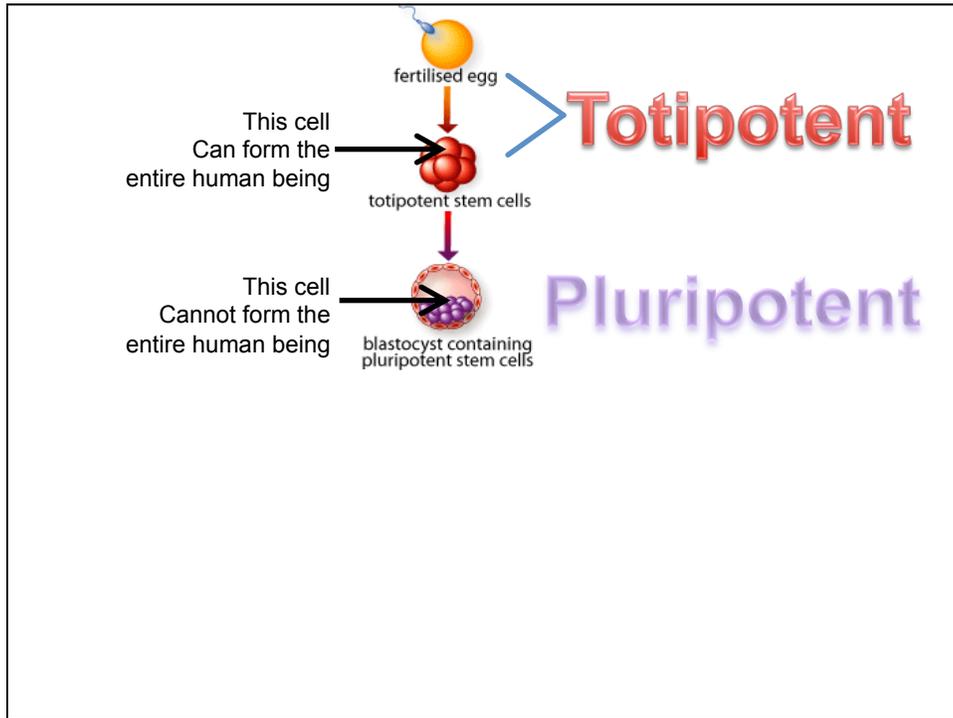


Fluorescent imaging of embryonic stem cell colonies.



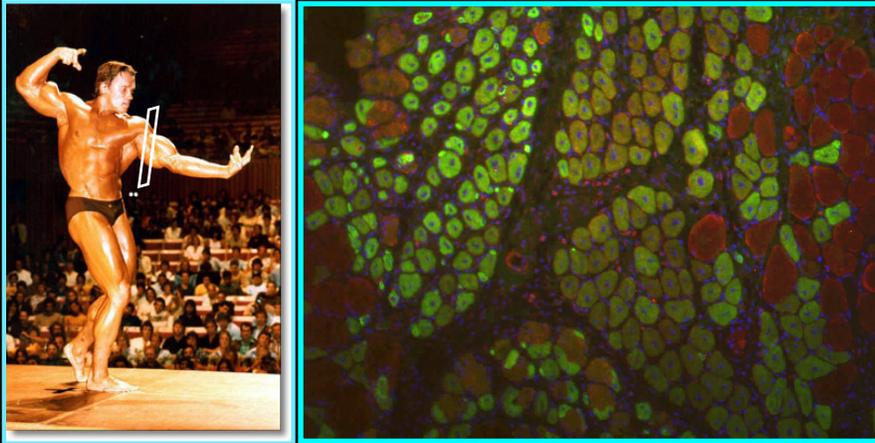
Outline of Presentation

- Introduction to fertilization and embryonic development
- What makes stem cells unique?
- What do stem cells look like?
- **What are the different types of stem cells?**
- What are examples of stem cell research, therapies, and technologies?
- Conclusion and future directions



Stem cells in mature skeletal muscle:

Is there power still in our stem cells?

