Stem Cells and their Applications

by

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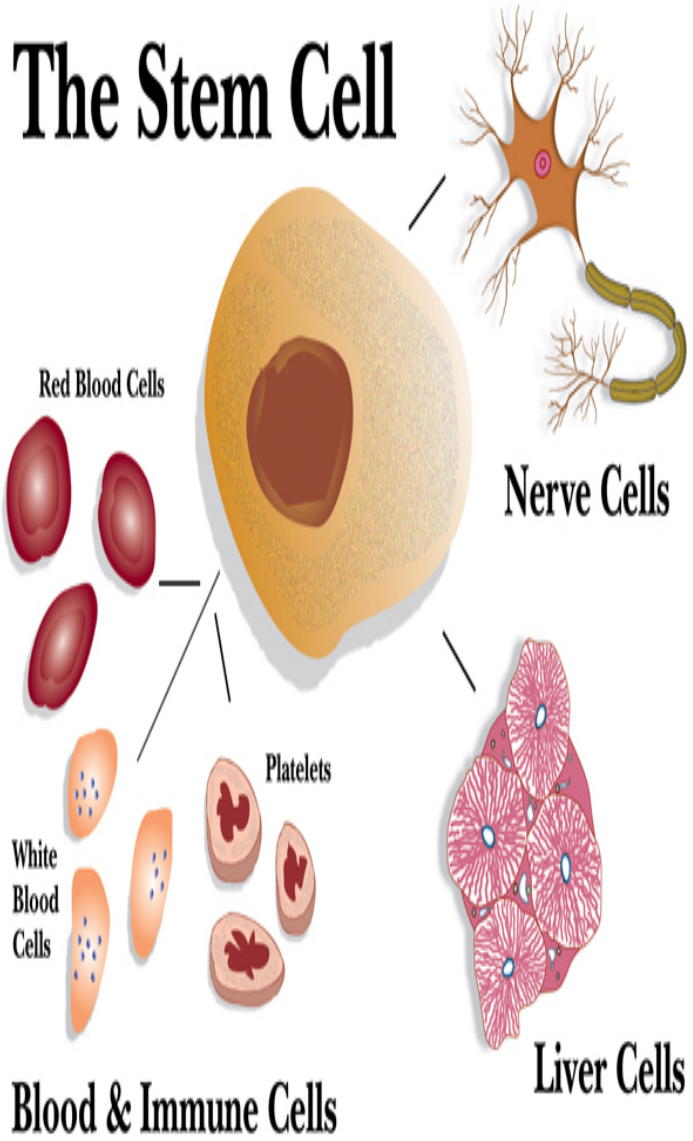
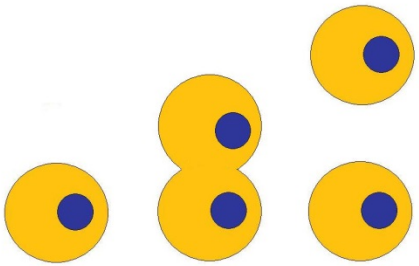


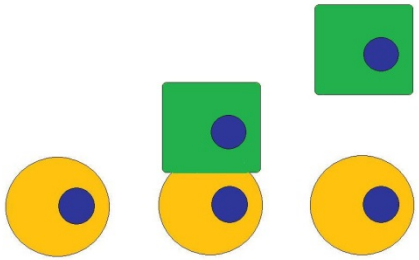
- **What are the stem cells?**

Stem cells are class of **undifferentiated** cells that have the potential to differentiate into any type of cell in the body.

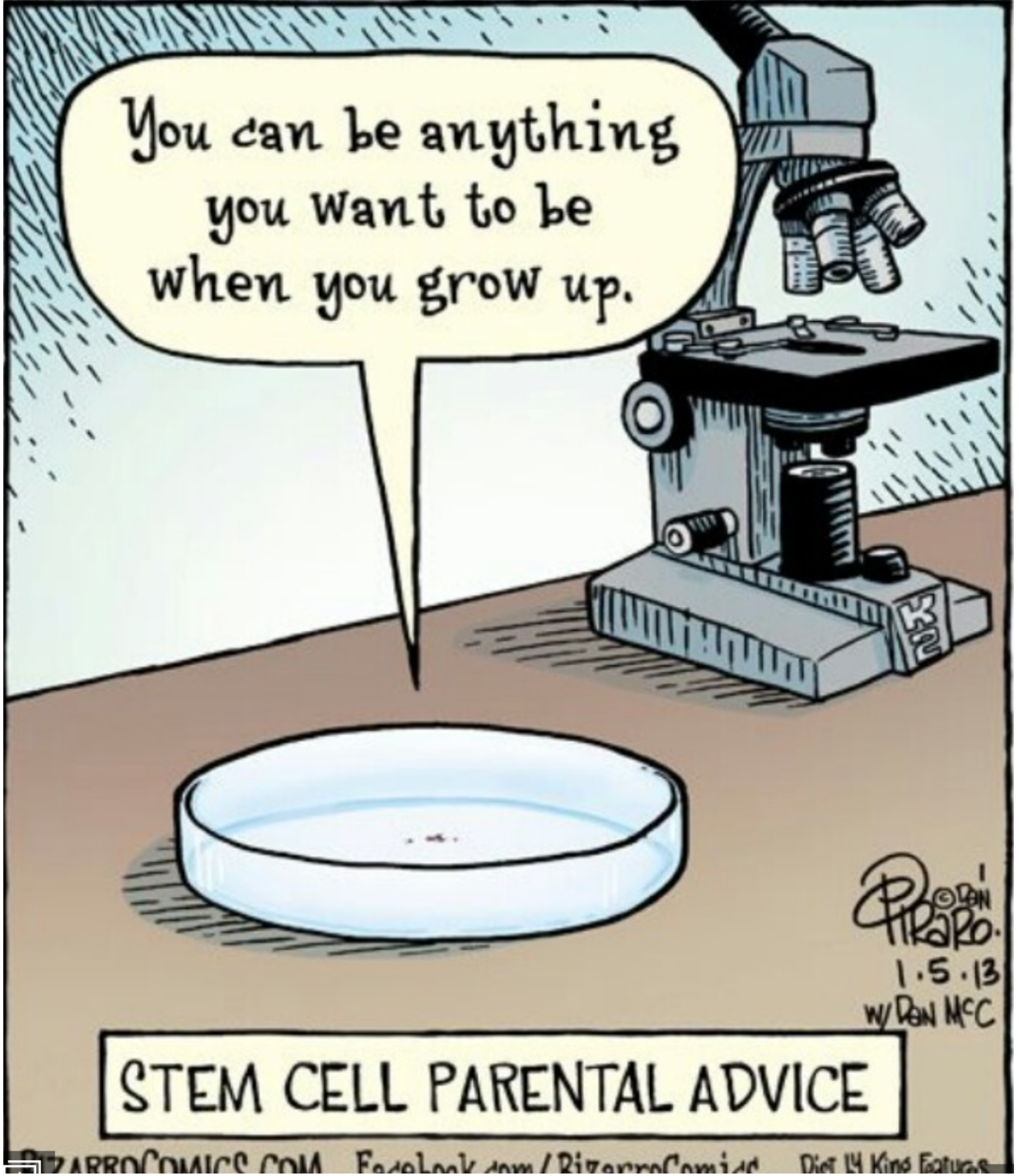
- **Unique characters of stem cells:**



Can renew



Can specialize


You can be anything you want to be when you grow up.
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1.5.13
W/DON MCC
STEM CELL PARENTAL ADVICE
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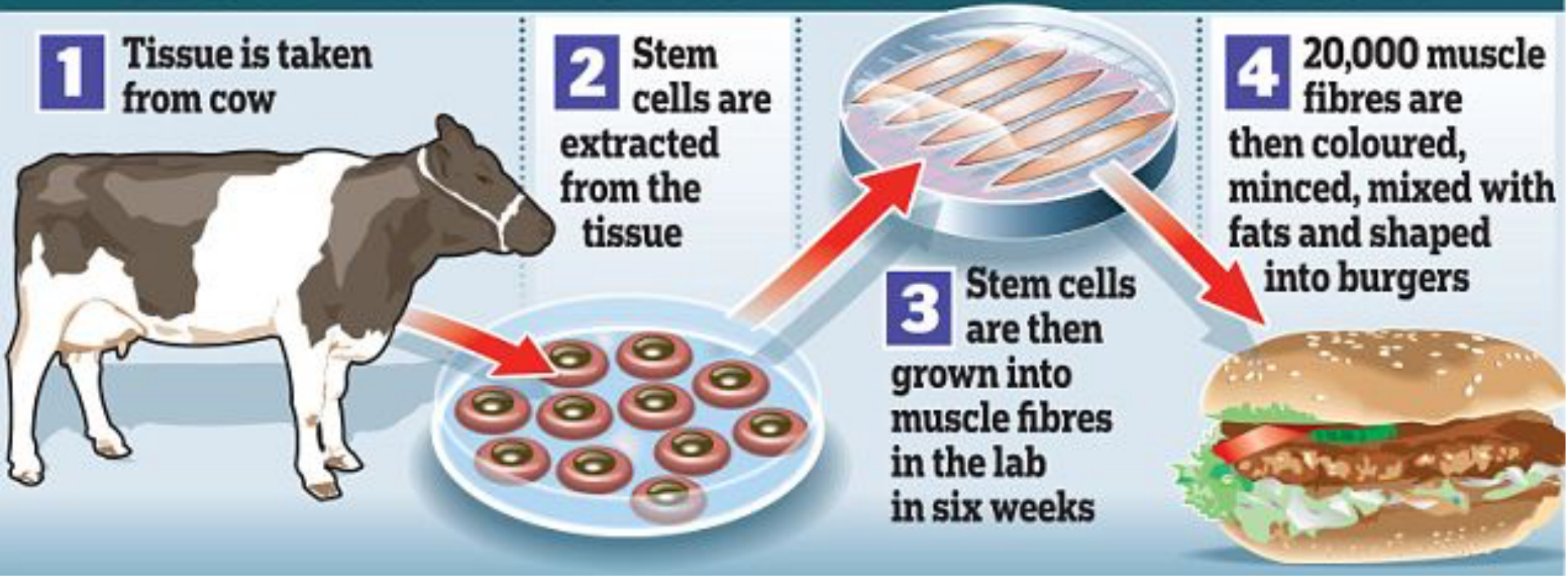
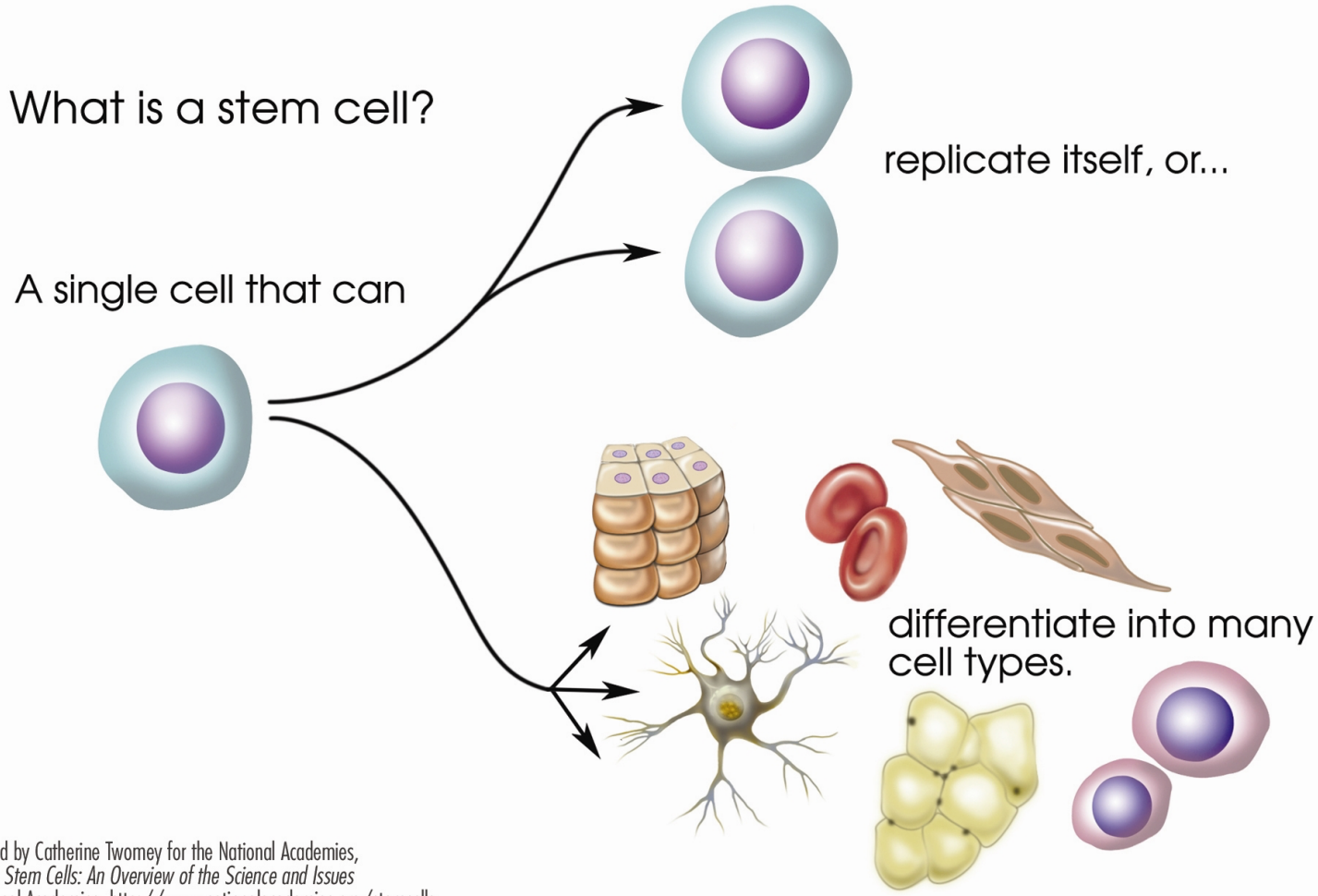
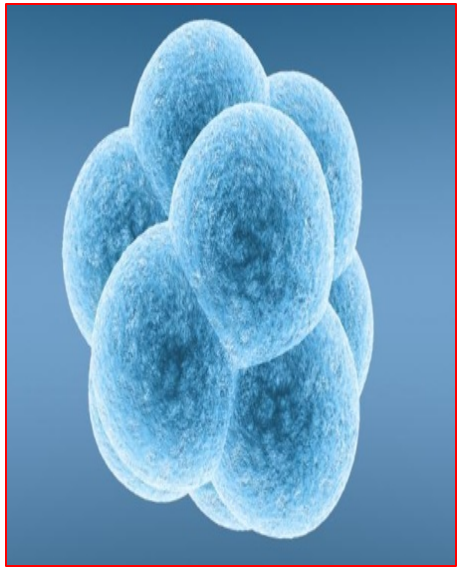
HOW THE BURGERS ARE GROWN

