Exploring human stem cell research: separating myth from reality

Dr. Tamra Werbowetski-Ogilvie
Assistant Professor, Regenerative Medicine
Department of Biochemistry & Medical Genetics
University of Manitoba
October 12, 2011

So, what is a stem cell?

Distinguishing and Defining Features of Stem Cells:

1. Self-renewal

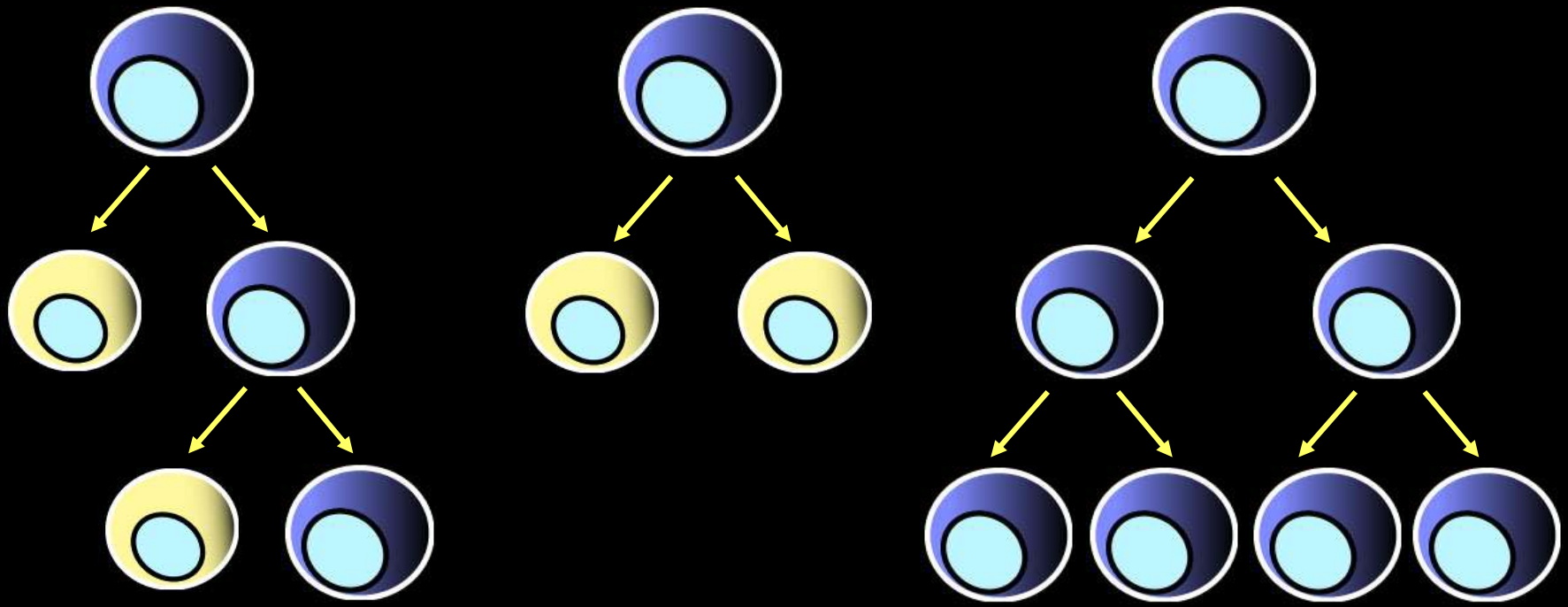
2. Developmental Potential

What is so special about stem cells ?

Self-renew and differentiate

Differentiate

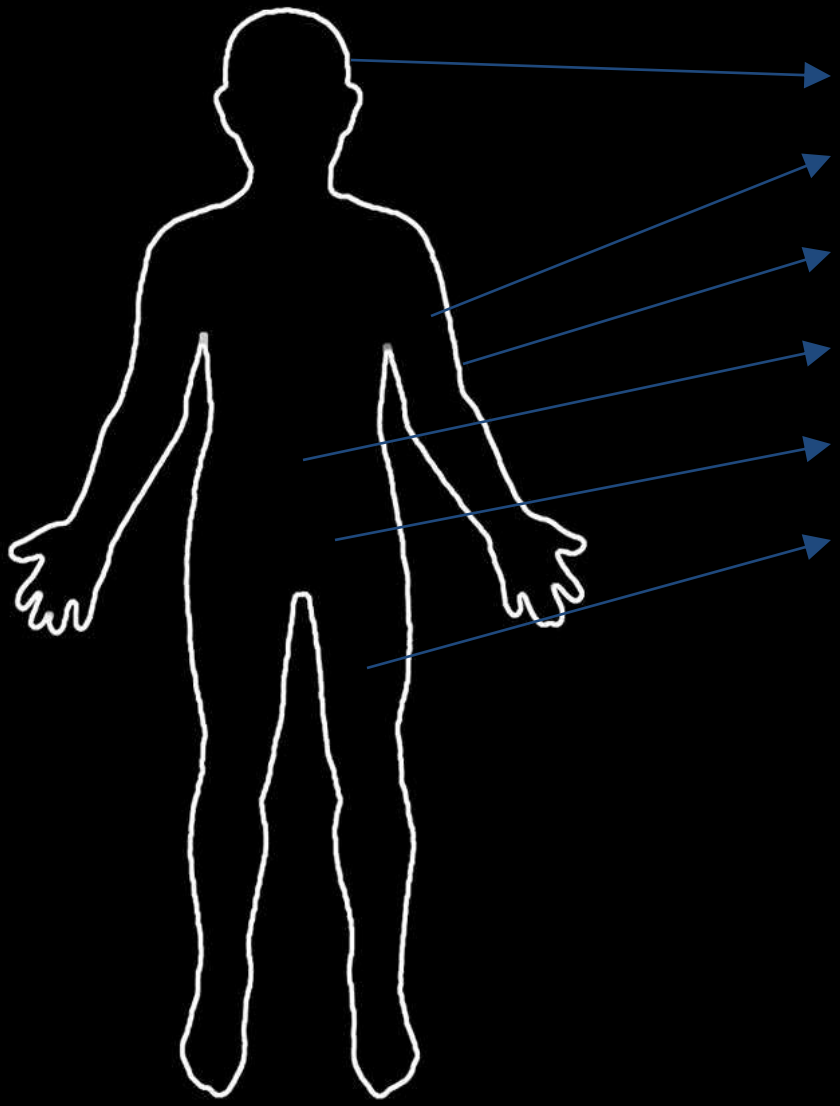
Expansion (Dysregulated -Cancer)



Adult Stem Cells

Undifferentiated cells found in the differentiated tissue that can renew and mostly produce specialized cell types of tissue from which they originated

Where are stem cells?



Neural Stem Cells
Muscle Stem Cells
Skin Stem Cells
Intestinal Stem Cells
Germ Stem Cells
Hematopoietic Stem Cells
Mesenchymal Stem Cells

These stem cells have limited differentiation potential

Pluripotent Stem Cells

Primitive undifferentiated cells that have the potential to become all types of specialized cells that make up the body

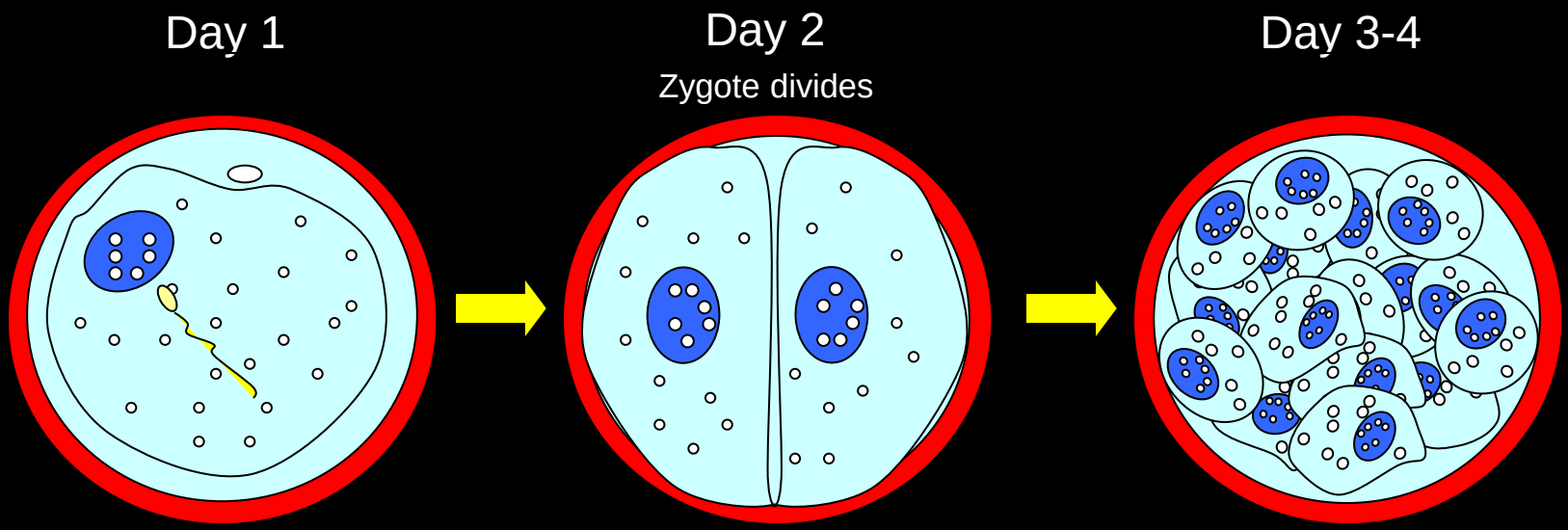
Where do they come from ? How do we get them ?