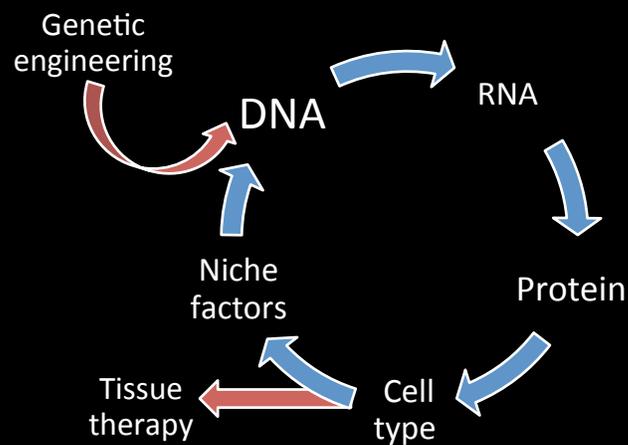


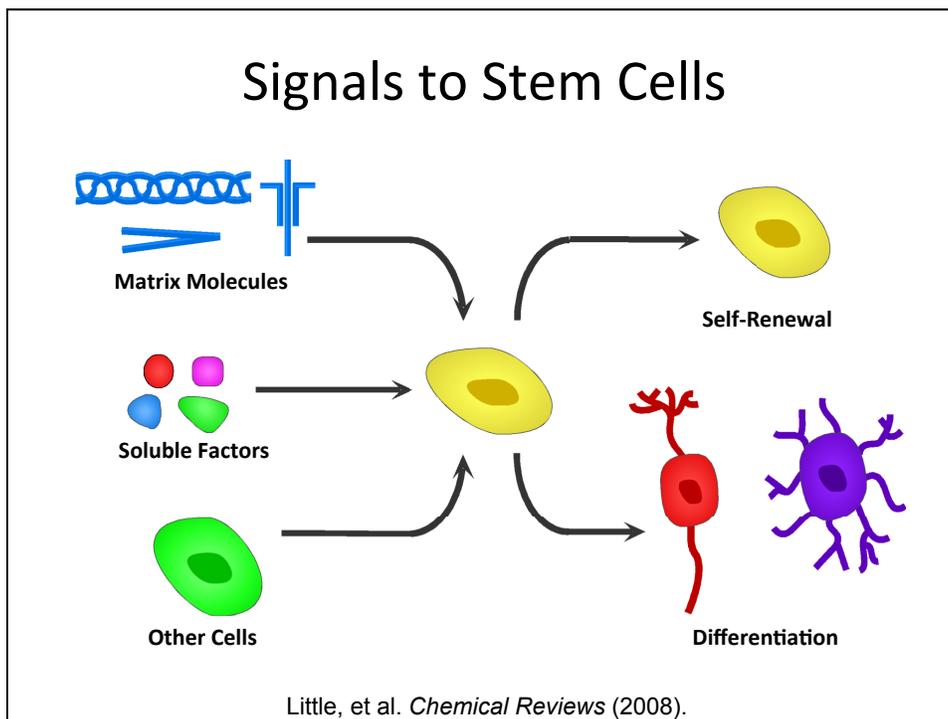
How do cells know what to become?