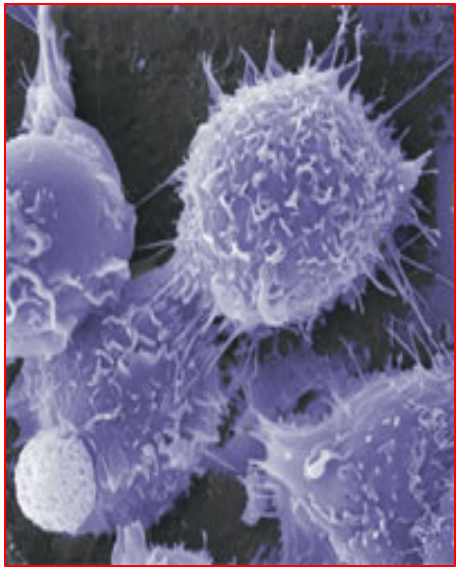




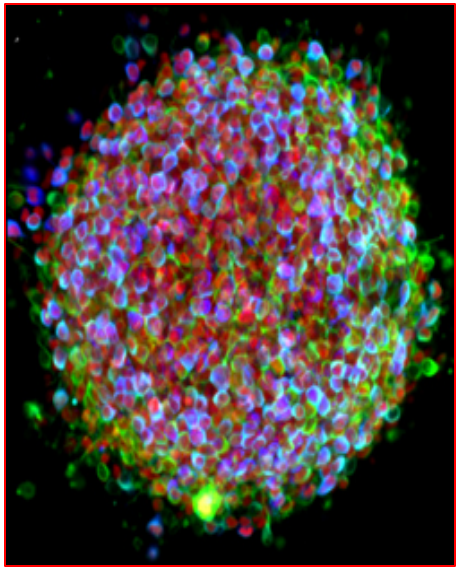
- **Types of stem cells:**



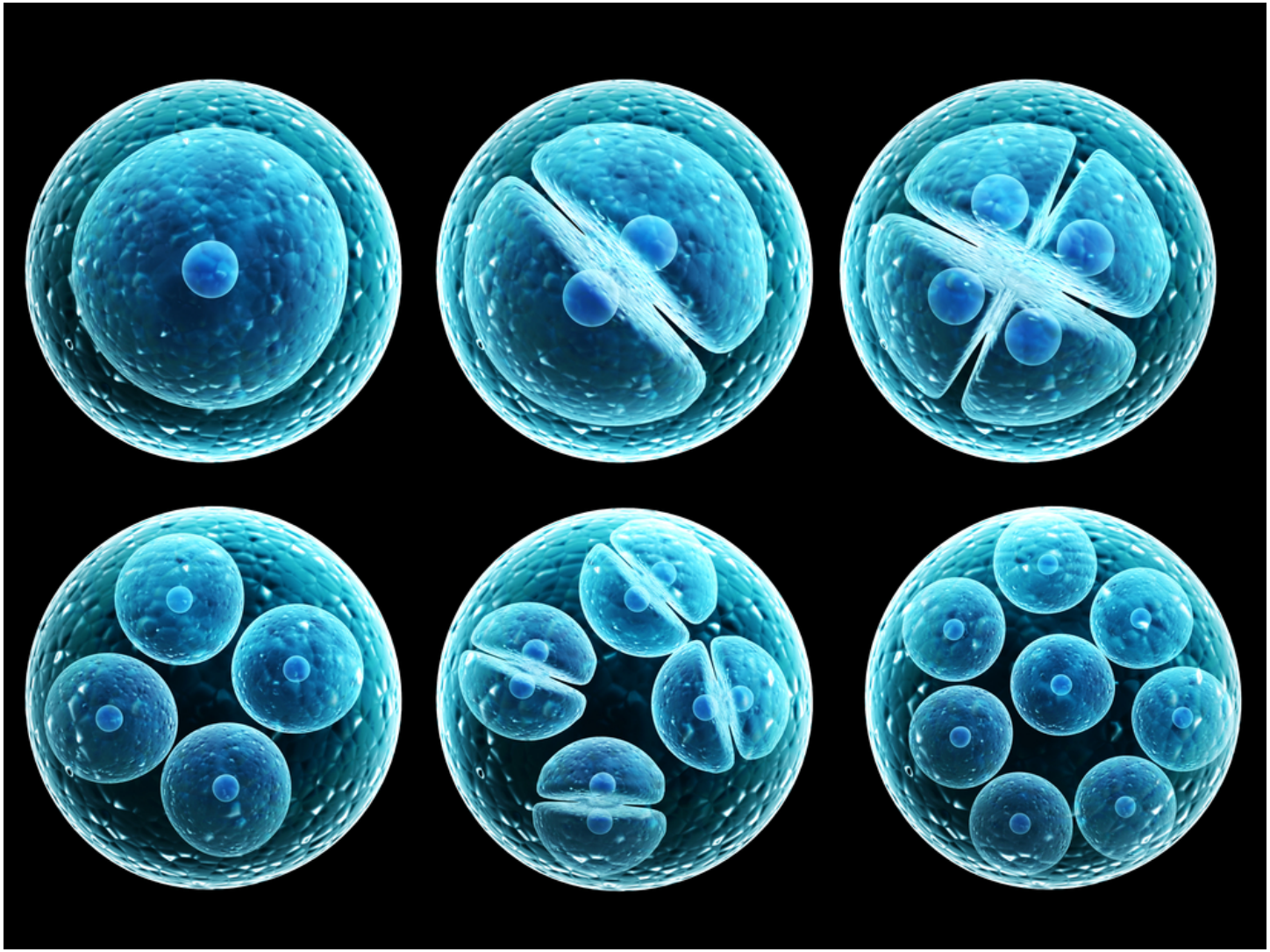
Embryonic stem (ES) cells



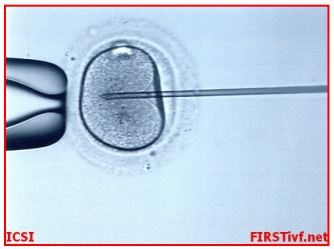
Adult stem cells

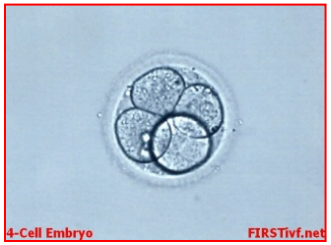


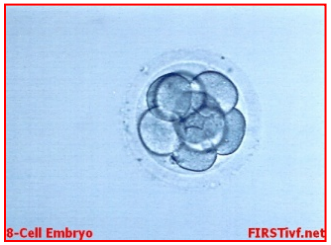
Induced pluripotent stem cell (iPSCs)

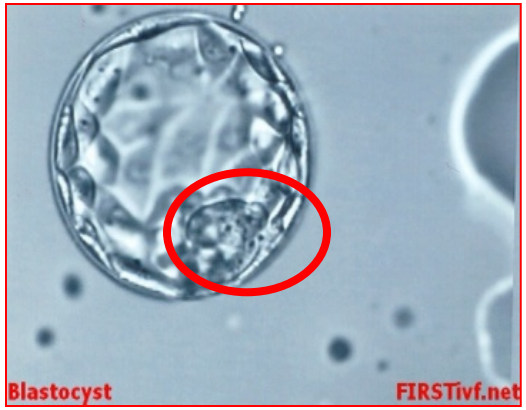


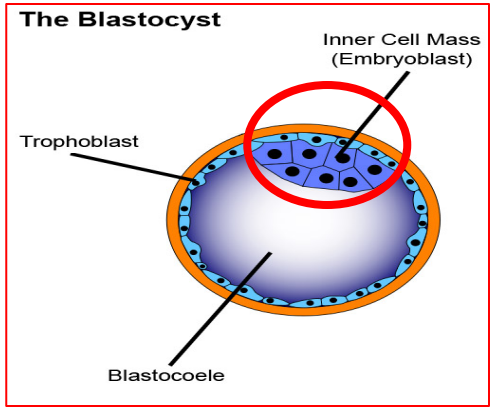
1. Embryonic stem cells











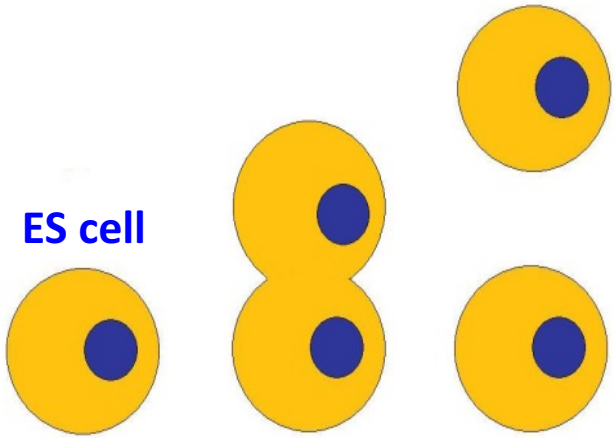
Derived from the **inner cell mass** of an in vitro **blastocyst-stage embryos** after the consent of the donor.

To create an embryonic stem cell line, the inner cell-mass is removed from the blastocyst, separated from the trophoectoderm, and cultured on a layer of supportive cells in vitro. In the derivation of human embryonic stem cell lines, embryos left over from in vitro fertilization (IVF) procedures are used.

This controversy stems from the fact that derivation of human embryonic stem cells requires the destruction of a blastocyst-stage, pre-implantation human embryo.

- **Maintenance of ES cells:**

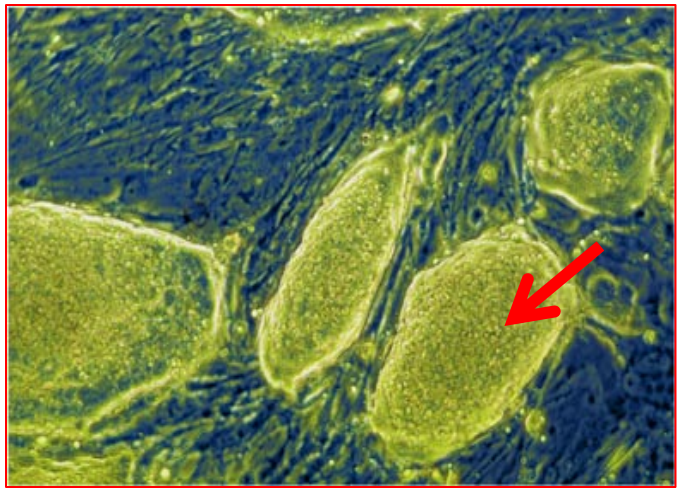
▫ By co-culturing of ES cells with **mouse embryonic feeder** cells.



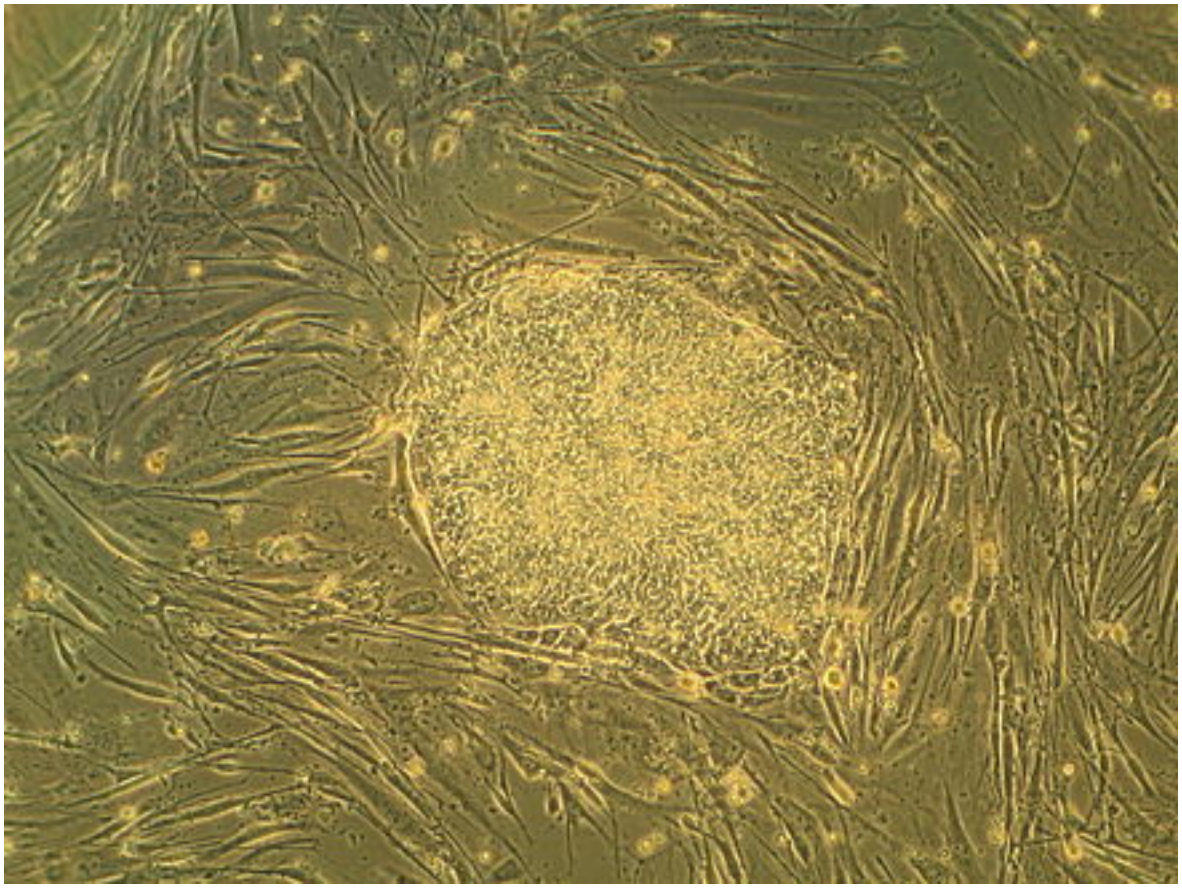
▫ **Leukemia inhibitory factor** (LIF) plays a pivotal role in the maintenance of ES cells.

