Human Embryonic Stem (ES) Cells and Induced Pluripotent Stem (iPS) Cells

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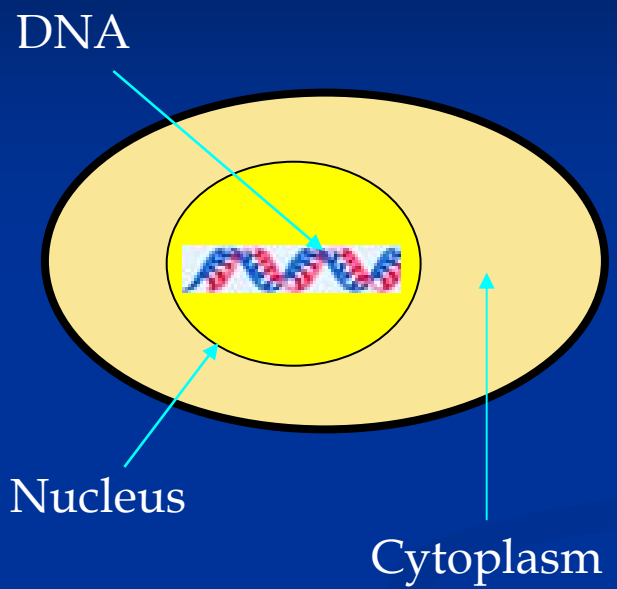
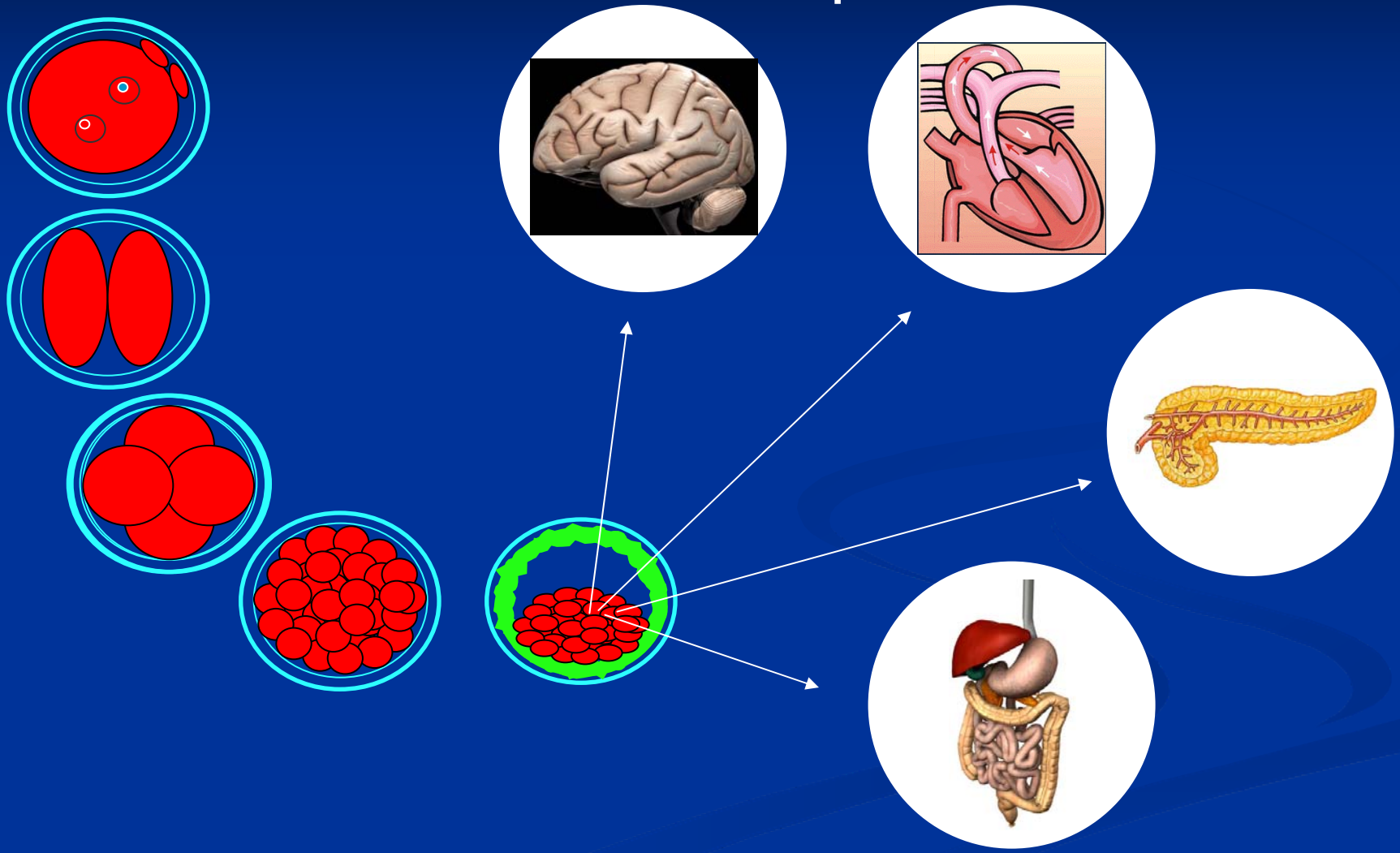
What is a Cell?