Human pluripotent stem cells: hPSCs

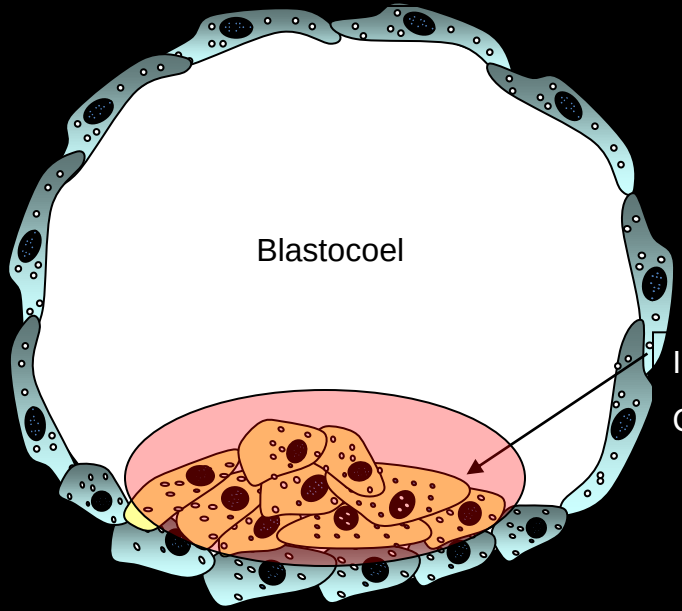
- Human embryonic Stem Cells (hESCs)

- Induced pluripotent stem cells (iPS cells): skin to stem cell

Where do hESCs come from?

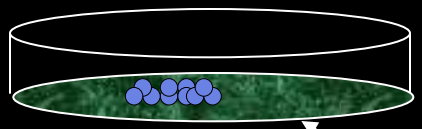


Day 5: Blastocyst Development

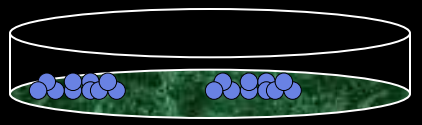


How do we get them?