All cells in a person share the same genotype

Yet eye cells differ from nose cells

Central dogma of biology





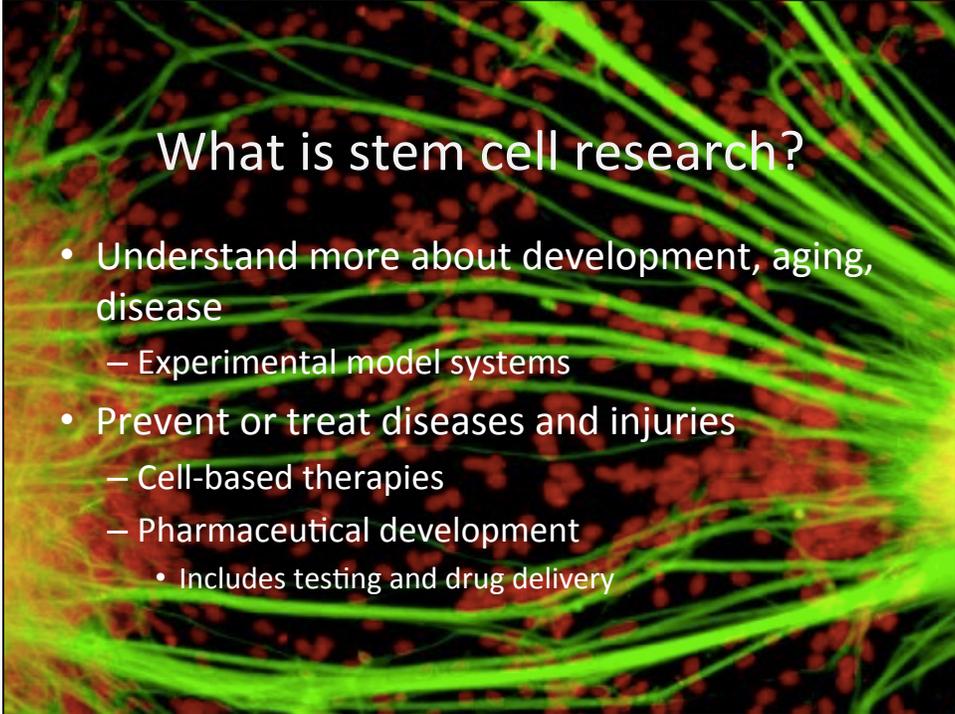
Factors known to affect stem cells

- Low stress levels
- Regular exercise
- Enriching experiences
- Learning new information
- Healthy diets: rich in antioxidants
- Avoid excessive drinking

Helping you help yourself

Outline of Presentation

- Introduction to fertilization and embryonic development
- What makes stem cells unique?
- What do stem cells look like?
- What are the different types of stem cells?
- **What are examples of stem cell research, therapies, and technologies?**
- Conclusion and future directions



What is stem cell research?

- Understand more about development, aging, disease
 - Experimental model systems
- Prevent or treat diseases and injuries
 - Cell-based therapies
 - Pharmaceutical development
 - Includes testing and drug delivery

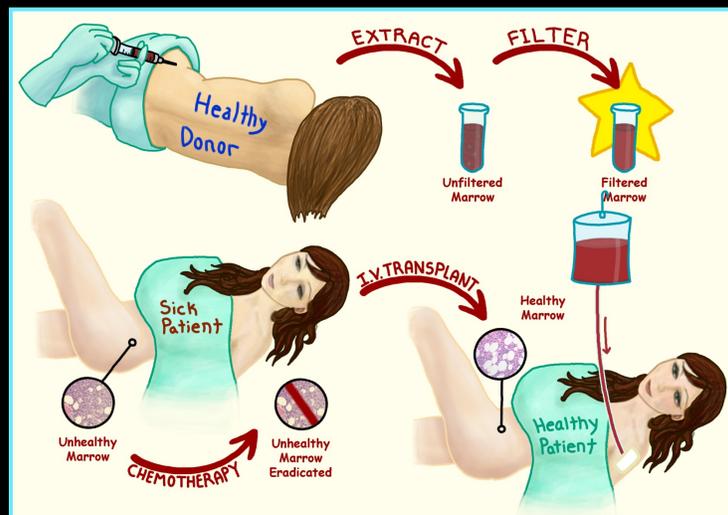
Experimental model system

Heart muscle cells beating in a petri dish!



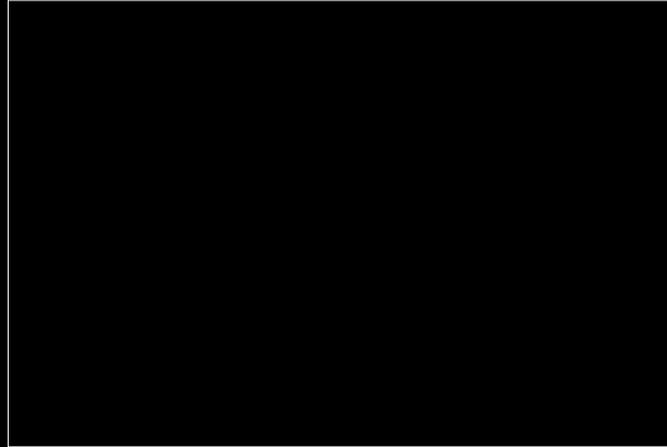
Bone marrow transplant:

Example of adult stem cell-based therapy



Spinal cord injury:

Example of embryonic stem cell-based therapy



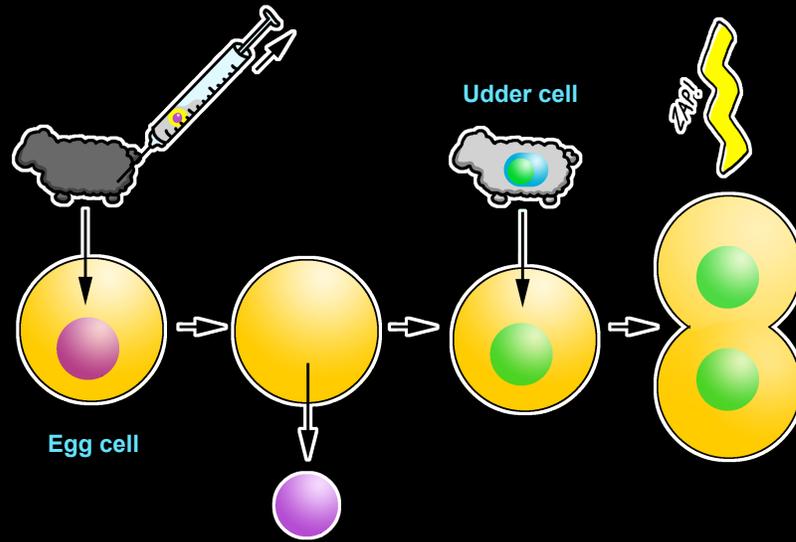
Geron video: <http://www.geron.com/grnopc1clearance/>

What are stem cell technologies?

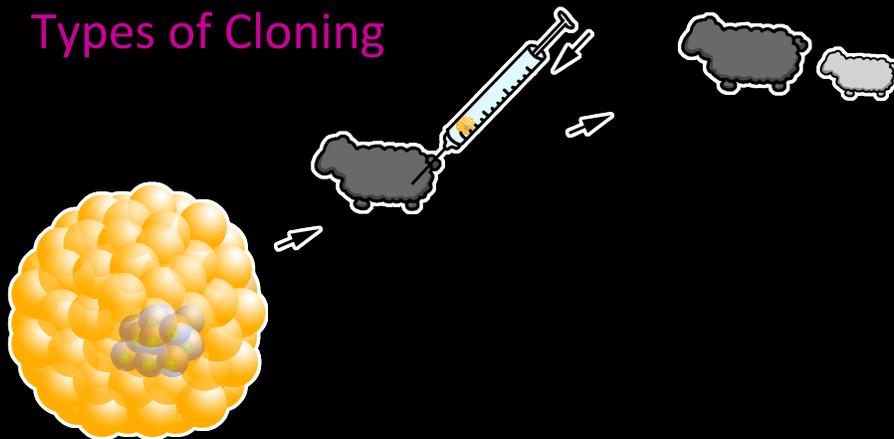
- **Cloning technologies**
 - Is human cloning a technology?
 - What is different about cloning embryonic stem cells?
- **Induced Pluripotent Stem cells**
 - New ways to potentially avoid the use of embryos
 - Disease-specific stem cell lines created
 - The promise and potential pitfalls of this approach