- Cells are the fundamental, structural, and functional units of living organisms.

Step-wise restriction of differentiation potential during human development



Neurological Diseases

Parkinson's Disease

- Caused by the death of dopaminergic neurons
- 1.5 million people affected in the U.S.
- $5.6 billion total cost in the U.S.
- Fetal tissue transplants have been performed, but the source of tissue is inadequate.

ALS (Lou Gehrig's Disease)

- Caused by death of motor neurons

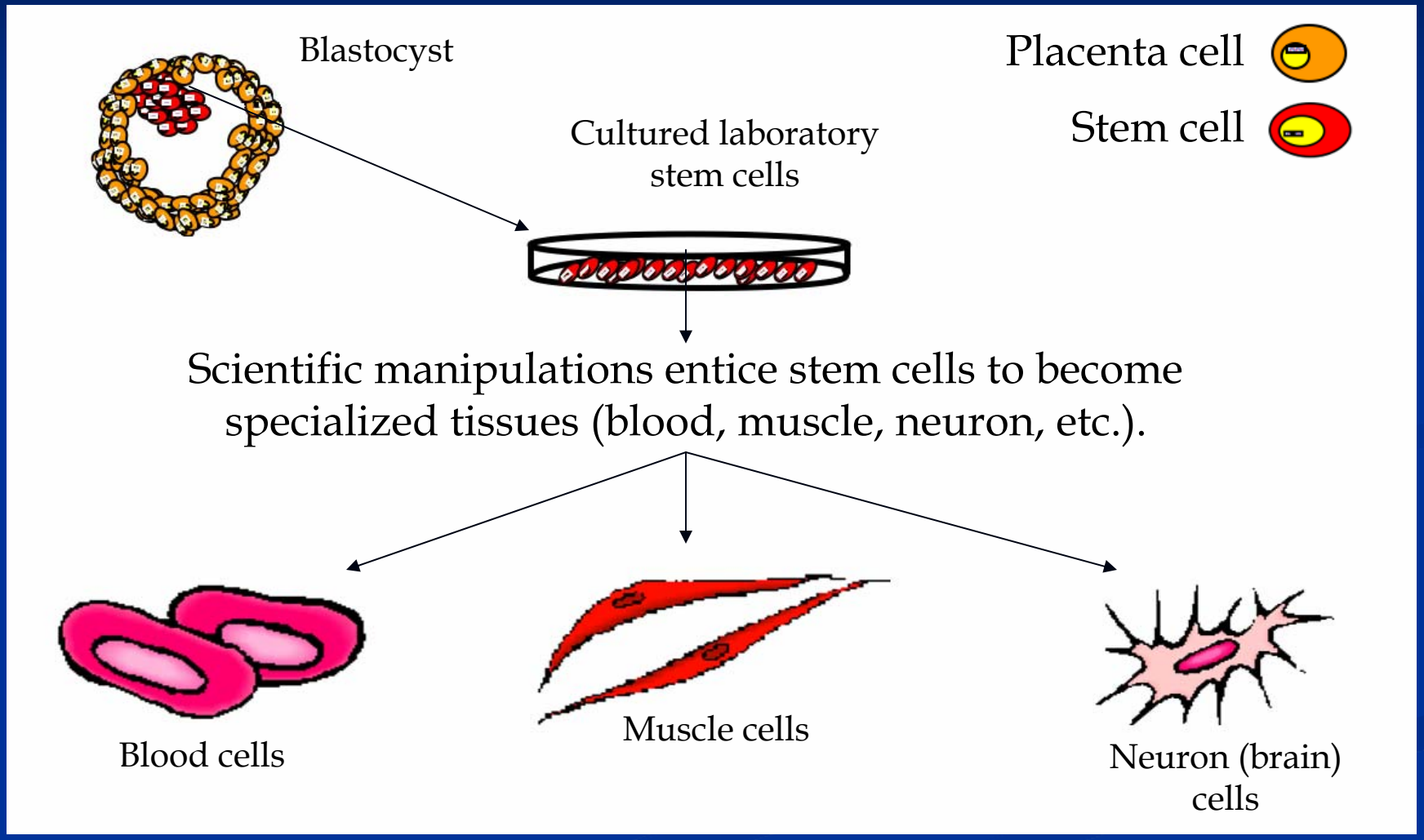
Heart Disease

- Afflicts 1 in 3 people ... over 70 million Americans
- The #1 killer in U.S. and every Wisconsin county ... over 920,000 people a year (2002)