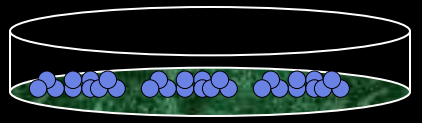
Remove
ICM



Irradiated Mouse
Embryonic Feeders

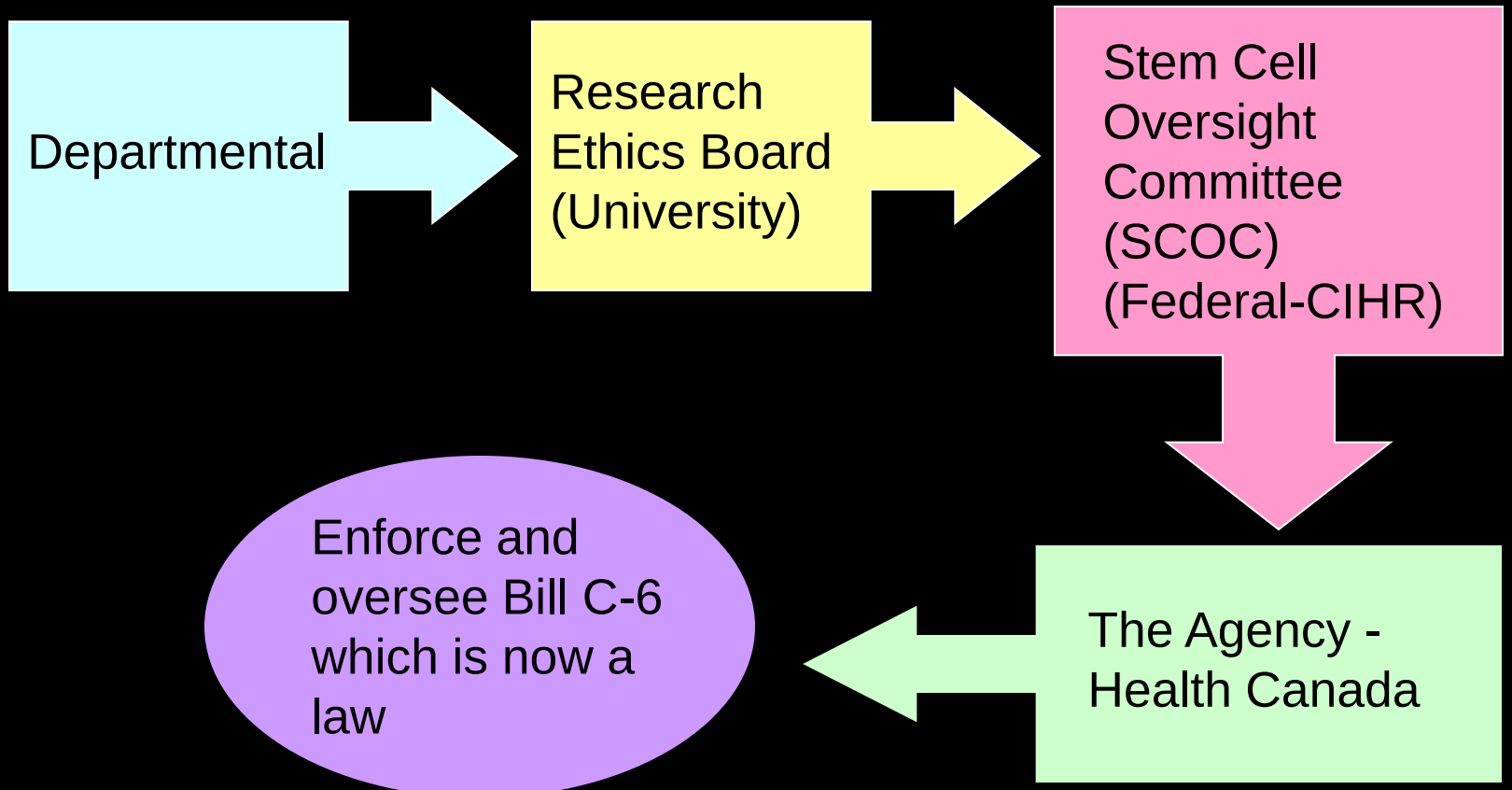


- Matrigel
- Fibronectin
- Laminin



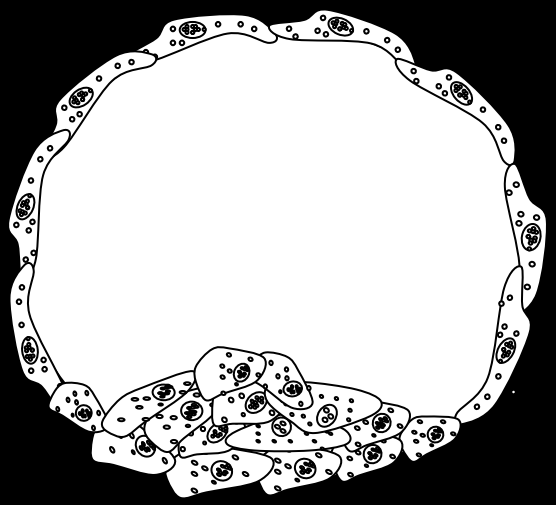
hES Cell Line

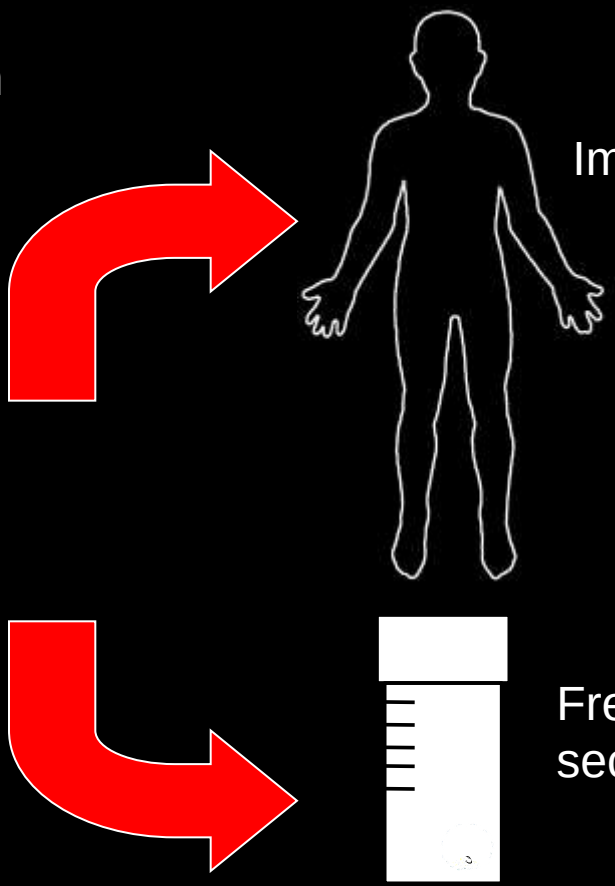
The Controversy, the ethics, and the laws



Sequential Consent

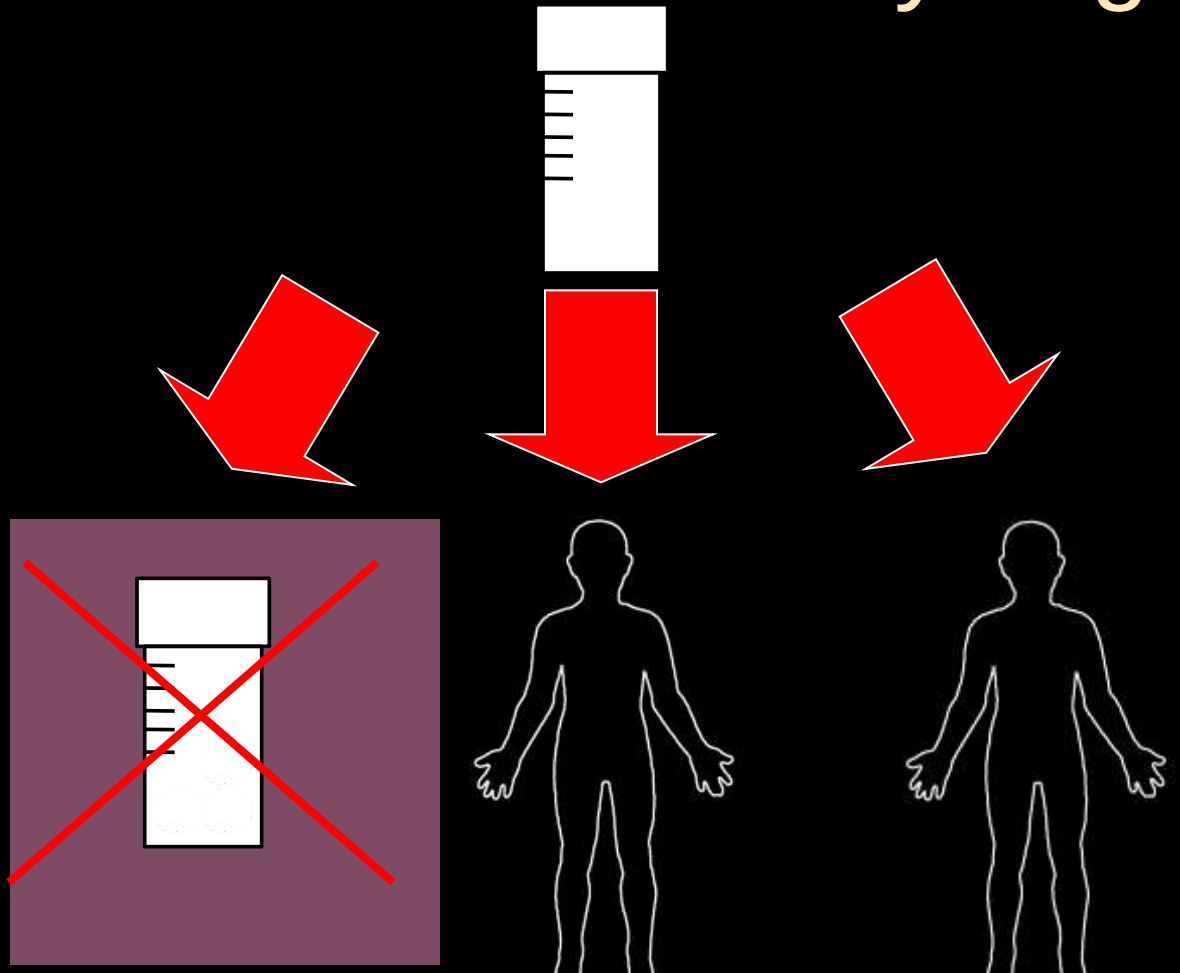
Day 3 or Day 5 pre-implantation embryo/blastocyst



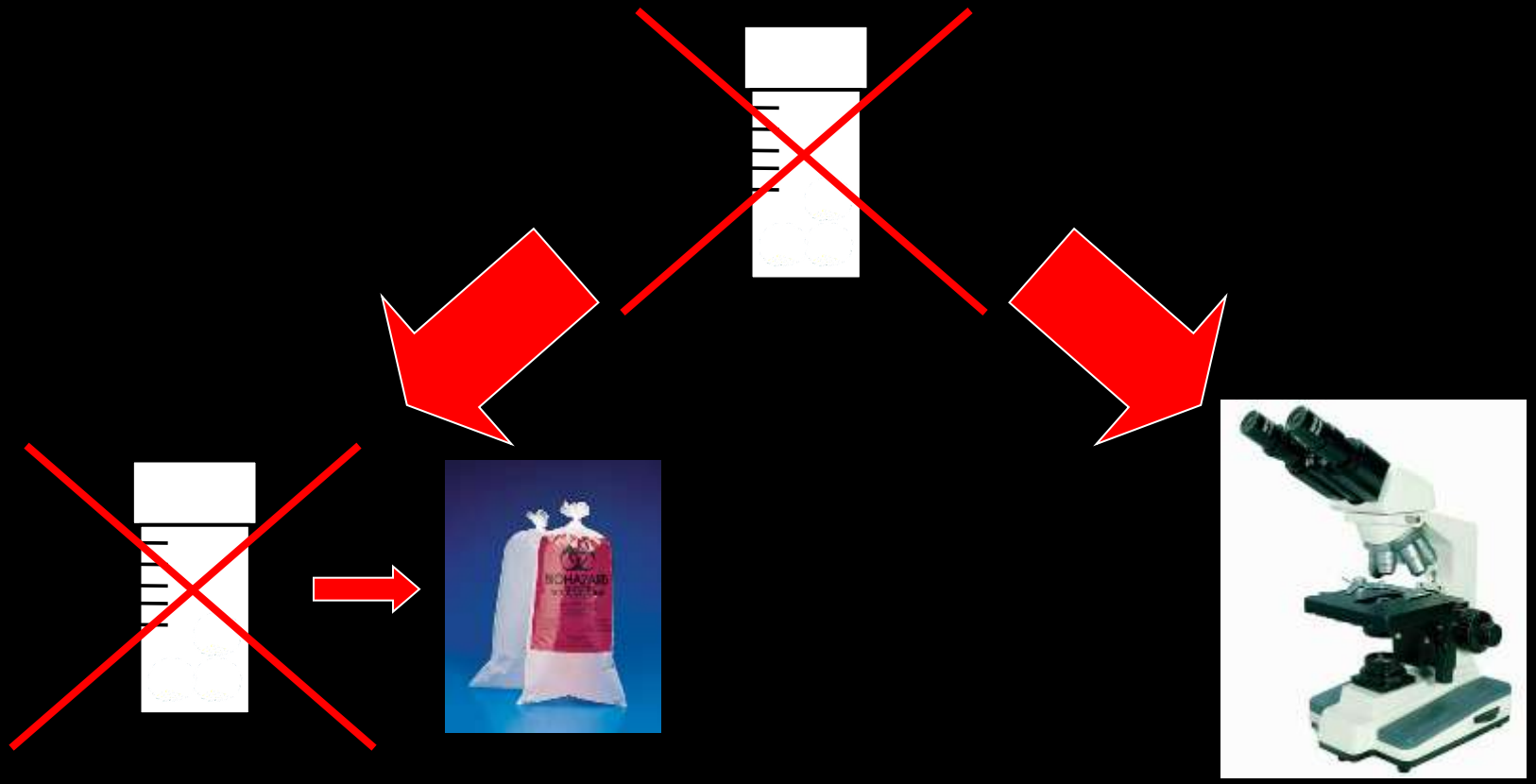


- Extra embyros become an issue - where do they go from here?