▫ In the presence of **FCS**, LIF can replace the function of feeder cells.

▫ In the presence of LIF, **BMP4** can replace the requirement for serum.

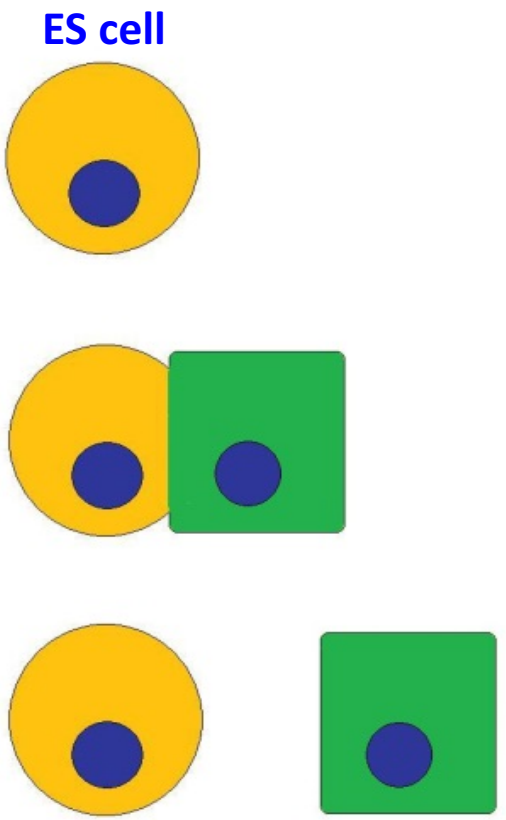


Mouse embryonic stem cells



- **Differentiation:**

Deprivation of the factors that maintain ES cells as stem cells make these cells **differentiate** and under appropriate conditons, **generate progeny** consisting of derivatives of the three embryonic germ layers: **mesoderm**, **endoderm** and **ectoderm**.



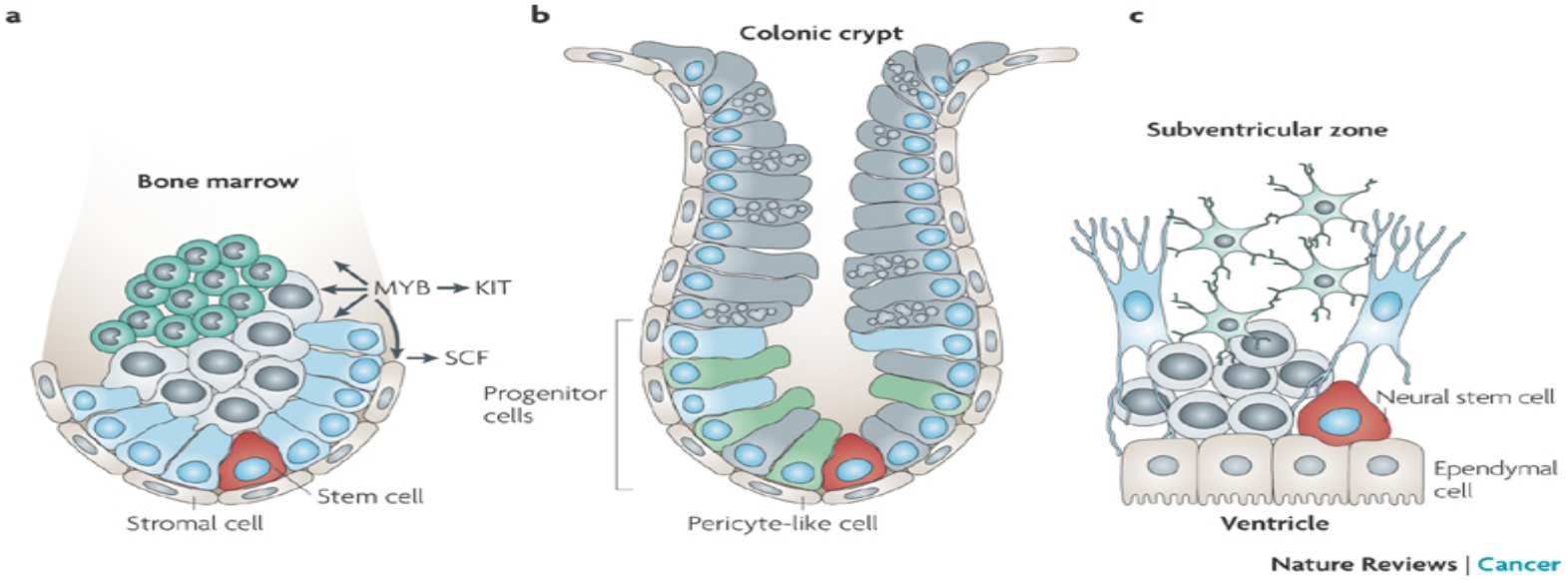
Embryonic stem cell research

- contributes significantly to the scientific understanding of adult stem cells; knowledge that is now being used to research new medical treatments utilizing harvested adult stem cells.

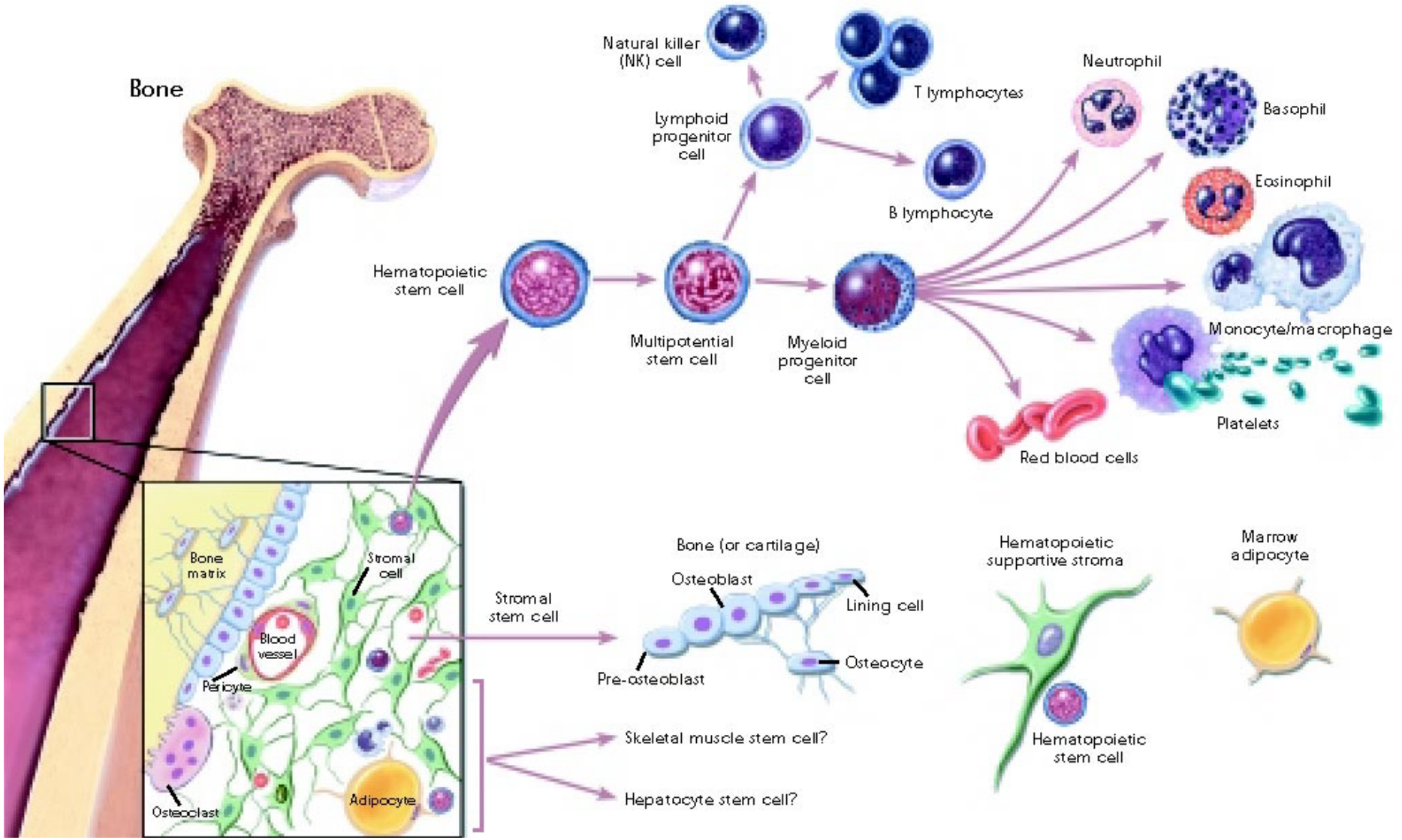
  An important factor in adult stem cell medical treatments is the value of using the patient's own stem cells in order to create the most effective medical treatments that will not be rejected by the body's immune system. New treatments using adult stem cells, such as those found in teeth and bone marrow, are the focus of countless medical research studies around the world.

2. Adult Stem Cells

- **Undifferentiated cells** found among differentiated cells in many organs including brain, bone marrow, peripheral blood, blood vessels, skeletal muscle, skin, teeth, liver, ovarian epithelium and testes.



- Adult stem cells reside in a specific area of each tissue called "stem cell niche".


Bone
Natural killer (NK) cell
T lymphocytes
Lymphoid progenitor cell
B lymphocyte
Neutrophil
Basophil
Eosinophil
Monocyte/macrophage
Platelets
Red blood cells
Hematopoietic stem cell
Multipotential stem cell
Myeloid progenitor cell
Bone matrix
Stromal cell
Blood vessel
Pericyte
Osteoclast
Adipocyte
Stromal stem cell
Bone (or cartilage)
Osteoblast
Lining cell
Osteocyte
Pre-osteoblast
Skeletal muscle stem cell?
Hepatocyte stem cell?
Hematopoietic supportive stroma
Hematopoietic stem cell
Marrow adipocyte

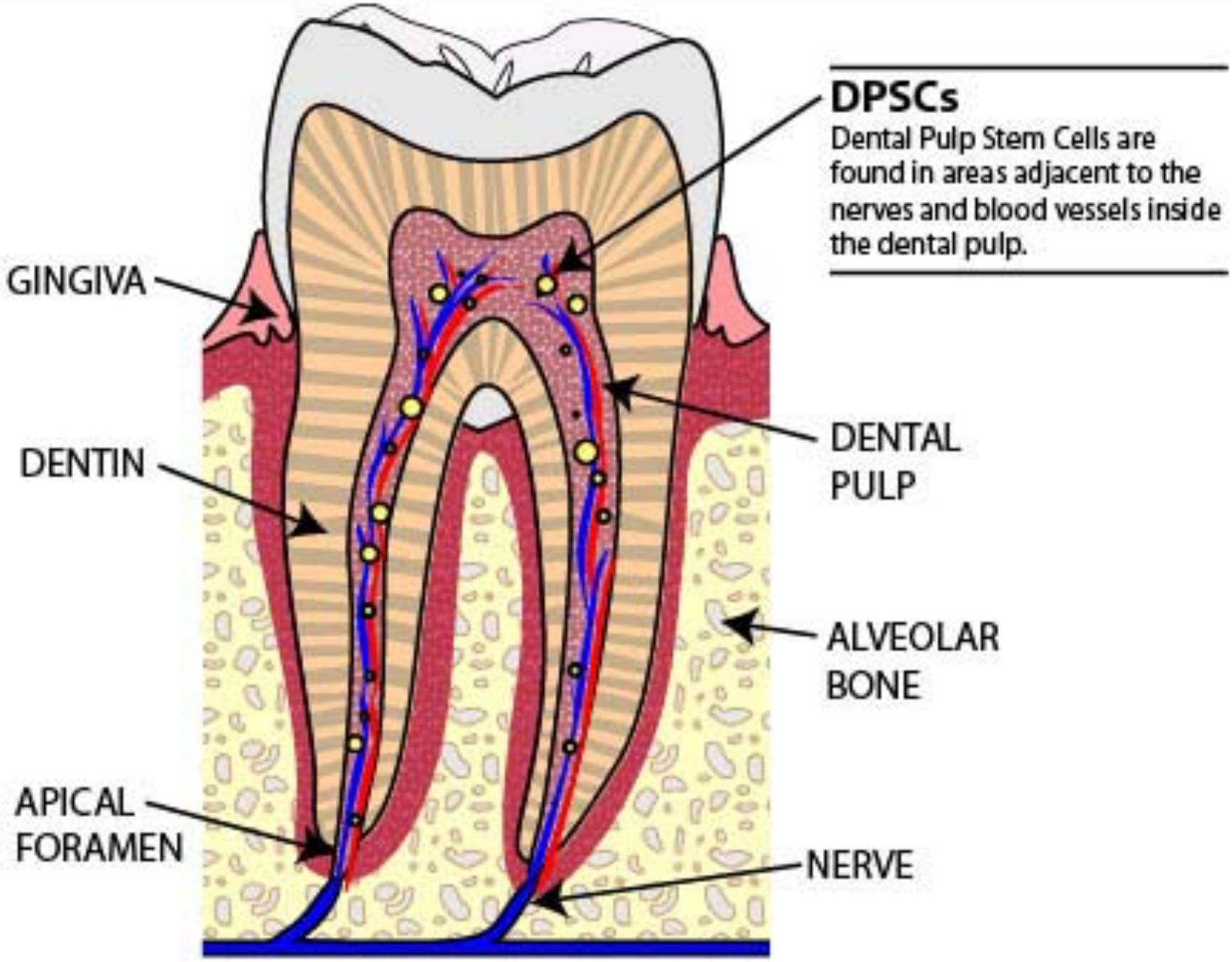
Stem Cells in Teeth

-
- **The tooth is nature's 'safe' for your family's unique stem cells**

  While stem cells can be found in most tissues of the body, they are usually buried deep, are few in number and are similar in appearance to surrounding cells. With the discovery of stem cells in teeth, an accessible and available source of stem cells has been identified.