- Prevalence increasing as population ages
- Costs our nation $393 billion estimated in 2005
- There is a severe shortage of heart donors to treat end stage heart failure
- The adult heart does not have a stem cell

Juvenile Onset Diabetes

- Juvenile onset diabetes is caused by the death of specific pancreatic cells (islet cells).
- 1 million people affected in the U.S.
- More than 15% of U.S. healthcare dollars.
- The transplantation of pancreatic islet cells has been successful, but the source of cells is inadequate.
- It is not yet possible to sustainably culture adult pancreatic stem cells, and they may not exist.

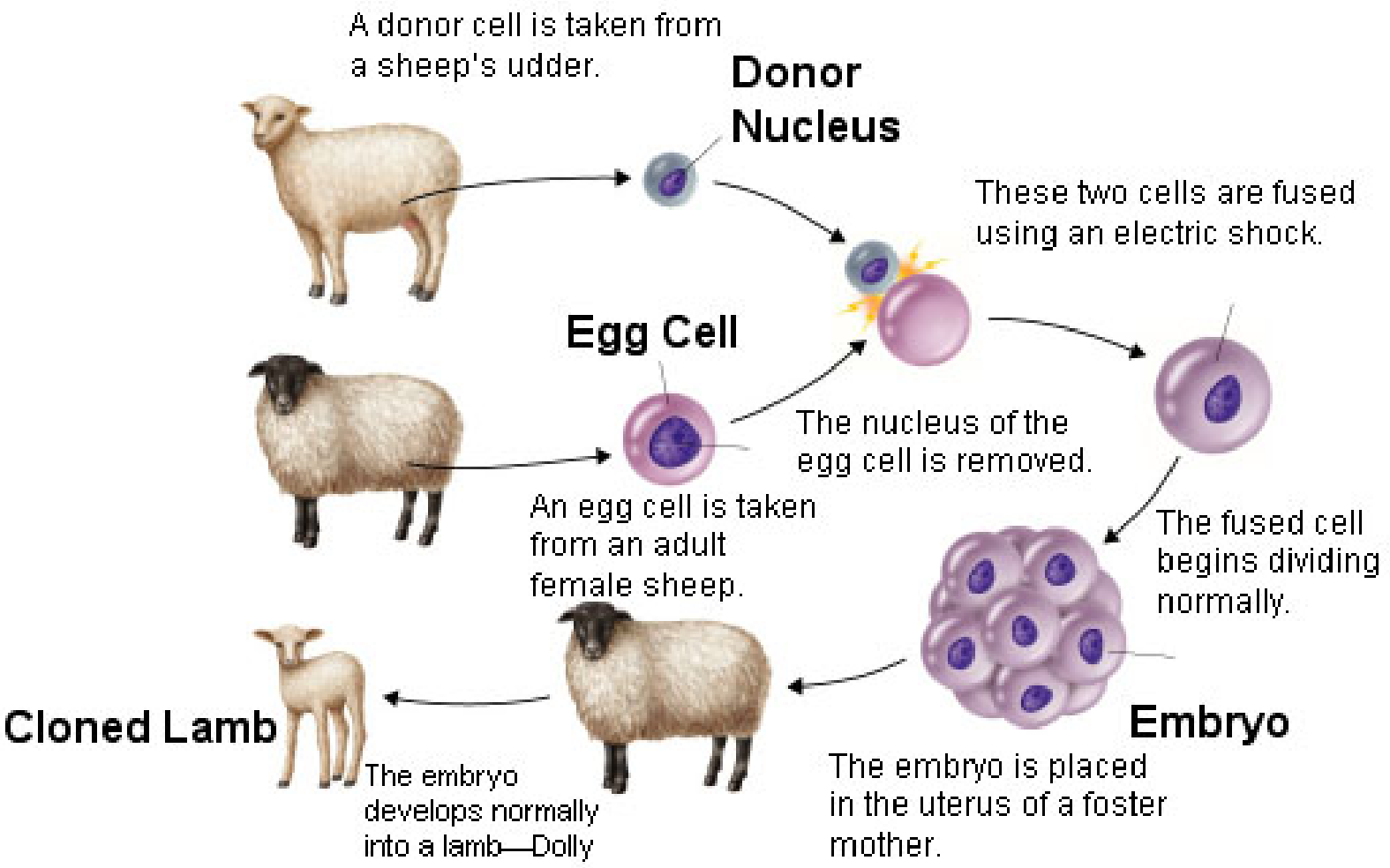
Embryonic Stem Cells Can Become Any Tissue in the Body