Consent: level 1 - Where do the embryos go?



Consent: level 2 - If choose to discard, which way?

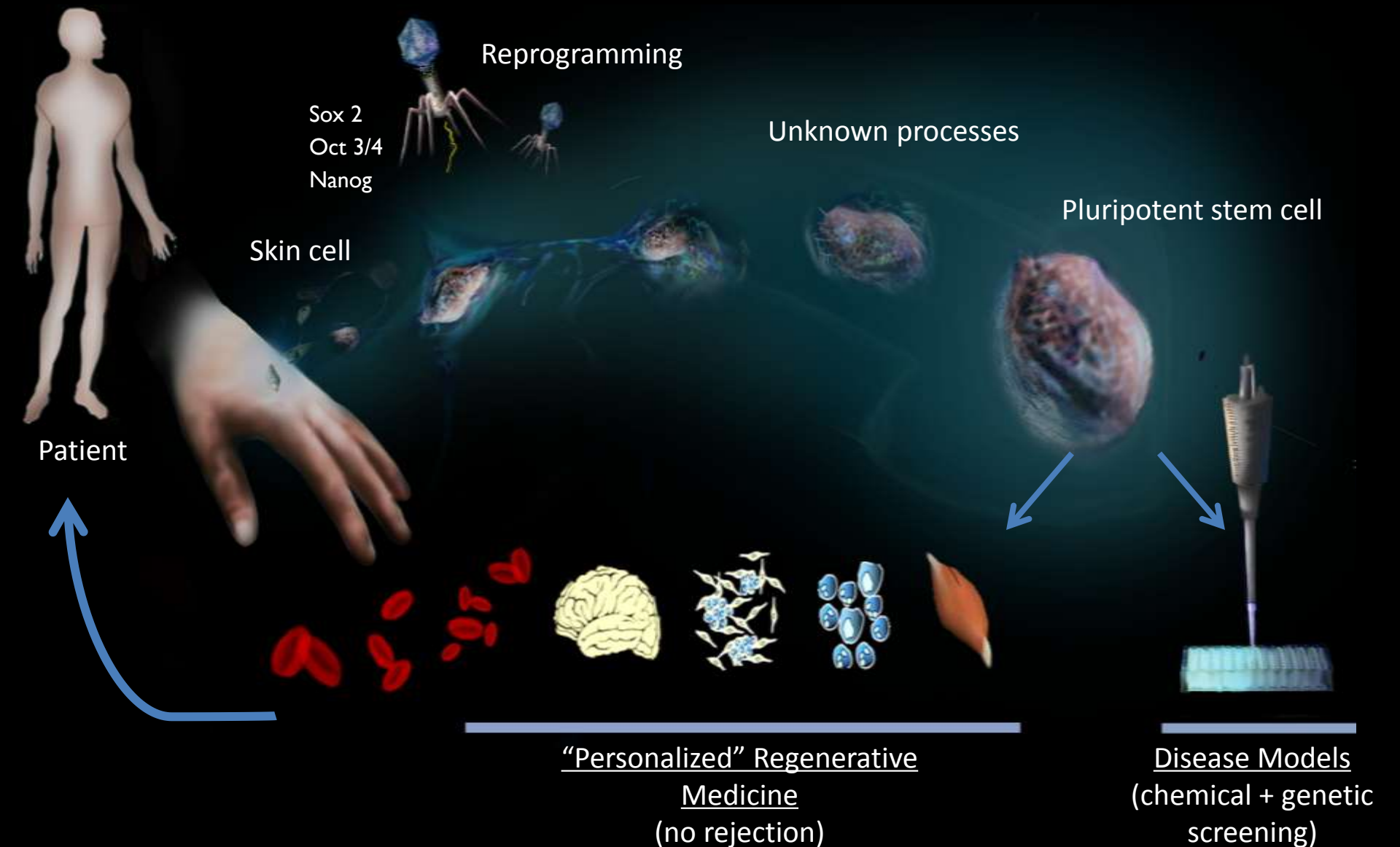


- If choose to discard, then destroy or research purposes

Issues with hESCs

- Ethical issue involving the use of embryos
- Use of animal products during derivation
- Cell rejection

From Skin to Stem Cells: iPS cells



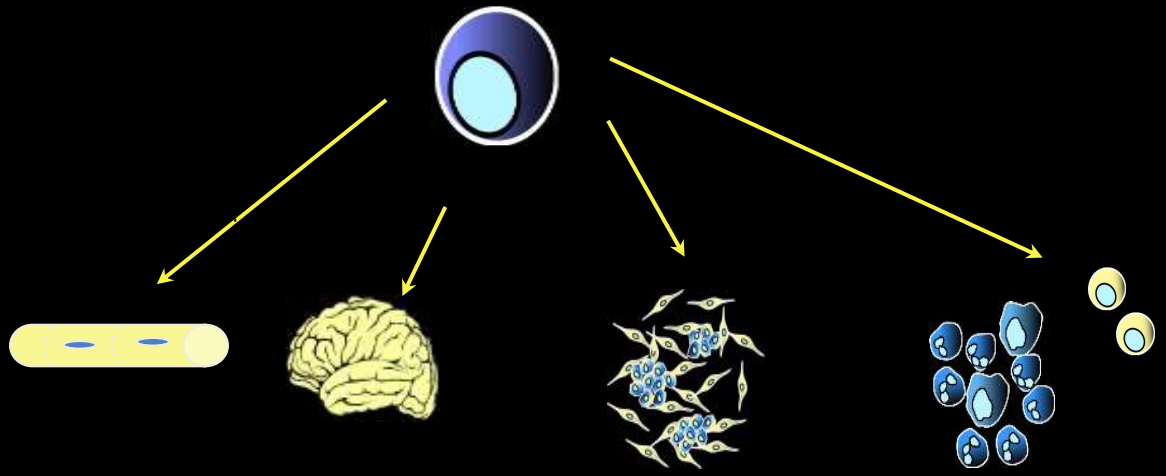
Issues with iPSCs

- Generation methods
  - genetically modified cells with viruses
  - genes that promote tumor progression
  - THESE ISSUES HAVE BEEN FIXED
- Efficiency
- Genetic integrity, epigenetic “memory”
- Controlling cells in a dish
- Similarities between pluripotent stem cells and cancer cells

Why study hPSCs?

1. Robust cell proliferation in tissue culture (contrast to adult stem cells)

2. Differentiation potential into many cell types



3. Immune privilege properties (vs. xenotransplantation and immunosuppression)

Why do we need hPSCs?