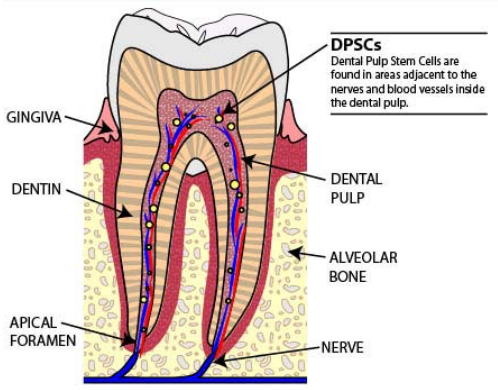
  The tooth is nature's "safe" for these valuable stem cells, and there is an abundance of these cells in baby teeth, wisdom teeth and permanent teeth - **Tooth Eligibility Criteria**.
- The stem cells contained within teeth are capable of replicating themselves and can be readily recovered at the time of a planned dental procedure.

  Living stem cells found within extracted teeth were routinely discarded every day, but now, with the knowledge from recent medical research, StemSave gives you the opportunity to save these cells for future use in developing medical treatments for your family.
- Aside from being the most convenient stem cells to access, dental stem cells have significant medical benefits in the development of new medical therapies. Using one's own stem cells for medical treatment means a much lower risk of rejection by the body and decreases the need for powerful drugs that weaken the immune system, both of which are negative but typical realities that come into play when tissues or cells from a donor are used to treat patients.
- Further, the stem cells from teeth have been observed in research studies to be among the most powerful stem cells in the human body. Stem cells from teeth replicate at a faster rate and for a longer period of time than do stem cells harvested from other tissues of the body.
- Stem cells in the human body age over time and their regenerative abilities slow down later in life. The earlier in life that your family's stem cells are secured, the more valuable they will be when they are needed most.
- .

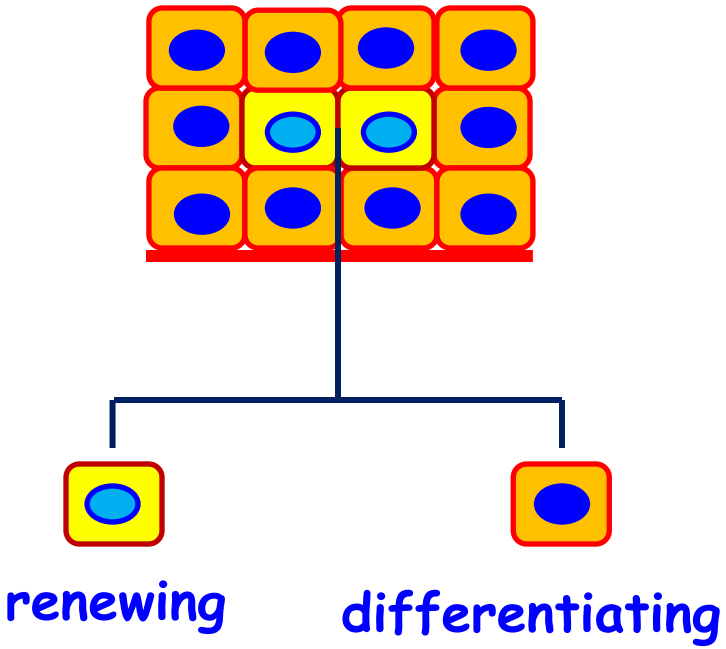

DPSCs
Dental Pulp Stem Cells are found in areas adjacent to the nerves and blood vessels inside the dental pulp.
GINGIVA
DENTIN
DENTAL PULP
ALVEOLAR BONE
APICAL FORAMEN
NERVE

Dental Pulp Stem Cells DPSCs

- They differentiate into various tissue types such as:
- adipocytes, chondrocytes, osteoblasts, neural progenitors, and odontoblasts.
- Extracting stem cells from the pulp is an easy way to obtain them.
- They exhibit excellent ex vivo expansion rate and stable transplantation potential.
-



- Adult stem cells **renew** themselves and **differentiate** to yield some or all of the specialized cell types of the tissue where they are reside.
- The primary role of adult stem cells in a living organism is to **maintain** and **repair** the tissues where they are found.



Why would they are promising in regard to the brain and heart?

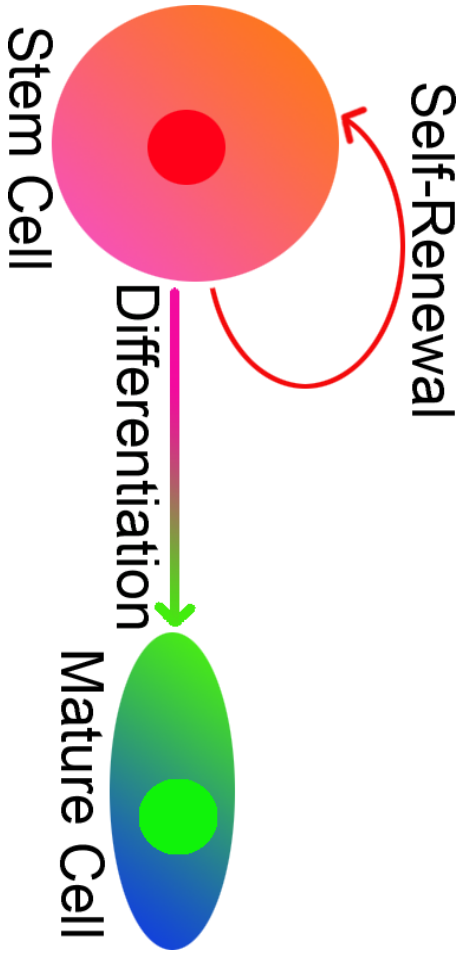
- **Differentiation of adult stem cells:**

1. Normal differentiation:

Adult stem cells **divide** when needed and give rise to **mature** cell types.

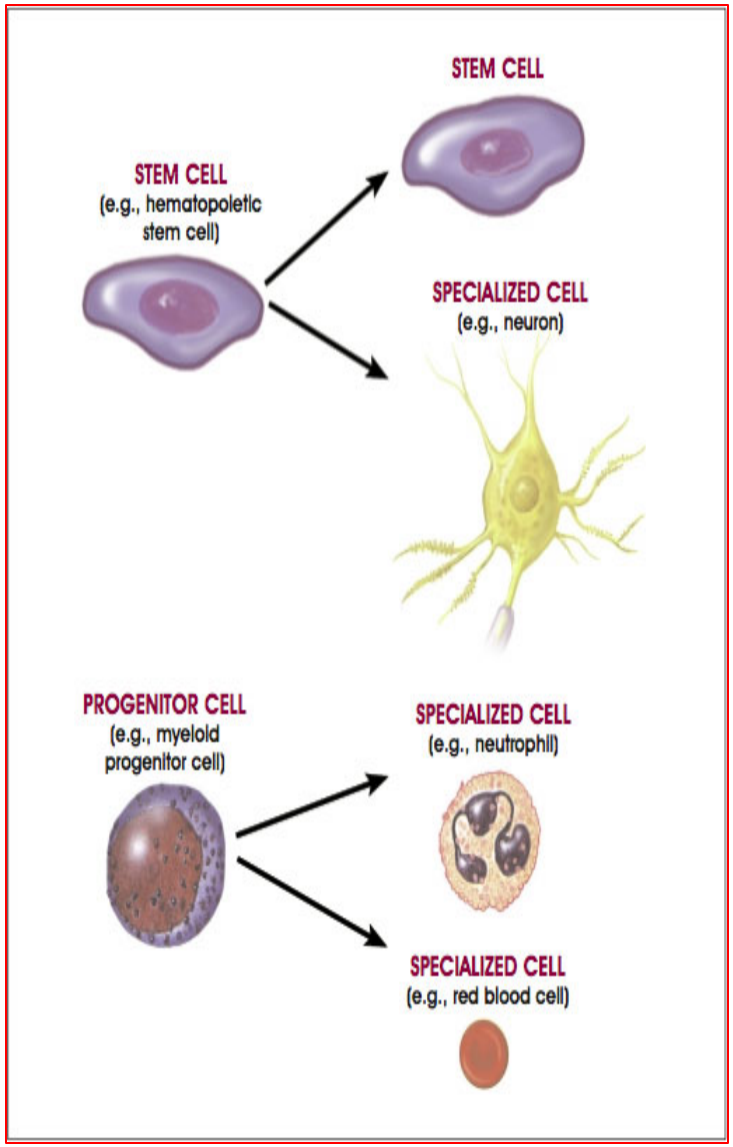
For example:

- **Hematopoietic** stem cells give rise to **blood** cells.
- **Mesenchymal** stem cells present in many tissue can give rise to **bone** cells, **cartilage** cells and **fat** cells.



2- Transdifferentiation:

- **Differentiation** of adult stem cells into **other cell types** e.g. differentiation of blood-forming cells into cardiac muscle … etc.
- **Patient's** own adult stem cells would **escape** immune system surveillance.



3- Induced pluripotent stem cells (iPSCs)

Programming of **somatic cells** to become **embryonic stem cells** through the introduction of embryonic genes.

Why using iPSCs is advantageous over both differentiated embryonic and adult stem cells?

As the donor and recipient of the iPSCs can be the same individual, the chance of compatibility increases.

General applications of stem cells

1- Studying cell differentiation and maturation, and tissue development:

This help us to better understand how **birth defects** develop and how to **prevent** them.

2- In vitro modelling of different diseases:

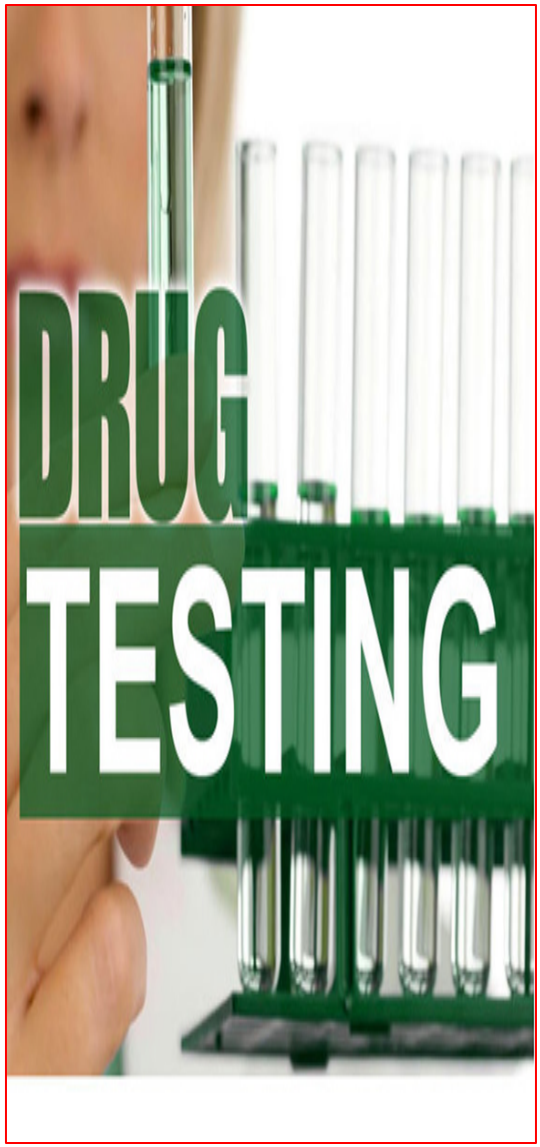
Stem cells provide an **ideal in vitro system** to study underlying mechanisms that mediate different diseases at the molecular and cellular levels.

3- Drug testing and reproductive toxicology:

Stem cells can used as **biologically relevant models** for the **evaluating** different toxic compounds.

4- Drug and growth factor discovery:

Stem cell models offer new opportunities to improve the manner in which pharmaceutical companies **identify** lead candidates and **brings** new drugs to the market.

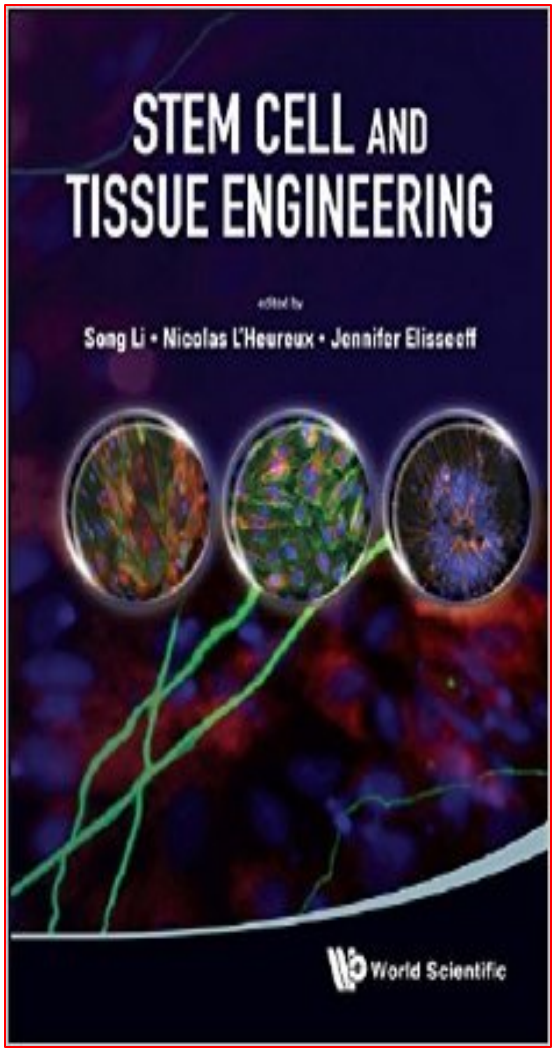


5- Tissue engineering:

Most current strategies for tissue engineering depend upon:

i. Using **autologous cells** from the diseased organ of the host. Tissue biopsy may not yield **enough** normal cells for expansion and transplantation particularly in patients with end-stage organ failure.

ii- Using **pluripotent embryonic stem cells** as an alternative source of cells from which, the desired tissue can be derived.



6- Cell-based therapies:

- The most **successful** example in this context is using **hematopoietic stem cells** from the bone marrow to treat **leukemia**.