Challenges For ES Cell-Based Transplantation Therapy

- Immune Rejection
- Making the Cell Type of Interest
- Safety Concerns, Including Cancer
- Preventing the Process That Killed the Cells Originally
- Integration in a Physiologically Useful Form

Nuclear Cloning



Nature. 2007 Nov 22

Producing primate embryonic stem cells by somatic cell nuclear transfer.

Byrne JA, Pedersen DA, Clepper LL, Nelson M, Sanger WG, Gokhale S, Wolf DP, Mitalipov SM.

Oregon National Primate Research Center, Oregon Health & Science University, 505 N.W. 185th Avenue, Beaverton, Oregon 97006, USA.

Human Embryonic Stem Cells are able to reprogram human blood cells

Stem Cells. 2006 Jan

Human embryonic stem cells reprogram myeloid precursors following cell-cell fusion.

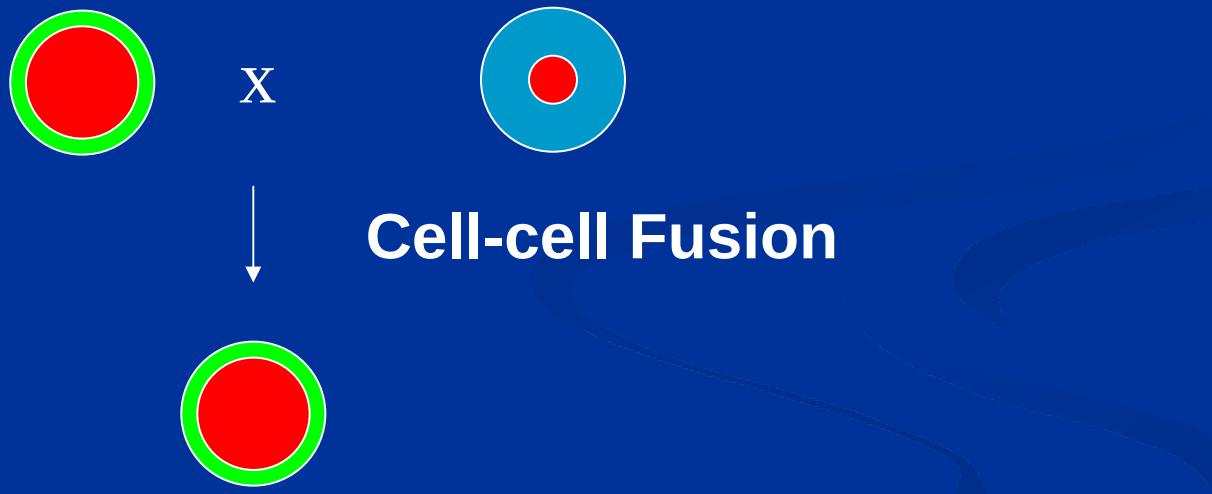
Yu J, Vodyanik MA, He P, Slukvin II, Thomson JA.