Hematopoietic reconstitution
(chemotherapy, irradiation, infection (HIV)

Myocardium: Smooth muscle, myocardiocytes, endothelial cells
(Myocardial infarction=Heart attack)

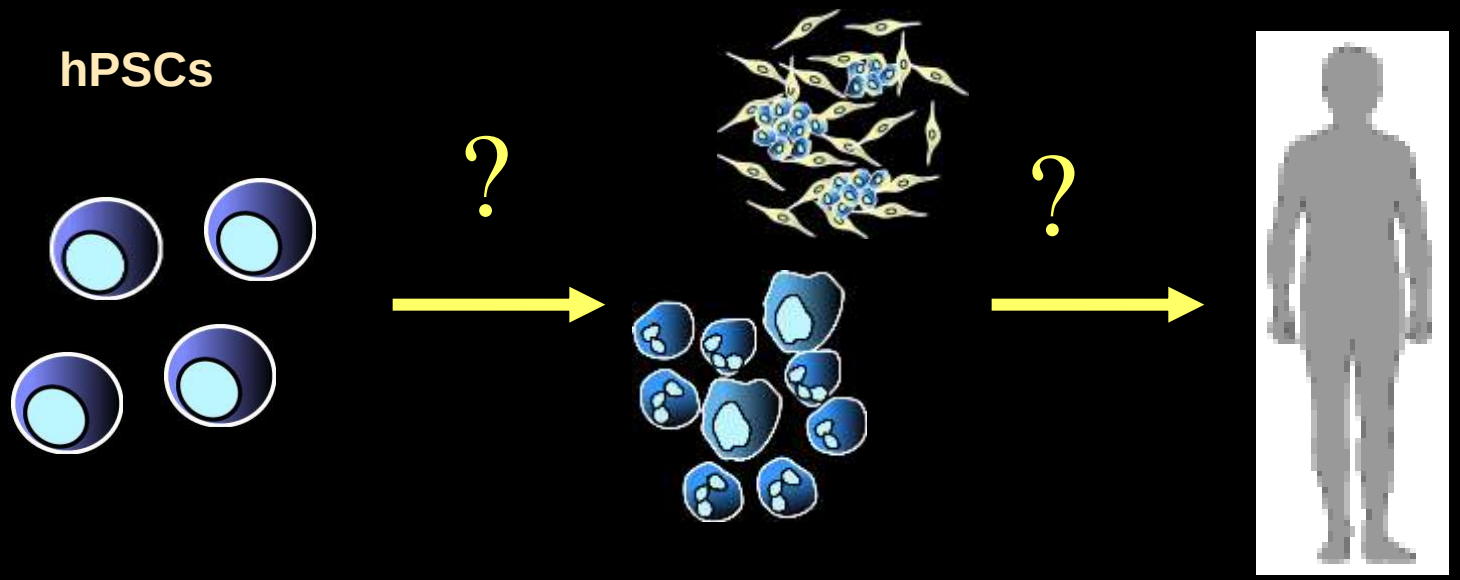
Skeletal Muscle
(Muscular dystrophy)

Neural Cells:
Motor Neurons in ALS, Dopaminergic Neurons in Parkinson's,
Spinal Cord Injury

Islet Cell Regeneration
(Type I Diabetes)

Cancer
Leukemia and solid tumor cancer stem cells (ie. brain, lung, breast, colon, prostate)

ciple of Cell Replacement Therapy and Regenerative Medicine: “Deceptively Simple”



Fundamentally an issue of applying our limited understanding of human developmental biology

Allowing pluripotent stem cell research to continue

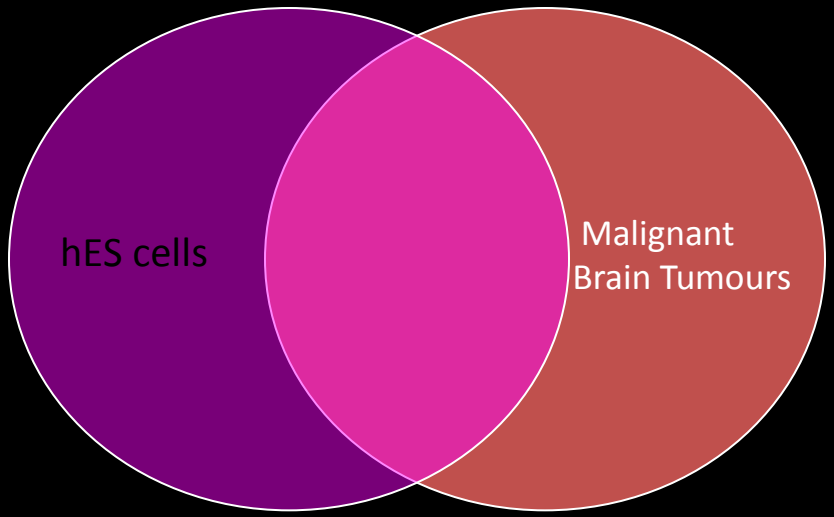
- Unpredictable effects of policy, legalities and minority groups on health care in country
- Legislation well established for consent
- Benefits are immense - not only to regenerative medicine but in understanding cancer

Why do I study hPSCs?

Using hESCs as disease models

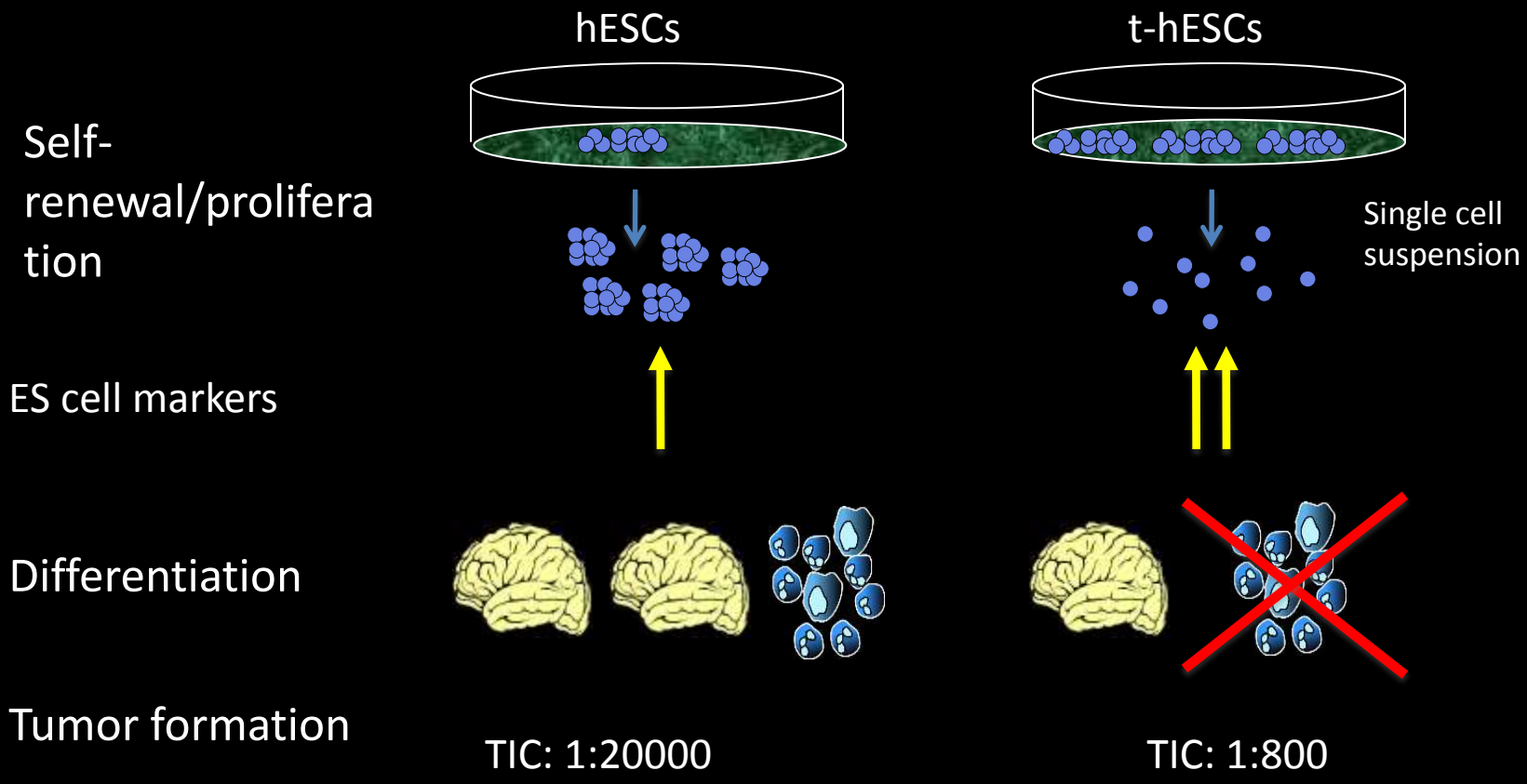
- Modeling disease in hESCs with p53 KO (Song et al., Cell Stem Cell, 2010)
- hESCs as models of Fanconi anemia (Tulpule et al., Blood, 2010)
- Recently been shown to model cancer and genetic disorders

Interface between human embryonic stem cells and brain tumours



What can we learn about malignant brain tumors from human embryonic stem cells?