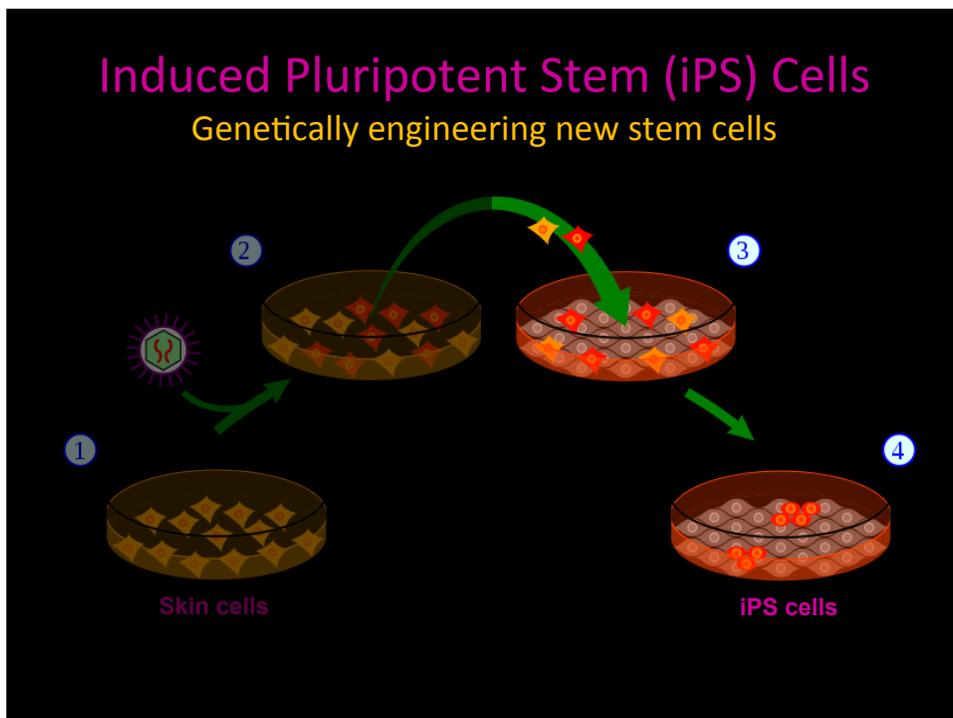
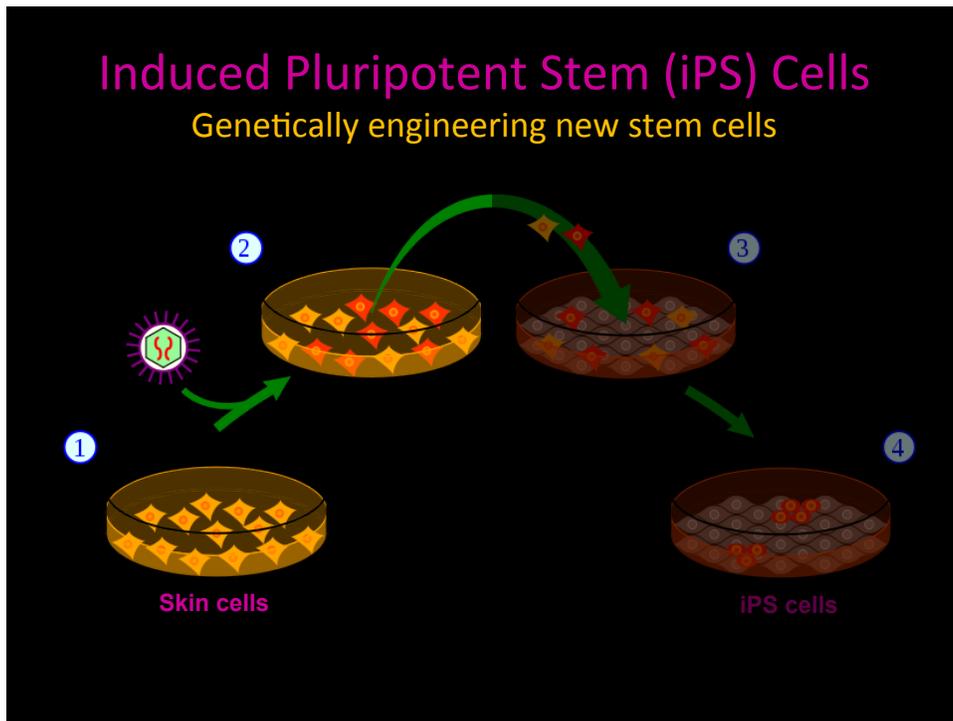
When does research actually become technology?

Somatic Cell Nuclear Transfer (SCNT) Cloning of embryonic stem cells



Types of Cloning





Outline of Presentation

- Introduction to fertilization and embryonic development
- What makes stem cells unique?
- What do stem cells look like?
- What are the different types of stem cells?
- What are examples of stem cell research, therapies, and technologies?
- **Conclusion and future directions**

Why do researchers want to use embryonic stem cells along with other technologies?

- **Pluripotent**
 - Expanded developmental potential allows them to be used in ways that adult stem cells cannot
- Can proliferate indefinitely in culture
- Easier to obtain than adult stem cells

Science is discovering the unknown

- Stem cell field is still in its infancy
- Human embryonic stem cell research is a decade old, adult stem cell research has 30-year head start
- Holds hope for curing or improving treatments for 70+ diseases

How can you help to shape the direction of this field?

digitalblasphemy.com

Take our survey please!

Students:

<http://tinyurl.com/stemcell-student>

Teacher:

<http://tinyurl.com/stemcell-teacher>