Wisconsin National Primate Research Center, University of Wisconsin, Madison, WI 53706, USA.

Human Embryonic Stem Cells are able to reprogram human blood cells

Embryonic stem cells

Blood cell

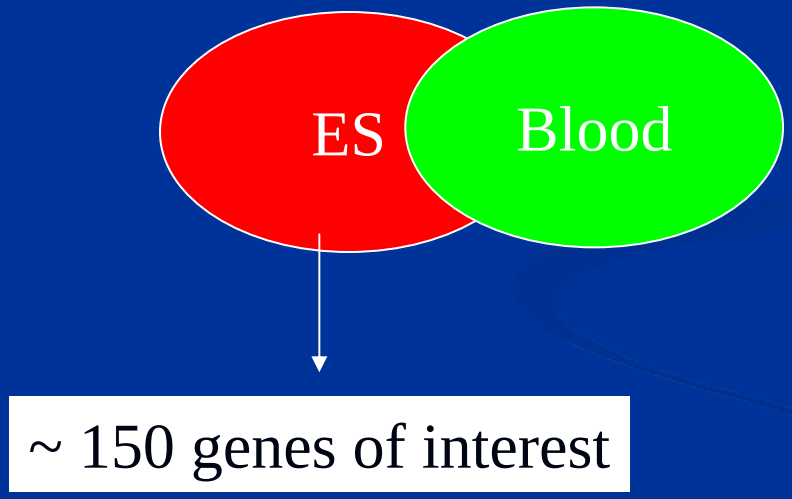


What are the factors in human embryonic stem cells involved in reprogramming?

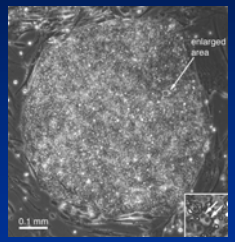
- genes whose expression are enriched in human embryonic stem cells.

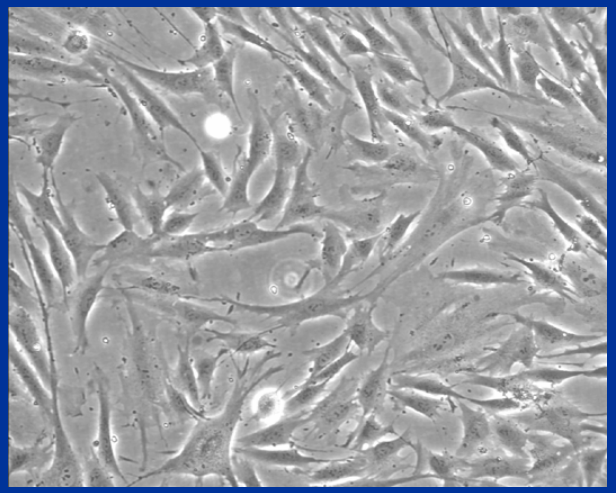
Identification of genes with enriched expression in human embryonic stem cells