Characterization of transformed-human embryonic stem cells (t-hESCs) that display cancer features



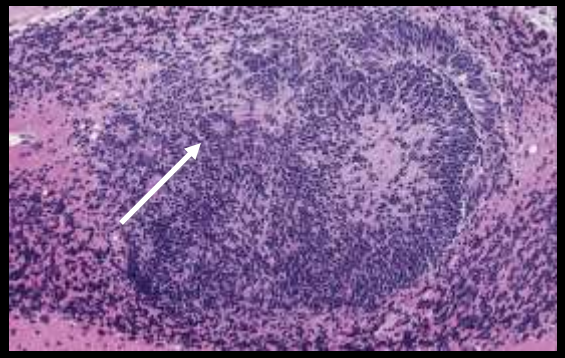
Werbowetski-Ogilvie et al., Nature Biotechnology, 2009

Embryonal tumours of the CNS: medulloblastoma and other pediatric tumours

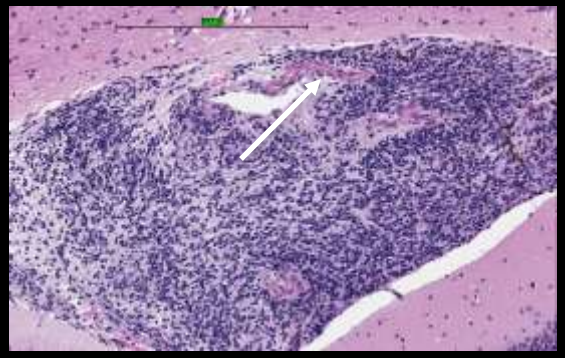
- Presumably originate *in utero* – but not proven
- Few comparative normal counterparts in humans
- Recent studies have linked tumor signaling pathways to proteins associated with embryonic stem cells
- Question: Can we use embryonic stem cells to understand how pediatric neural tumors form?

Cancer-like hESCs in vivo: Infiltration of transformed cells along ventricles and cerebellum

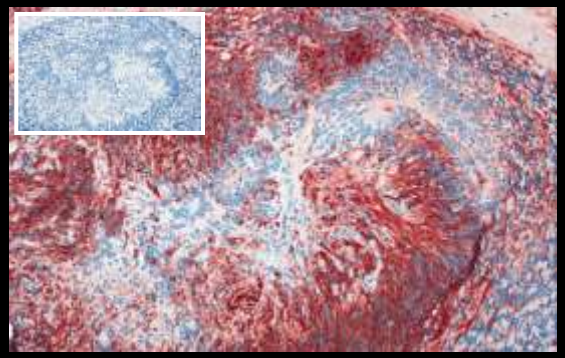
Cerebellar infiltration



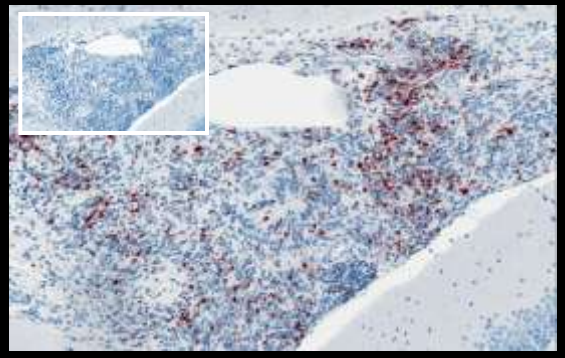
Ventricular infiltration



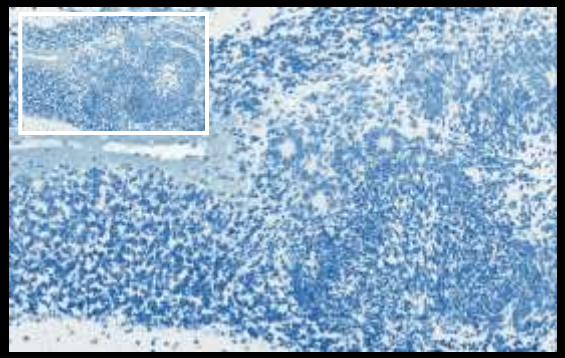
βIII Tubulin – for neurons



Ki67- for proliferating cells



Oct4 – for residual ES cells



Note: neural rosettes, high nuclear/cytoplasmic ratio and disorganized appearance, staining for neuronal and proliferative markers

The results so far

- Independently confirmed by neuropathologist as classic medulloblastoma/primitive neuroectodermal phenotype – embryonal CNS tumors
- Confirms *in vitro* data demonstrating predominant neuronal marker expression
- Comparative human model system from which to evaluate mechanisms of brain tumorigenesis from a new perspective

Why can’t we use iPS cells from brain tumors?

- Malignant cancer cells are exceedingly difficult to reprogram to iPS (too many genetic changes)
- To date, iPS cells have not been made from malignant brain tumors
- We cannot truly study early events using cancer cells with major genetic abnormalities

What are the stem cell misconceptions?


Discover your body's own ability
to renew itself
click here
StemEnhance

Beauty Update

"Stem Cells..."

The Future of Skin Rejuvenation

Über-sophisticated "stem cell creams" really do make you look younger... but can you afford them?

By Tiffany Strobel

If you haven't heard that "Stem-Cell" technology is revolutionizing skin care, you're probably one of those people who... Next

Buy Now

StemCellin

Stem Cell Wrinkle Cream

Contact JabaLabs

Home | About StemCellin | About Us | FAQ | Blog | Shop Online

Annual Fall Sale!
20% Off Every Purchase Over $100
Use Coupon code **FALL** at checkout

Stem Cell Skin Care

2008 Award Winning Ingredient

StemCellin® with 5% PhytoCellTec™:

- Extremely popular in Europe
- Swiss Patented Formula
- Made From Apple Stem Cells
- Enhanced with Vitamin C & E

The future of skin care...Today!

StemCellin® Stem Cell cream Intensive Emulsion

- 4% PhytoCellTec™ stem cell extract
- 2 oz. 90 day supply bottle
- Great light formula
- Made for night use
- Very popular in Europe

Product Details

$69.00

StemCellin® Stem Cell Serum

- 5% PhytoCellTec™ stem cell extract
- 2 oz. 90 day supply bottle
- Formulated all natural
- Activated by skin heat
- Made from Apple stem cells

Product Details

$79.00

+You Web Images Videos Maps News Gmail More ▾ Sign in

Google [ ] [ ] Advanced search

Search About 8,310,000 results (0.22 seconds)

Everything
Images
Maps
Videos
News
More

Winnipeg, MB
Change location

The web
Pages from Canada

Any time
Past hour
Past 24 hours
Past 2 days
Past week
Past month
Past year
Custom range...

All results
Timeline

More search tools

▸ **Stem Cell Treatment** - Accepting Patients Now.
www.**cell**medicine.com
Medical Information: (800) 980-**STEM**
Multiple Sclerosis - Spinal Cord Injury - Autism - Rheumatoid Arthritis

Clinic Lemana Switzerland - 50 year **cell therapy** experience
www.lemana.com
Preserving your health capital.

GMP **Cell** Therapeutics | GMPbio.org
www.gmpbio.org
Clinical **Cell Therapy** Production including **stem cell** therapies

Scholarly articles for **stem cell treatments**
... **stem cell** transplantation and **cell** therapy as an ... - Slavin - Cited by 1649
Treatment of severe acute graft-versus-host disease ... - Le Blanc - Cited by 1117
... **stem cell** transplantation for the **treatment** of severe ... - Buckley - Cited by 414

Stem cell treatments - Wikipedia, the free encyclopedia
en.wikipedia.org/wiki/**Stem_cell_treatments**
Stem cell treatments. From Wikipedia, the free encyclopedia. Jump to: navigation, search. **Stem cell treatments** are a type of intervention strategy that introduces ...
Current treatments - Potential treatments - Clinical Trials - Stem cell use in animals

Stem Cell Treatment – Stem Cell Therapy – Stem Cell Research
stemcelltreatments.org/
Stem Cell Treatment – Find comprehensive information regarding current **stem cell Therapy**, Treatment, Research and where to find a stem cell clinic near you.

Closer Look
www.isscr.org/public/index.htm
A Closer Look at **Stem Cell Treatments** ... Clinics all over the world claim to offer **stem cell treatments** for a wide variety of conditions. But are all of these ...

News for **stem cell treatments**
What is **stem cell therapy**?
Culpeper Star Exponent - 10 hours ago
A: The term "**stem cell therapy**" can be applied to various medical treatments that utilize stem cells to promote healing. Due to the vast potential of stem ...
11 related articles
Stem cells helped heal a dog's crippling injuries - maybe
Philadelphia Inquirer - 2 related articles
Injected **Stem Cells** In ALS Trial Allow Cautious Optimism for ...
Physical Therapy Products

Home - **Stem Cell** Network
www.**stemcell**network.ca/
In pursuit of Canadian excellence and global leadership in applied stem cell ... Should the fight against bogus **stem cell therapies** be turned back to the lab? ...