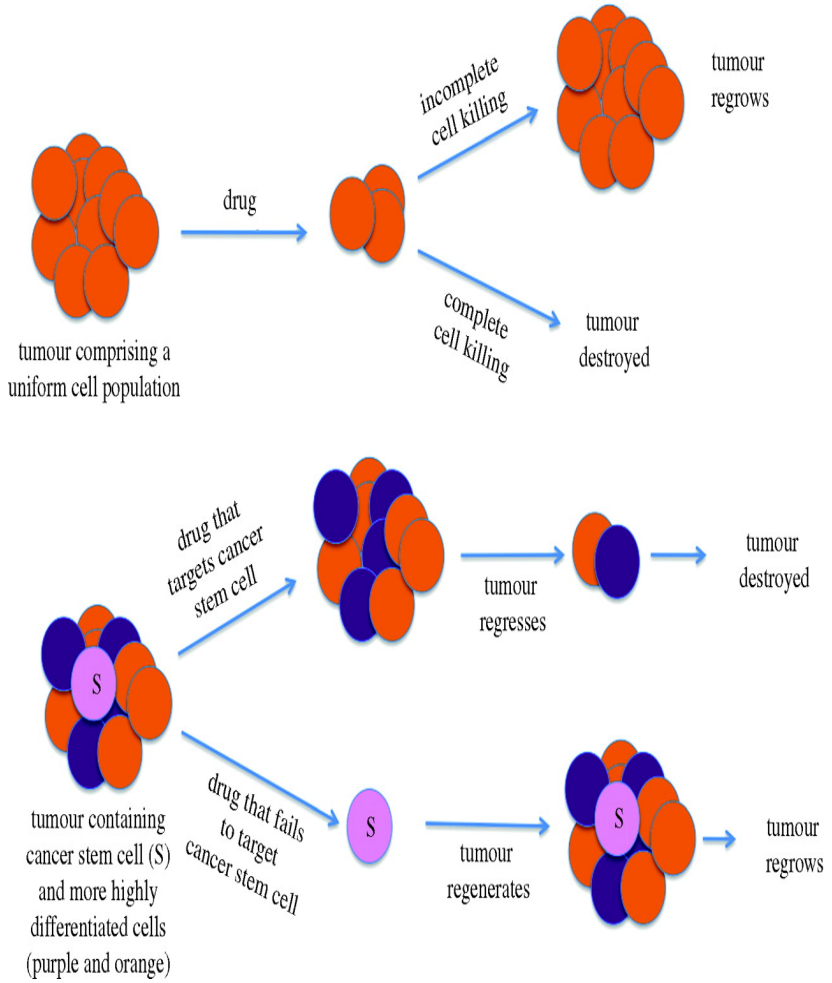
- Other **applications** include cell therapy for spinal cord injury, heart diseases, rheumatoid arthritis and type I diabetes.

7- Cancer therapy:

- Killing **tumor stem** cells

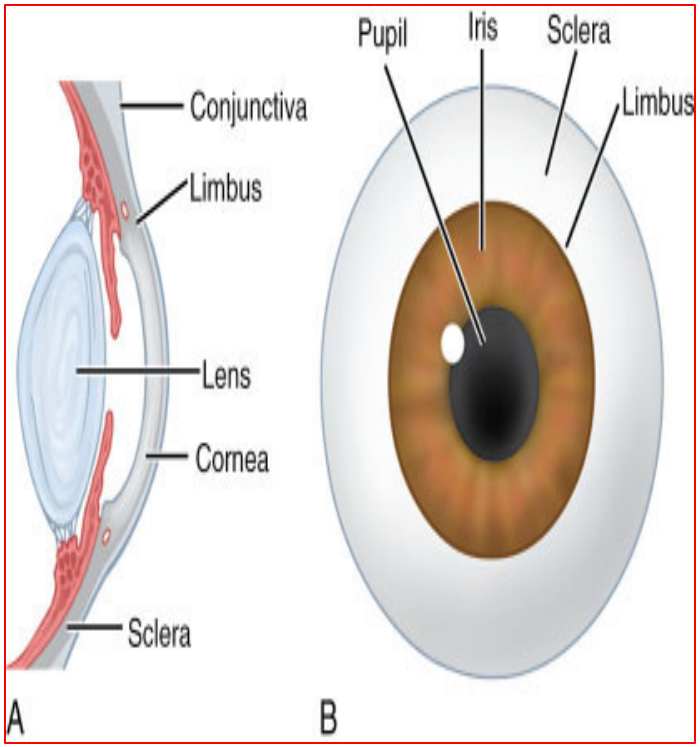
give a chance for tumor

regression.



Using a limbal stem cell to repair injured cornea

- Limbal stem cells are found in the limbus, the area located at the border between cornea and sclera.
- Limbic stem cells usually heal damage to the corneal epithelium, the outer corneal layer.

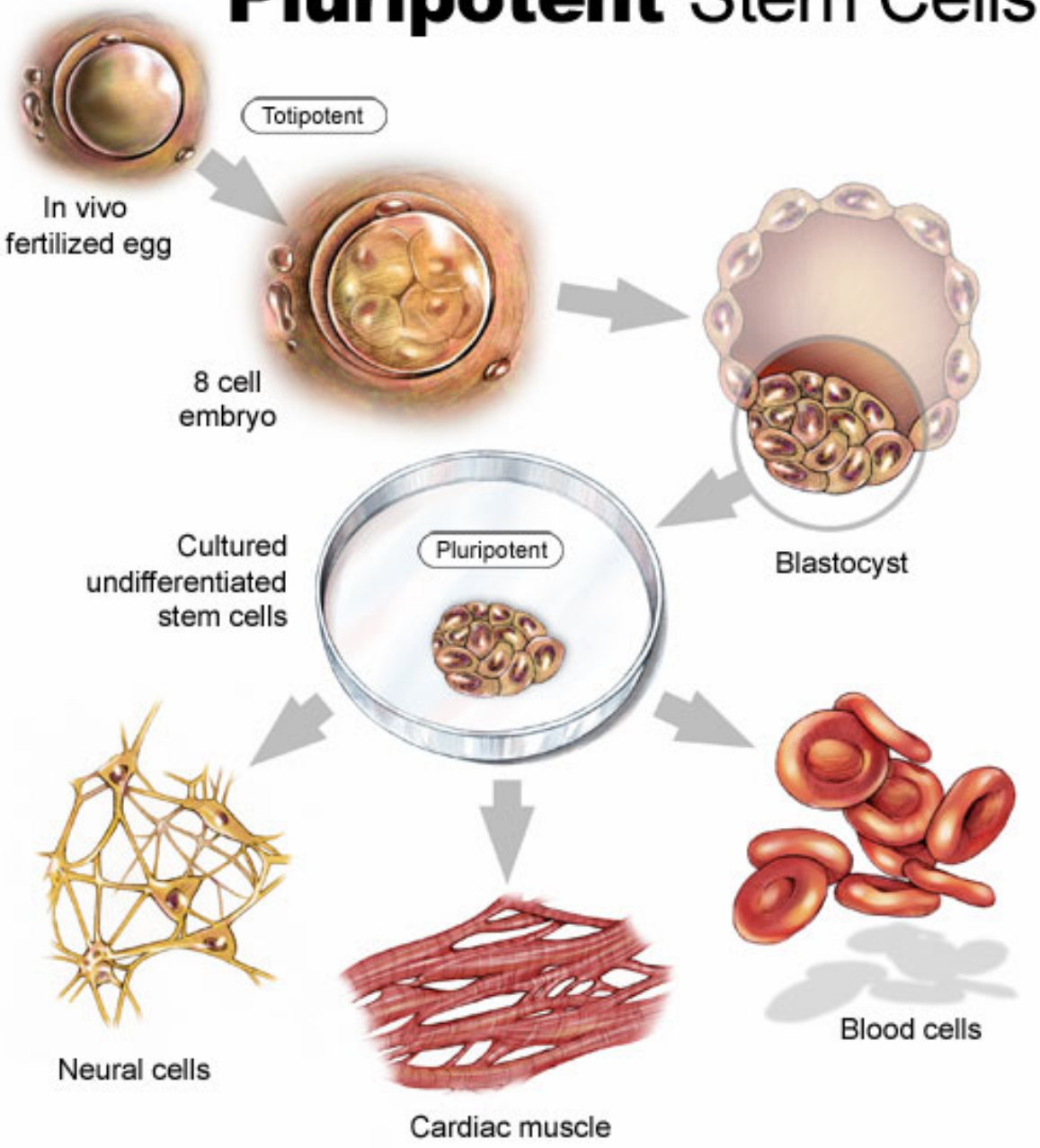


- **Limbal stem cell deficiency** as the result of physical or chemical burns to the eye can cause blindness due to corneal destruction and loss of the healing process.

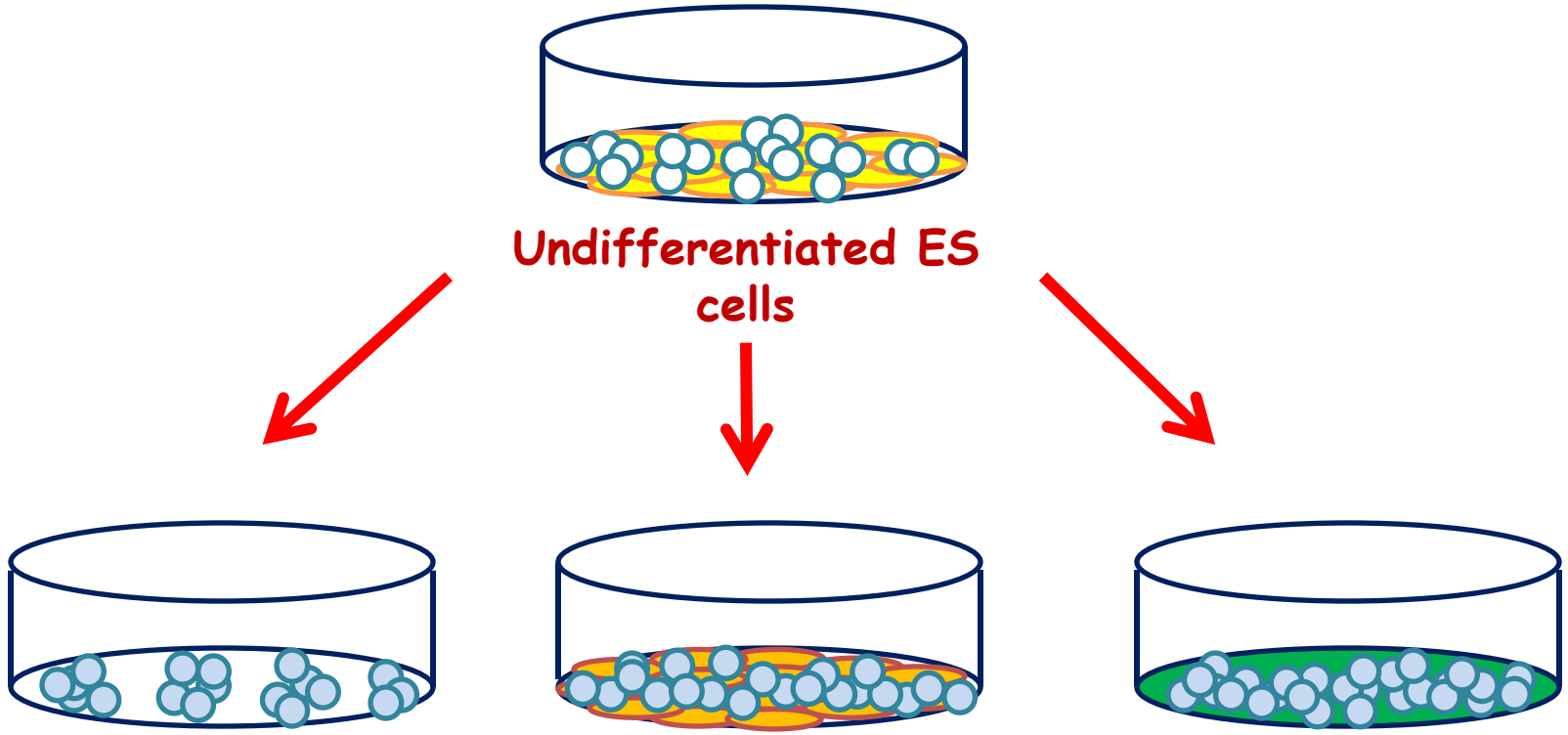
- The therapy works by **taking a tiny portion** of the undamaged limbus and growing it in a laboratory using cell culture techniques.

- This produces **a sheet of cornea** that can then be transplanted back onto the eye rstoring sight in the absence of deep corneal stromal damage.

Pluripotent Stem Cells



- **Three approaches for ES cells differentiation:**

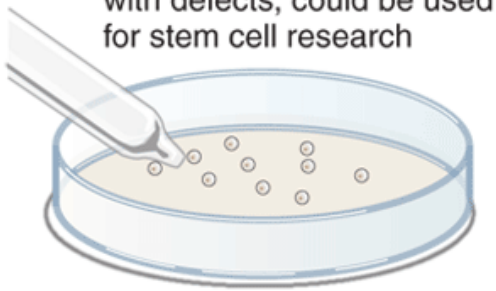


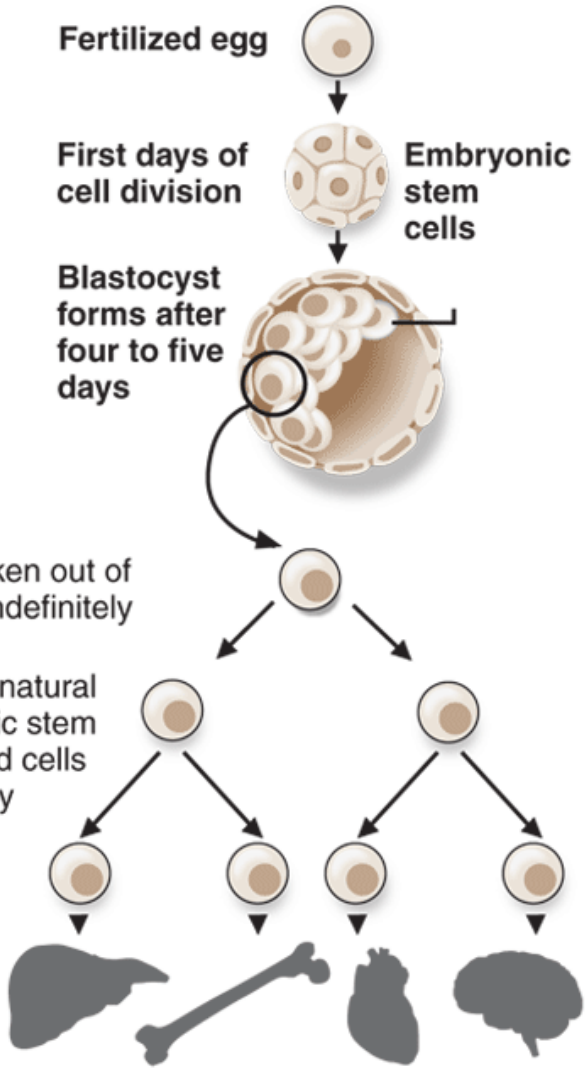
Stem Cell Cultures

Researchers say embryonic stem cells could unlock secrets of disease and lead to cures for illnesses such as Alzheimer's and diabetes.