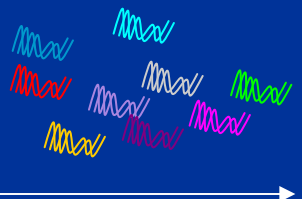
- Gene expression analysis

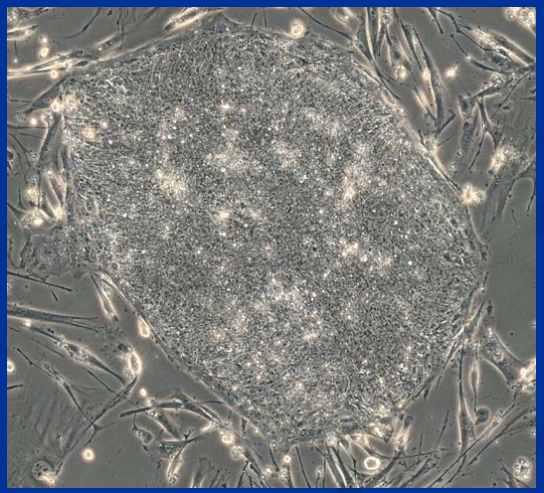


Screening









Skin cells

iPS cells

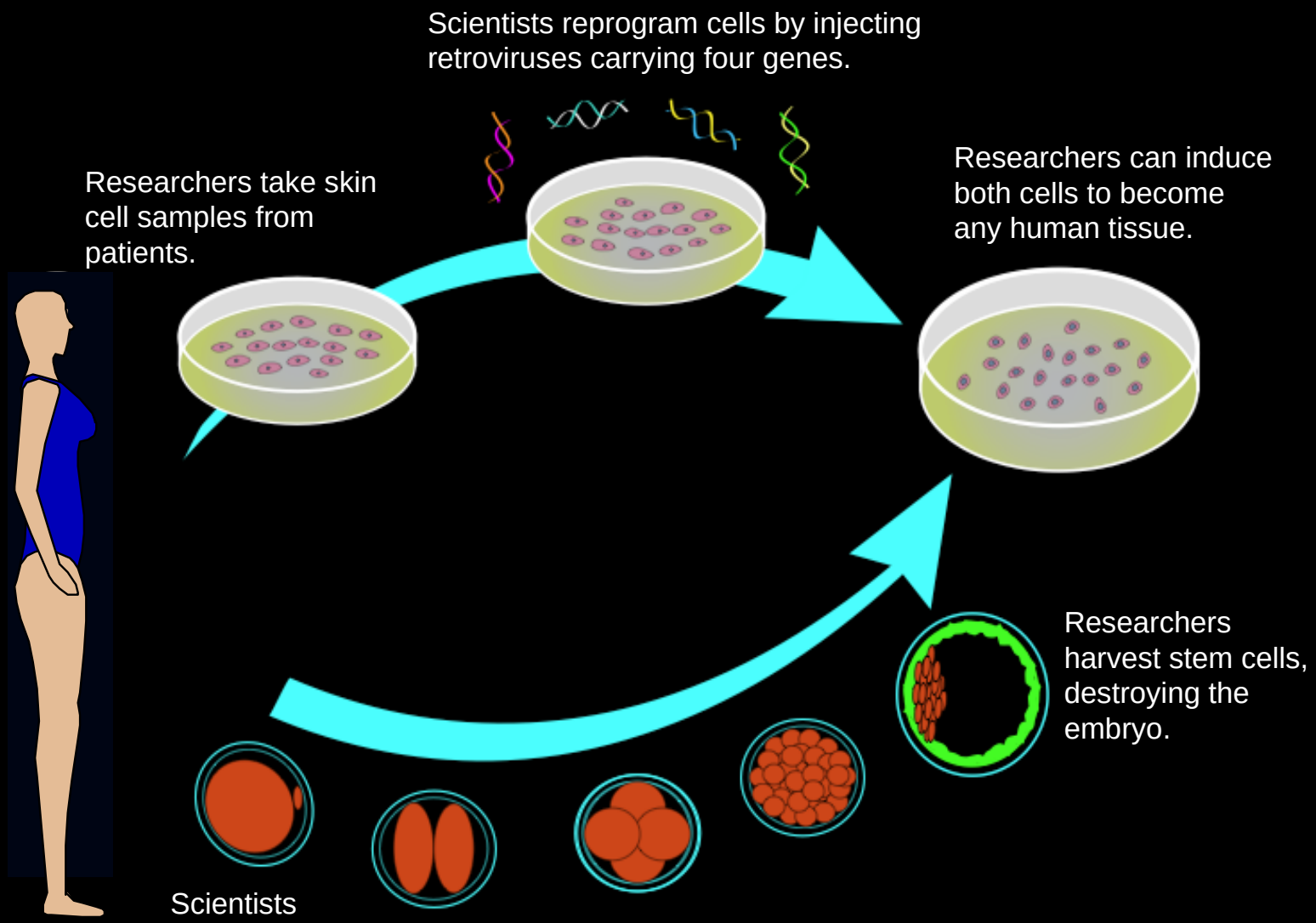
Science. 2007 Nov 20

Induced Pluripotent Stem Cell Lines Derived from Human Somatic Cells.