Can they **cure** diseases? - **Stem Cell** Information

Ads

Stem Cell Warning
www.rc**therapy**.net
Read this report before getting **Stem Cell treatments**!

Stem-Kine
www.**stem**-kine.com
Natural Product Clinically Proven to Increase Circulating **Stem Cells**

Leaders in Biobanking
www.healthtech.com/biobanking
International Congress November 7 - 8, 2011

Top **Stem Cell Treatment**
www.medra.com/**StemCell**
Breakthrough **Stem Cell Therapy**! 2000 **Stem Cell** Patients Treated.

Human **Stem Cells**
www.neuromics.com
Pancreas Derived hMSCs-Consistent, Easy to Grow and Reasonably Priced.

Sciencell **Stem Cell** Media
www.sciencellonline.com
1 (877) 770 2925
Mesenchymal **Stem Cell** Media invitro - A Specialty **Cell** Culture Media

StemCell SkinRepair Cream
www.**stemcell**skinrepair.com
Anti-Wrinkle Cream As Seen On TV Rejuvenates Skin. Feel Younger!

Cell Therapy Switzerland
www.**celltherapy**program.com
Be 20 yrs younger, more energetic & healthy with Swiss **Cell Therapy**.

See your ad here »

Delhi stem cell jabs 'help woman walk again'

By Peter Foster in New Delhi and Nic Fleming
Last Updated: 11:55pm BST 14/04/2007

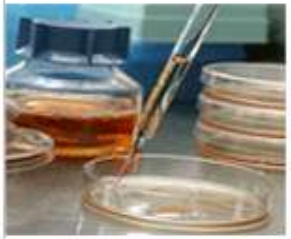
An Australian woman who was told she would never walk again after a car accident has claimed to be on her way to recovery after embryonic stem cell treatment from an Indian doctor.

When Sonya Smith, a 45-year-old mother of three from Brisbane, arrived in New Delhi for the treatment two months ago she was confined to a wheelchair and unable to control the most basic bodily functions.

After eight weeks of injections from Dr Geeta Shroff - a controversial pioneer of embryonic stem-cell research - Mrs Smith says she is able to stand with the aid of callipers and has regained bowel and bladder control.

She also reports recovering "deep sensation" in her thighs and feet and has been able to swing her legs. "When I first moved my toes, I was blown away," Mrs Smith told Sky News.

Sonya Smith learns to walk again at the Indian clinic



MEDRA INC.

The Future is Already Here

Human Fetal Stem Cell Therapy

A medical treatment whereby Human Fetal Stem Cells are transplanted into a patient. These cellular building blocks are usually administered intravenously and subcutaneously (under the skin). It is a painless procedure, which takes place in approximately one hour, and has no negative side effects.

The Fetal Stem Cell searches out, detects and then attempts to repair any damage or deficiency discovered, as well as releases growth factors, which stimulate the body's own repair mechanisms.

William C. Rader MD

Medra's Medical Director William C. Rader, MD. has **treated over one thousand patients** with Human Fetal Stem Cells, including children and adults **suffering from many of mankind's most devastating diseases**.

Very recent examples…all news outlets

ANALYSIS

How safe is Peyton Manning's stem cell therapy?

The Colts' injured quarterback is one of several pro athletes to travel abroad for a controversial — and potentially dangerous — stem-cell treatment

POSTED ON SEPTEMBER 22, 2011, AT 12:06 PM

In order to get back on the field, Indianapolis Colts quarterback Peyton Manning traveled abroad for a controversial stem cell treatment aimed at healing his injured neck. *Photo: REUTERS/Brent Smith*

SEE ALL 5 PHOTOS

Indianapolis Colts star quarterback Peyton Manning said over the summer that he would do "everything I can to get my health back," after a bulging disc in his neck benched him for the foreseeable future. Apparently, the future Hall of Famer really meant it. According to Fox's Jay Glazer, Manning flew to Europe on a private jet in early September for an experimental stem-cell treatment that's not approved in the U.S. Here's what you should know:

What did Manning have done to his neck?

Doctors "took some fat cells, probably out of his belly," put them in a culture, and injected them into Manning's neck, says Fox's Glazer. The hope is "that these cells are going to regenerate the area" and fix the damaged tissue. The stem cells were probably mesenchymal cells, which can develop into bone, cartilage, fat, or muscle, says Dr. Joshua Hare, a University of Miami stem cell expert.

Is that safe?

"When you leave a well regulated environment, all bets are off," says Dr. Lawrence Goldstein at U.C. San Diego's stem cell program. There's a real risk of injury and "no evidence of benefit to be gained" from stem-cell injections. As such, it's a problem "when a highly visible celebrity athlete

NEWS IN FOCUS

PHYSICS Researchers bid a fond farewell to the top US particle collider p.379

EXOPLANETS Flash of results see astronomers close in on exo-Earths p.383

MISCONDUCT Disgraced Austrian doctor gets job back p.384

SPECIAL SECTION A look inside the military-science complex p.386

Texas governor Rick Perry has received a stem-cell treatment deemed illegal in the United States.

REGENERATIVE MEDICINE

Texas prepares to fight for stem cells

Enthusiasm for unapproved treatments worries regulators.

BY DAVID CYRANOSKI

There's a showdown brewing in the state of Texas — and it could get ugly. On one side stands the US Food and Drug Administration (FDA), which is clamping down on the proliferation of unapproved stem-cell treatments being offered to Americans. On the other is state governor Rick Perry, who is riding high in the polls as the Republican party's favoured candidate for the 2012 presidential elections — and a staunch advocate of the stem-cell treatments.

At least a dozen companies in the United States offer the treatments, which involve extracting adult stem cells from a patient's tissue, culturing them, then reinjecting the cells. The theory is that the cells will flourish and replace diseased or damaged tissue in a range of conditions from spinal-cord injury to Alzheimer's disease and diabetes.

But no treatment that involves anything more than "minimal manipulation" of adult stem cells outside the body has been approved by the FDA. Although bone-marrow transplantations, for example, involve extraction and reinjection of haematopoietic stem cells, those cells are not cultured or significantly processed.

"Any procedure involving removing cells from the body and manipulating them — even if it's something as simple as centrifuging them or putting them in a plastic tube — and then putting them elsewhere in the body poses risks," says Paul Knoepfler, a stem-cell specialist at the Institute for Regenerative Cures at the University of California, Davis. No clinical trials have shown any evidence of efficacy, he says. "Patient testimonials cited by the people selling the treatments have little if any meaning."

Depending on exactly how the cells are processed and administered, many of these procedures are illegal in the United States. But that didn't stop Perry from being injected with a concoction of his own stem cells in July to treat a back complaint. Perry's procedure was carried out by Stanley Jones, a surgeon based in Houston, Texas, who specializes in cosmetic procedures and who is a friend of the governor.

The previous month, Perry had supported legislation that authorized Texas's health commission to create a stem-cell bank in which patients would be able to deposit their adult stem cells for future use.

PUBLIC INTEREST

Texas has poured millions of dollars into studying and commercializing adult stem-cell treatments through its Emerging Technology Fund, an initiative created at Perry's behest. Perry sees the treatments as both a potential boon to the Texan economy and an alternative to treatments that use embryonic stem cells, which he opposes. In a 25 July letter, he asked the Texas Medical Board (TMB), which regulates the state's physicians and is currently reviewing its policy on stem-cell treatments, to take a lenient view on the procedures. "It is my hope that Texas will become the world's leader in the research and use of adult stem cells," he wrote. "With the right policies in place, we can lead the nation in advancing adult-stem-cell research that will treat diseases, cure cancers and, ultimately, save lives." ▸

The Reality of Stem Cell Tourism

STEM CELLS

Korean deaths spark inquiry

Cases highlight the challenge of policing multinational trade in stem- cell treatments.

BY DAVID CYRANOSKI IN LOS ANGELES

The controversy over stem-cell tourism, in which patients travel to other countries for unapproved stem-cell treatments, continues to grow. In June, researchers in Thailand reported finding "strange lesions" in a patient who had died following stem-cell therapy for kidney disease (see *Nature* **465**, 997; 2010). And in August, an 18-month-old Romanian boy died after receiving a brain injection of stem cells.

Now South Korea is trying to crack down on the practice. Following the recent deaths of two Koreans who had received injections of stem cells, the Korea Food and Drug Administration and the health ministry last week launched an investigation into companies offering the treatments. But the latest cases highlight the difficulty of policing these therapies or determining their safety, because some companies are setting up operations around the globe, taking advantage of loopholes in other countries' regulations.