Making an embryonic stem cell culture

1. Several eggs are fertilized at once during in vitro fertilization; after genetic testing, healthiest embryos are implanted in womb; remaining embryos, some with defects, could be used for stem cell research





2. Embryonic stem cells are taken out of blastocyst; cells can divide indefinitely

3. Chemical agents that mimic natural processes turn the embryonic stem cells into adult stem cells and cells found everywhere in the body

4. Adult stem cells form

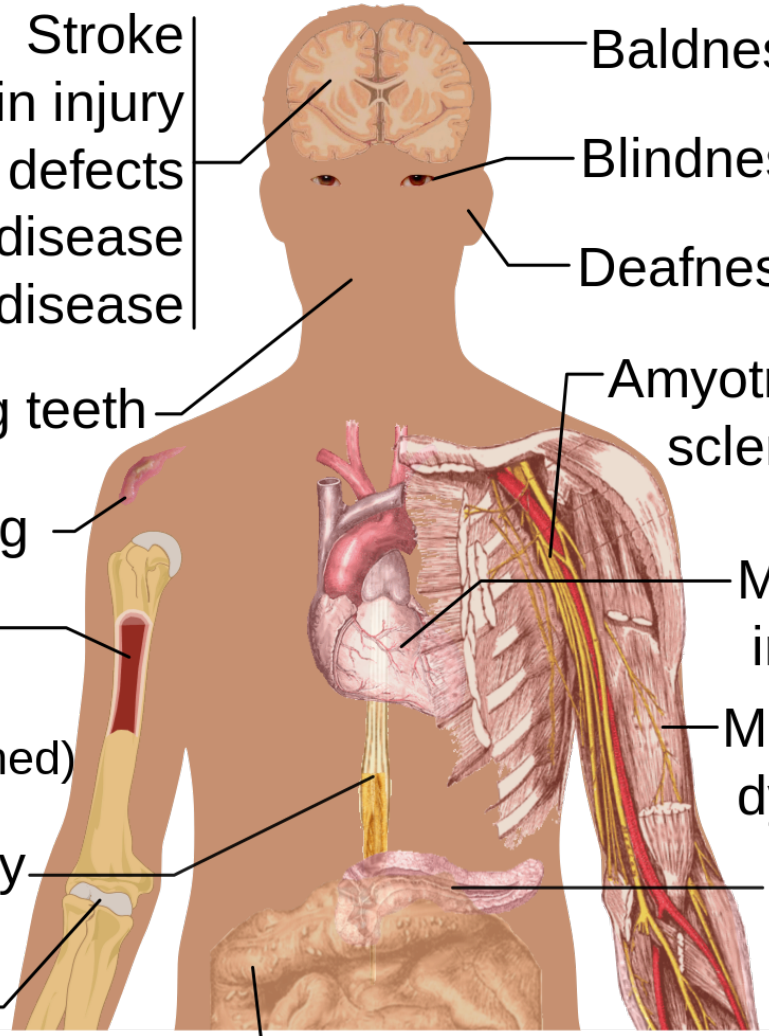
5. Researchers study cells, with the hope of repairing damaged organs

Source: University of Michigan

Graphic: Detroit Free Press

Potential uses of

Stem cells



Stroke
Traumatic brain injury
Learning defects
Alzheimer's disease
Parkinson's disease

Missing teeth

Wound healing

Bone marrow transplantation (currently established)