Yu J, Vodyanik MA, Smuga-Otto K, Antosiewicz-Bourget J, Frane JL, Tian S, Nie J, Jonsdottir GA, Ruotti V, Stewart R, Slukvin II, Thomson JA.

Genome Center of Wisconsin, Madison, WI 53706-1580, USA.; Wisconsin National Primate Research Center, University of Wisconsin-Madison, Madison, WI 53715-1299, USA.

New and Existing Methods



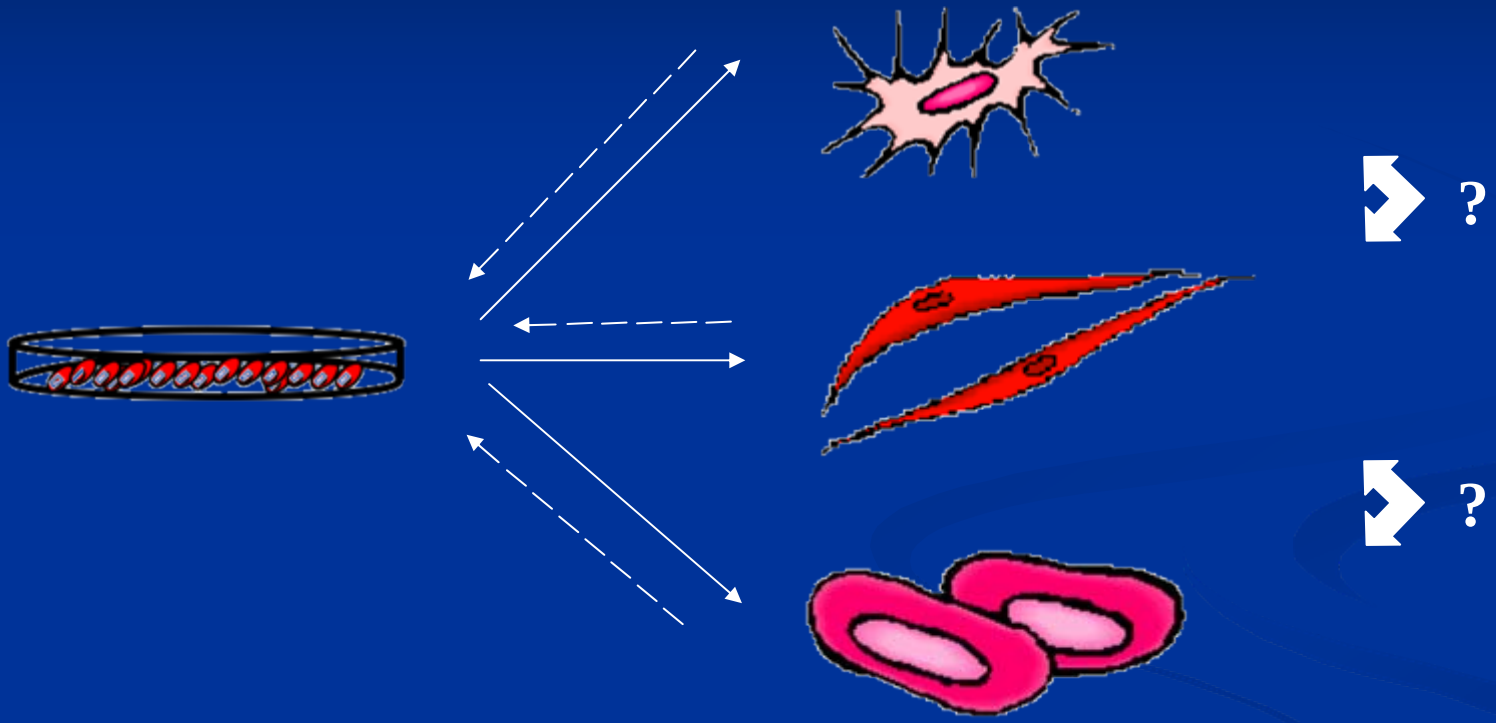
Why Are Human iPS Cells Important?

- They allow the development of accurate in vitro disease models

- iPS cells with diversity of genetic background can be used for drug screening.

- iPS cell technology solves the problem of immune rejection for transplantation therapies.

Human regeneration?



Urodele Regeneration

QuickTime™ and a
TIFF (LZW) decompressor
are needed to see this picture.

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Acknowledgement

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Other members