One of the companies under scrutiny is Seoul-based RNL Bio, which formulated the cells used to treat the two Korean patients. The firm prepares stem cells at its processing centre in Seoul and sends them to affiliated clinics in China, Japan or elsewhere. Patients travel to these clinics to have the injections, which are illegal in South Korea.

DRUG OR BODY PART?

In a statement, RNL Bio's chief executive, Ra Jeong-chan, has denied that his company's treatments had anything to do with the deaths. The Korean media are reporting that one patient, a 73-year-old man, died in Japan following a pulmonary embolism; the other failed to wake after receiving an anaesthetic while in China.

Jin Han Hong, president of RNL Life Science, the company's subsidiary in Los Angeles, California, says that the government's investigation will try to determine whether their stem-cell processing in Korea should be banned. "The government wants to define it as a drug and make it illegal," says Hong, who defends the practice: "From our viewpoint it is just part of the patient's body."

Nobuyoshi Tani, head of the regenerative medicine office of the Japanese health ministry's Research and Development Division, says that companies must gain government approval before they can sell stem-cell therapies in Japan. But Japanese doctors don't need approval to import stem cells for use in their practice.

Last year, China passed regulations that would require stem-cell therapies to pass clinical trials, but there has been much debate about how those rules should be implemented. While the government puts together guidelines, companies such as RNL Bio face an uncertain regulatory situation (see *Nature* **467**, 633; 2010).

RNL Life Science offers patient testimony at its California offices.

RNL Bio hopes to attract more US customers with the opening of RNL Life Science in 2009. Last week *Nature* visited the office, situated in a shopping mall called Koreatown Galleria, to learn more about the company's products. Jane Shin, whose business card describes her as a "stem-cell consultant", explained that patients visit an affiliated Los Angeles clinic where a plastic surgeon removes about 5 grams of fatty tissue. The sample is sent to the company's Maryland processing centre, where mesenchymal stem cells — which normally regenerate fat, bone or cartilage in the body — are isolated and sent to Seoul to be cultured. Even the simplest stem-cell treatments, such as those for arthritis, require 100 million cells, says Hong. Preparing and banking these cells for three years costs US$7,500; every subsequent 100 million cells cost an additional $5,000. Standard courses are 600 million cells, says Shin. "The more cells you use, the better you get."

Shin says that 10,000 patients worldwide, including 130 from the United States, have received injections of the firm's stem cells. About half have had facial injections, hoping to rejuvenate their appearance, but the company claims that the cells have been used to treat ailments including Parkinson's disease, kidney failure and diabetes.

STEM-CELL BANKING

Hong admits that there is not yet conclusive clinical-trial evidence that the treatment can help these various conditions, although the company is running trials in South Korea. Asked why RNL would start offering a therapy before it was proven effective, he says that the company offers only stem-cell isolation and banking services, not stem-cell therapy. "We don't offer therapy," he says. "It's true that we note the potential but we don't make promises."

But Hong and Shin do talk openly about treatments. Shin, for example, provided details about injection sites and the diseases that could be treated. RNL's patients are recommended to go to affiliated clinics such as the RNL Sunrise Regenerative Medical Center in Tangli, China. And Shin also provided a brochure that describes how a patient recovered from rheumatoid arthritis following treatment. According to the brochure, the patient was "escorted by RNL staff" to the Yangzi centre. And looking out from the front window of the Los Angeles office, a wide-screen TV broadcasts testimony of patients happy with the results of the company's services.

Stem-cell scientists contacted by *Nature* are sceptical about the efficacy of RNL's preparations. "Spontaneous differentiation of adipose-derived stem cells into therapeutic cell types for Parkinson's disease is biologically unrealistic," says Oliver Cooper, director of the Stem Cell Facility at Harvard University's Center for Neuroregeneration Research in Belmont, Massachusetts. Other scientists echoed his sentiments.

Cooper's team hopes to treat Parkinson's with stem cells. But the researchers will implant the cells only after they have differentiated into neurons. Injecting immature stem cells, he says, "does not provide a long-term treatment for Parkinson's disease, and the risk associated with uncontrolled growth of transplanted stem cells is unacceptable." ■

CLINICAL RESEARCH www.jasn.org

Angiomyeloproliferative Lesions Following Autologous Stem Cell Therapy

Duangpen Thirabanjasak,* Kavirach Tantiwongse,† and Paul Scott Thorner*‡§

Departments of *Pathology and †Surgery, Faculty of Medicine, Chulalongkorn University, Bangkok, Thailand; ‡Division of Pathology, Hospital for Sick Children, Toronto, Canada; and §Department of Laboratory Medicine and Pathobiology, University of Toronto, Toronto, Canada

ABSTRACT

Some reports suggest that autologous hematopoietic stem cell transplantation holds potential for treatment of renal diseases such as lupus nephritis, but the safety of delivering various stem cell types (hematopoietic, mesenchymal, and endothelial precursors) is not well established. Here, we report a case of lupus nephritis treated by direct renal injection of autologous stem cells recovered from peripheral blood. The patient developed masses at the sites of injection and hematuria. We suspected transitional cell carcinoma but nephrectomy revealed that the masses were angiomyeloproliferative lesions. We believe that this previously undescribed pathologic entity is stem cell–derived or –induced. The biologic potential, including the neoplastic potential, of this lesion is unknown. This case illustrates that the development of angiomyeloproliferative lesions is a possible complication of stem cell therapy.

J Am Soc Nephrol 21: 1218–1222, 2010. doi: 10.1681/ASN.2009111156

The Reality of Stem Cell Tourism

OPEN ACCESS Freely available online

PLOS MEDICINE

Donor-Derived Brain Tumor Following Neural Stem Cell Transplantation in an Ataxia Telangiectasia Patient

Ninette Amariglio[1,2], Abraham Hirshberg[3], Bernd W. Scheithauer[4], Yoram Cohen[1], Ron Loewenthal[5], Luba Trakhtenbrot[2], Nurit Paz[1], Maya Koren-Michowitz[2], Dalia Waldman[6], Leonor Leider-Trejo[7], Amos Toren[6], Shlomi Constantini[8], Gideon Rechavi[1,6*]

1 Cancer Research Center, Sheba Medical Center and Sackler School of Medicine, Tel Aviv University, Tel-Aviv, Israel, **2** Institute of Hematology, Sheba Medical Center, Tel Hashomer, Israel, **3** Department of Oral Pathology, School of Dental Medicine, Tel Aviv University, Tel-Aviv, Israel, **4** Department of Laboratory Medicine and Pathology, Mayo Clinic, Rochester, Minnesota, United States of America, **5** Tissue Typing Laboratory, Sheba Medical Center and Sackler School of Medicine, Tel Aviv University, Tel-Aviv, Israel, **6** Department of Pediatric Hemato-Oncology, Sheba Medical Center and Sackler School of Medicine, Tel Aviv University, Tel-Aviv, Israel, **7** Institute of Pathology, Tel-Aviv Medical Center, Tel-Aviv, Israel, **8** Pediatric Neurosurgery, Dana Children's Hospital, Tel-Aviv Medical Center, and Sackler School of Medicine, Tel Aviv University, Tel-Aviv, Israel

So, what are we doing about it?

- There are a lot of legitimate stem cell clinical trials, under proper control and government regulations (ie. Geron – hESCs for spinal cord injury)
- In Canada, multiple levels of consent and oversight
- ISSCR patient handbook, task force
- Appropriate websites for clinical trials
    - http://www.isscr.org/PatientHandbook/3296.htm
    - http://www.cihr-irsc.gc.ca/e/42071.html
    - http://www.closerlookatstemcells.org/Top_10_Stem_Cell_Treatment_Facts.htm

Still have ways to go: major challenges

- Control of differentiation
  - Yield has improved, but purity still an issue
  - Use of animal products *in vitro*
  - Generation methods
- Cell delivery
  - How many cells? Number of sites?
  - Single suspension, aggregates?
  - Optimal site
- Control of immune rejection

Still have ways to go: major challenges

- Preventing infection
- Design of clinical trials
- Ethical and legal considerations: Good manufacturing practice

- hPSCs for replacement therapy not yet a reality
- must not treat patients too soon

Take home messages

- 2 major sources of hPSCs: hESCs and iPS cells
- Ongoing work with hPSCs for transplantation and drug discovery
- Stem Cell Tourism has had a negative impact on public perception of research progress
- Still need more optimization before clinical application

Acknowledgements

- Ludivine Morrison
- Robyn McClelland