Spinal cord injury

Osteoarthritis
Rheumatoid arthritis

Baldness

Blindness

Deafness

Amyotrophic lateral-sclerosis

Myocardial infarction

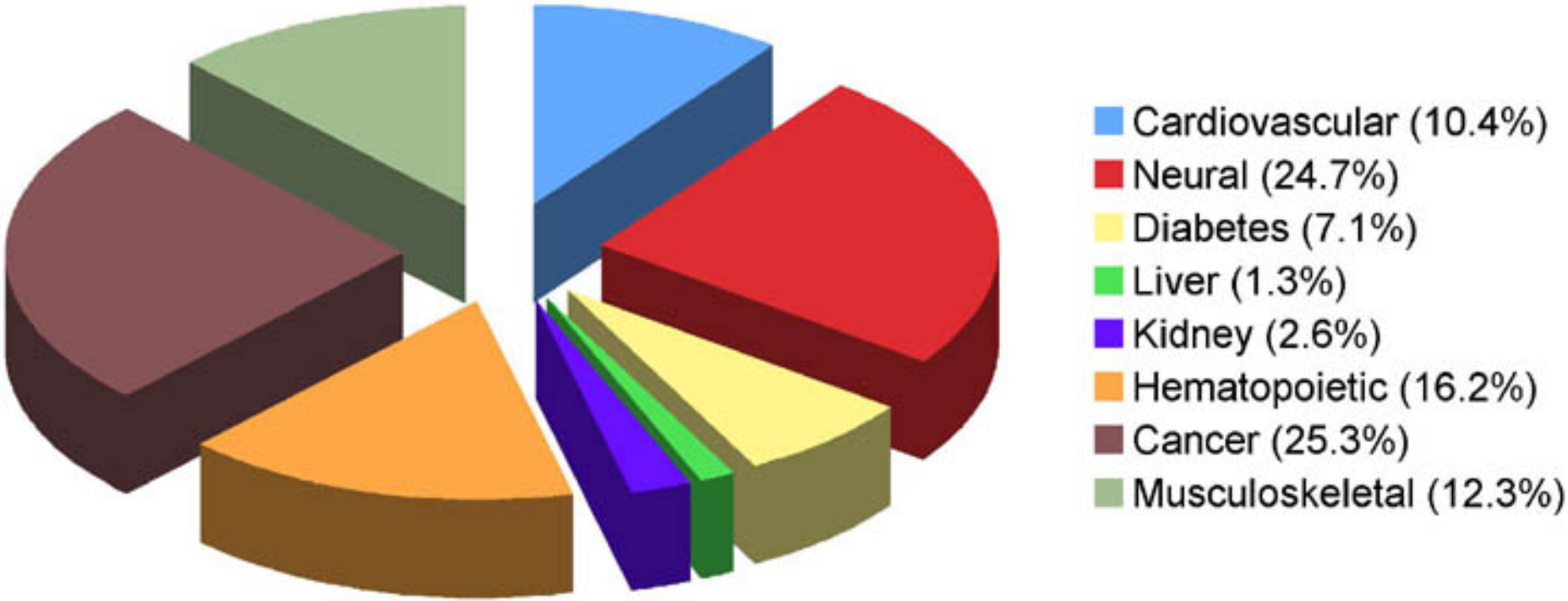
Muscular dystrophy

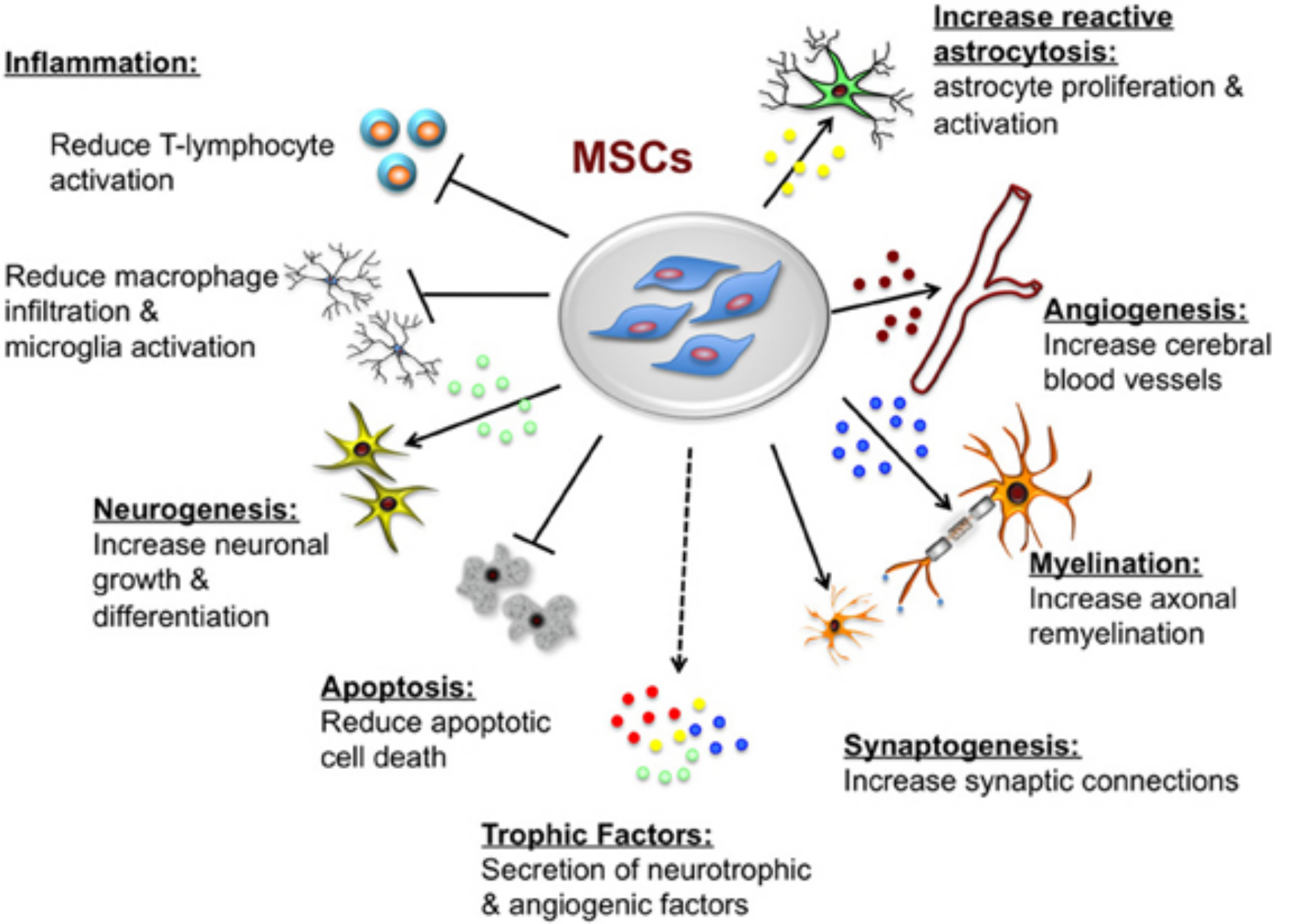
Diabetes

Crohn's disease

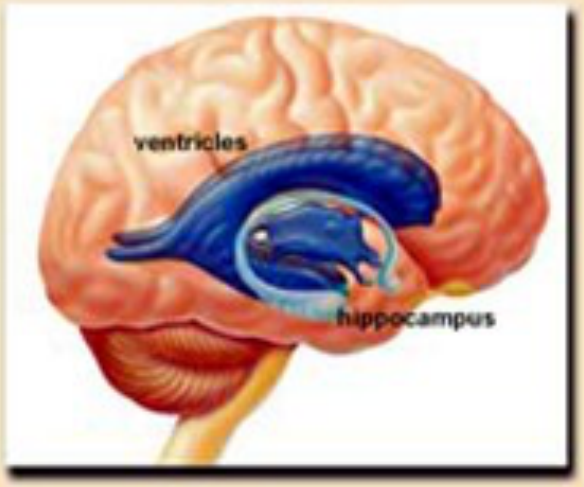
Multiple sites:
Cancers

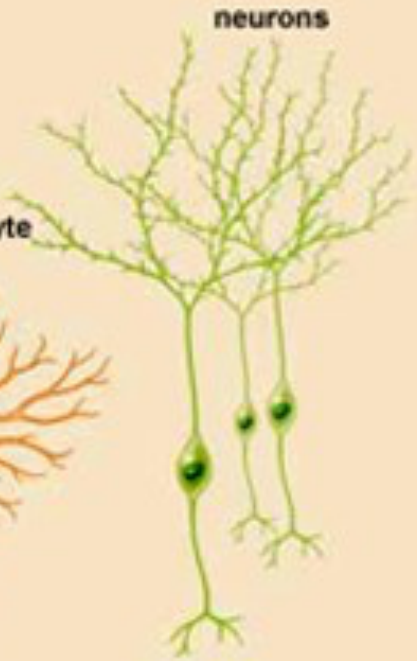
Disease Focus of NYS Stem Cell Research



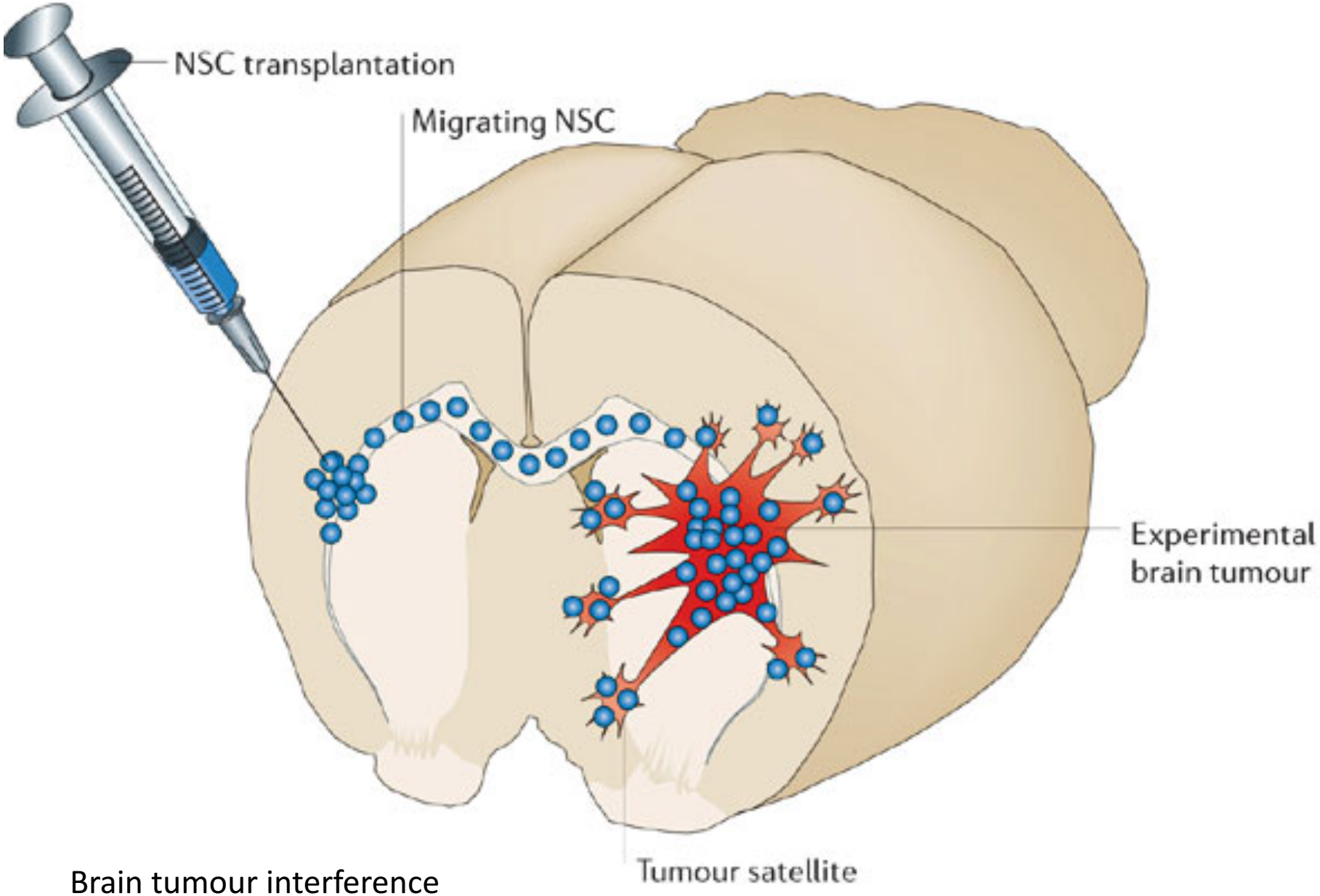

Inflammation:
Reduce T-lymphocyte activation
Reduce macrophage infiltration & microglia activation
MSCs
Increase reactive astrocytosis:
astrocyte proliferation & activation
Angiogenesis:
Increase cerebral blood vessels
Neurogenesis:
Increase neuronal growth & differentiation
Myelination:
Increase axonal remyelination
Apoptosis:
Reduce apoptotic cell death
Synaptogenesis:
Increase synaptic connections
Trophic Factors:
Secretion of neurotrophic & angiogenic factors

Neural stem cells arise in the ventricles (dark blue) & the hippocmapus (light blue). They give rise to other stem cells & neural precursors, that give rise to neurons or glial support cells as astrocytes & oligo-dendrocytes. The stem cell must migrate to differentiate & only 50% do, the others dying.

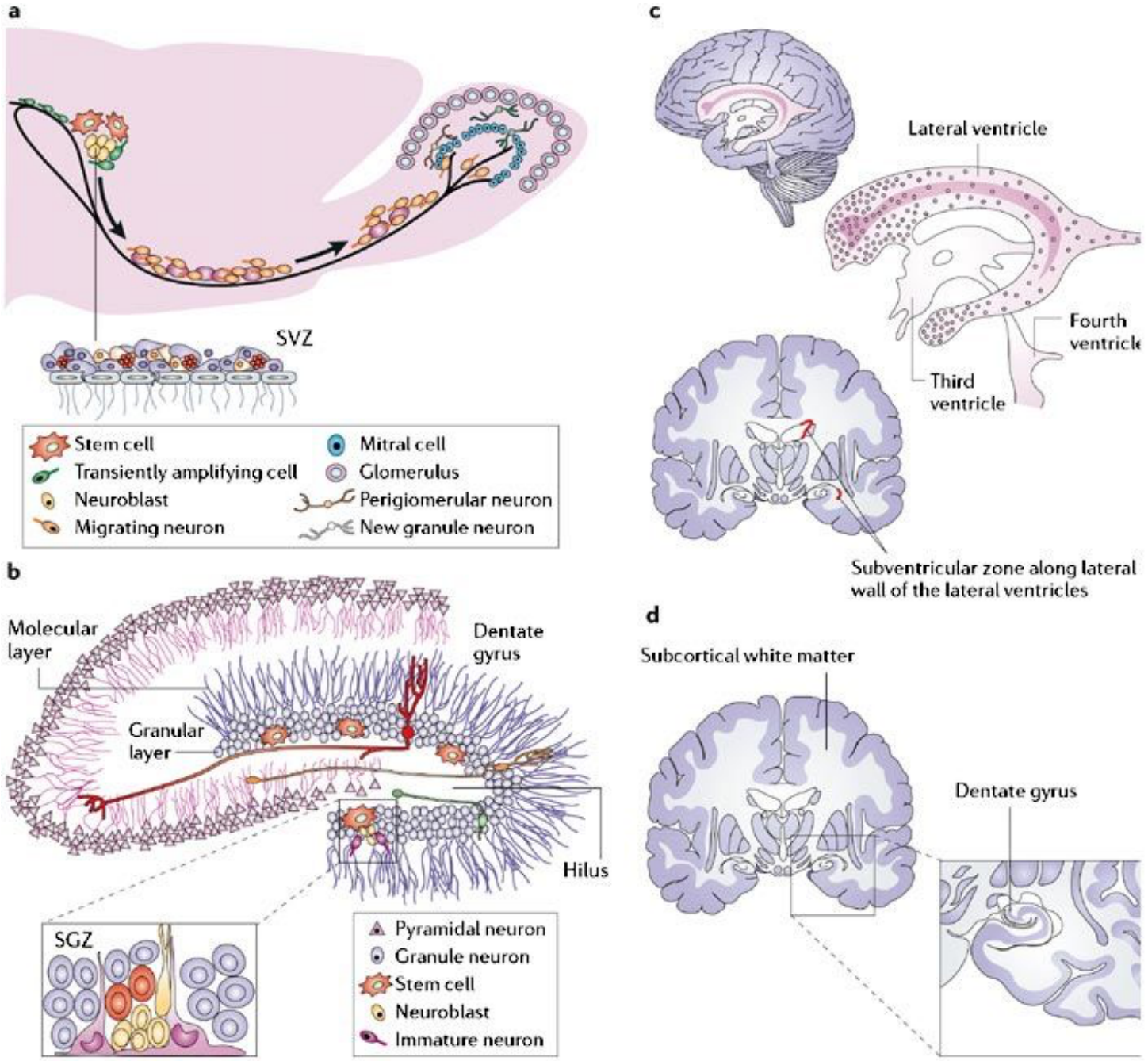


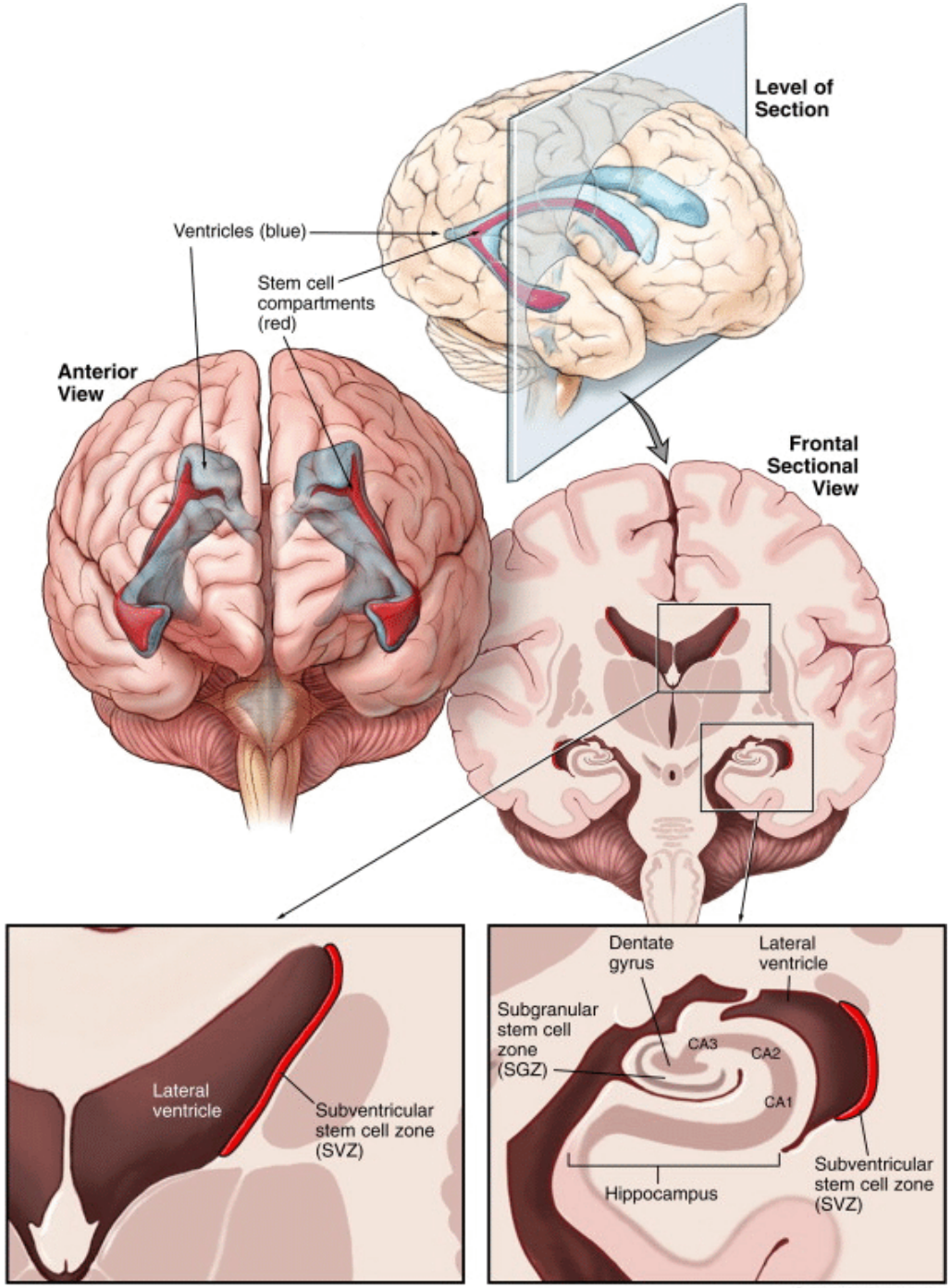


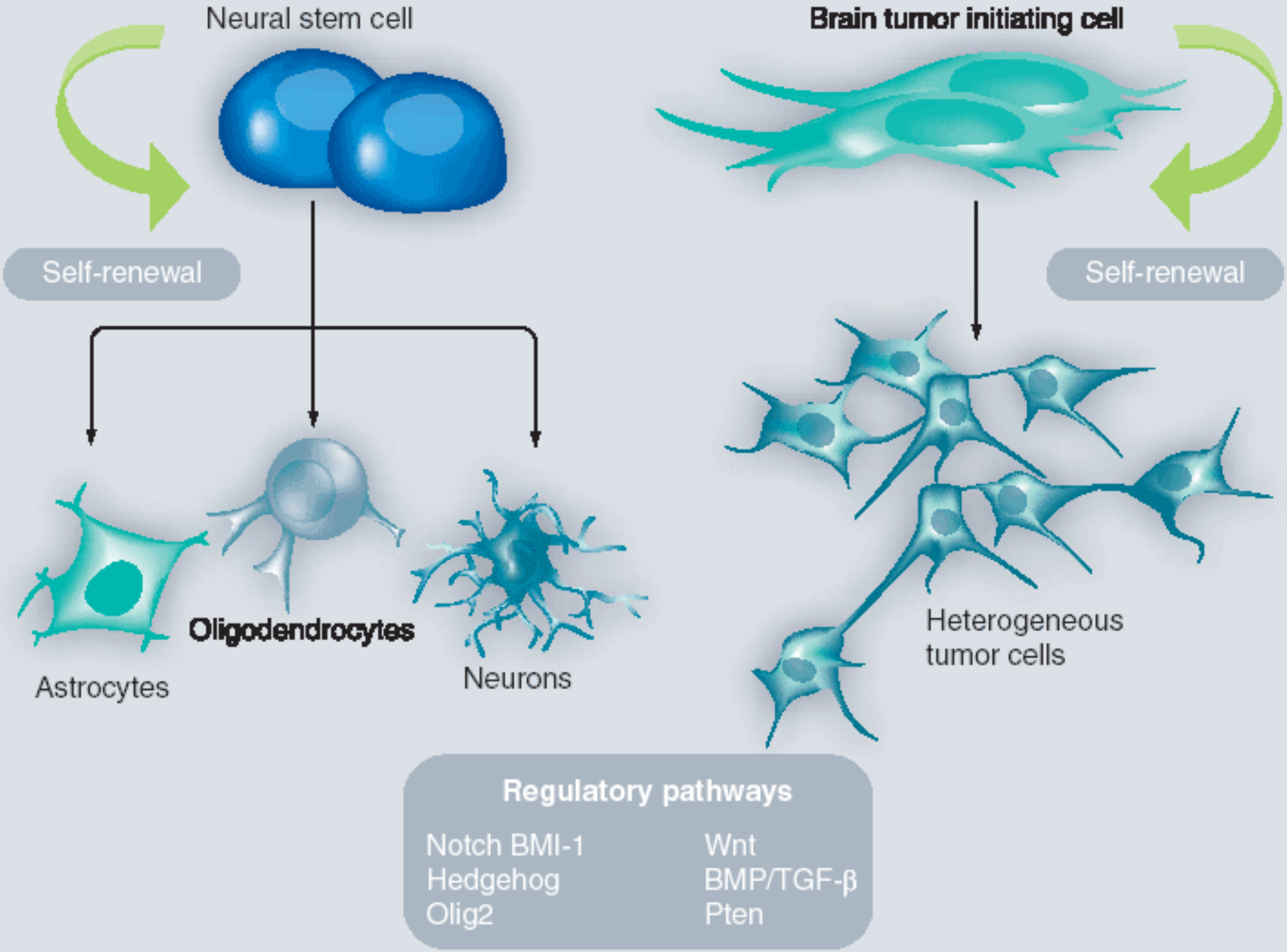
- Neural stem cells from the central nervous system give rise to neurons and the myelin-producing and support cells, oligodendrocytes and astrocytes,



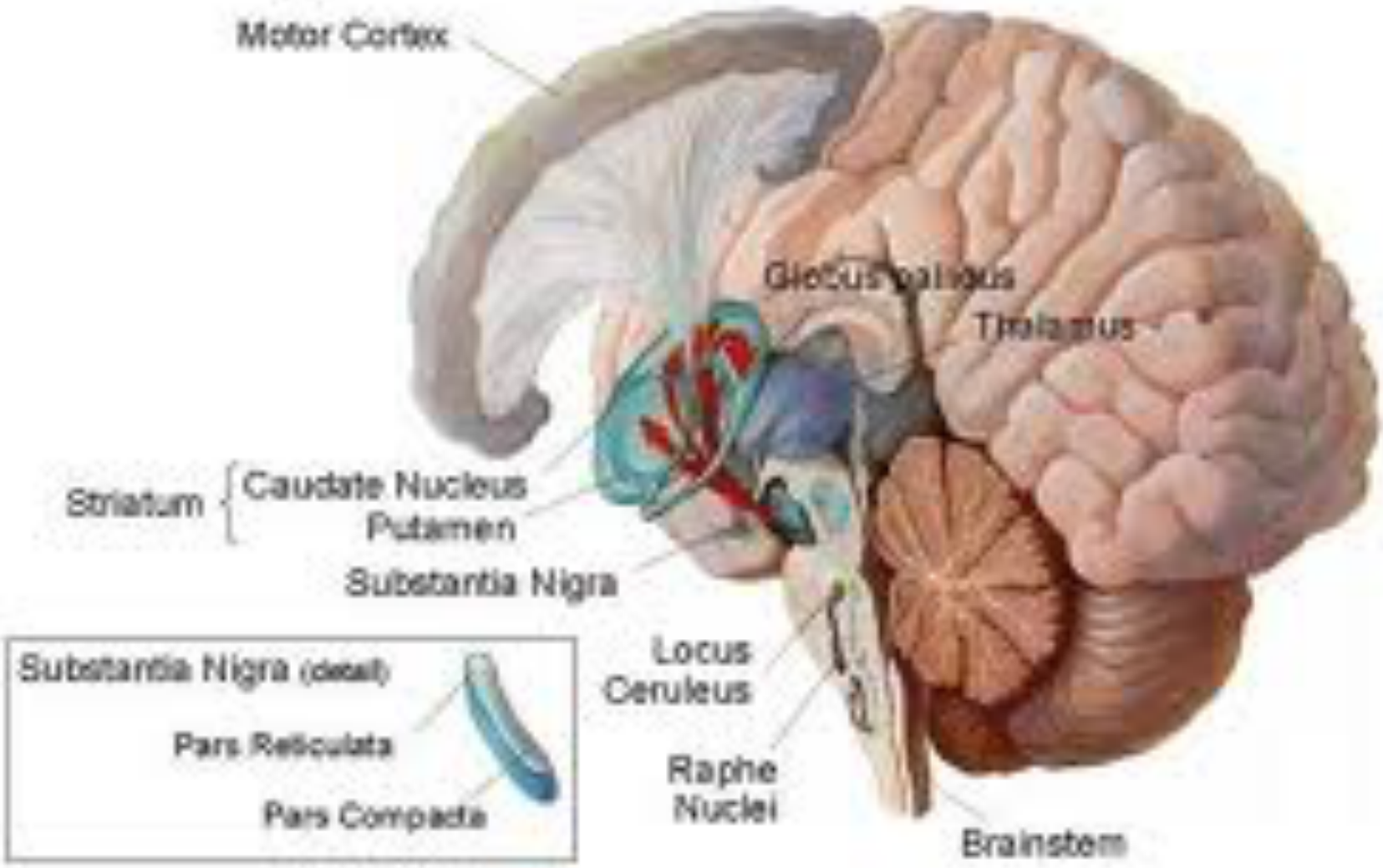
Brain tumour interference

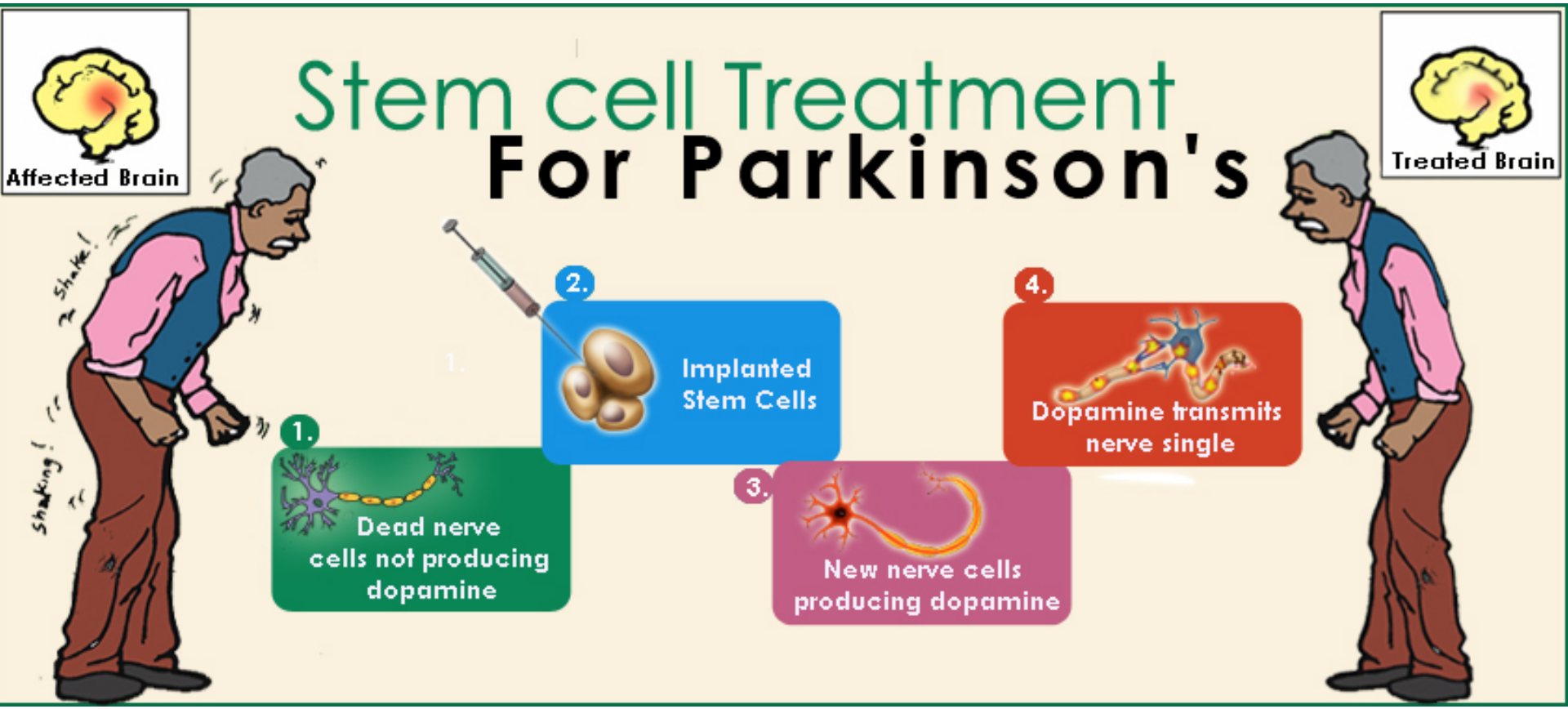

a
SVZ
Stem cell
Transiently amplifying cell
Neuroblast
Migrating neuron
Mitral cell
Glomerulus
Perigiomerular neuron
New granule neuron
b
Molecular layer
Granular layer
Dentate gyrus
Hilus
SGZ
Pyramidal neuron
Granule neuron
Stem cell
Neuroblast
Immature neuron
c
Lateral ventricle
Fourth ventricle
Third ventricle
Subventricular zone along lateral wall of the lateral ventricles
d
Subcortical white matter
Dentate gyrus




Neural stem cell
Brain tumor initiating cell
Self-renewal
Self-renewal
Oligodendrocytes
Astrocytes
Neurons
Heterogeneous tumor cells
Regulatory pathways
Notch BMI-1
Hedgehog
Olig2
Wnt
BMP/TGF-β
Pten

Brain Regions Affected by Parkinson's Disease




Affected Brain
Stem cell Treatment
For Parkinson's
Treated Brain
1.
Dead nerve cells not producing dopamine
2.
Implanted Stem Cells
3.
New nerve cells producing dopamine
4.
Dopamine transmits nerve single

Stem cells with Parkinson's Disease

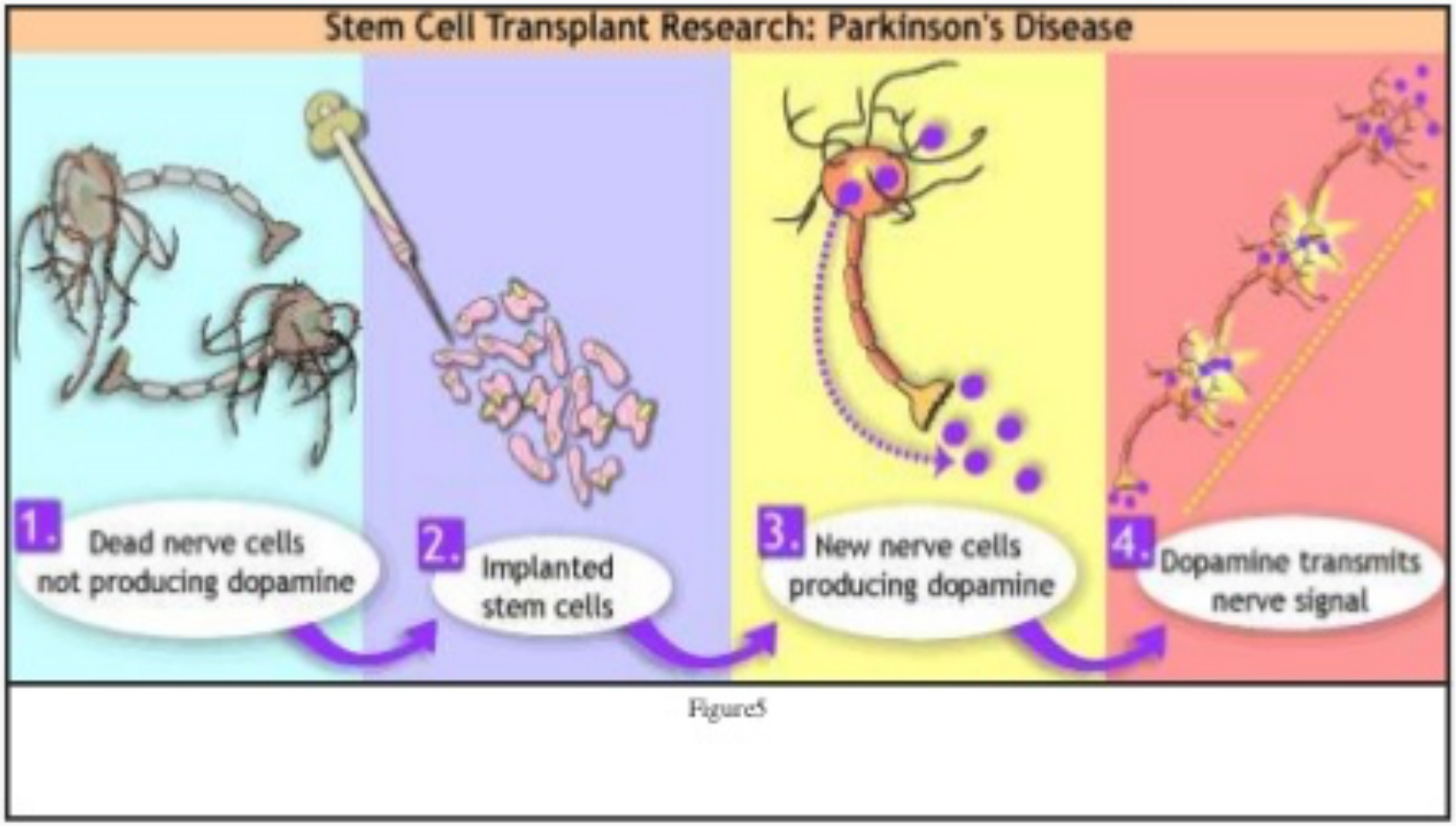
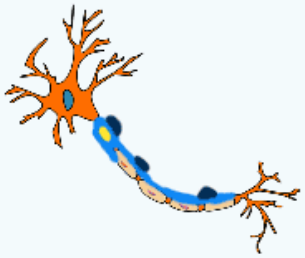


Figure5

How Stem Cells Help in Parkinson's

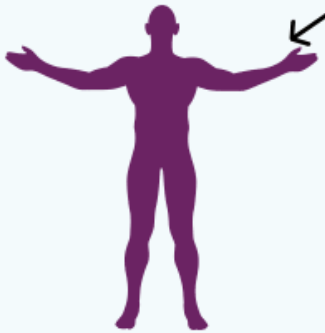


Damaged Nerve Cells Fail to Make Dopamine

Infusion of Stem Cells

Nerve Cells Produce Dopamine

Transmission of Signals Begins



Regain Control Over Yourself

MEDICALTOURISMCO.COM GIOSTAR

Dealing with deadly degeneration

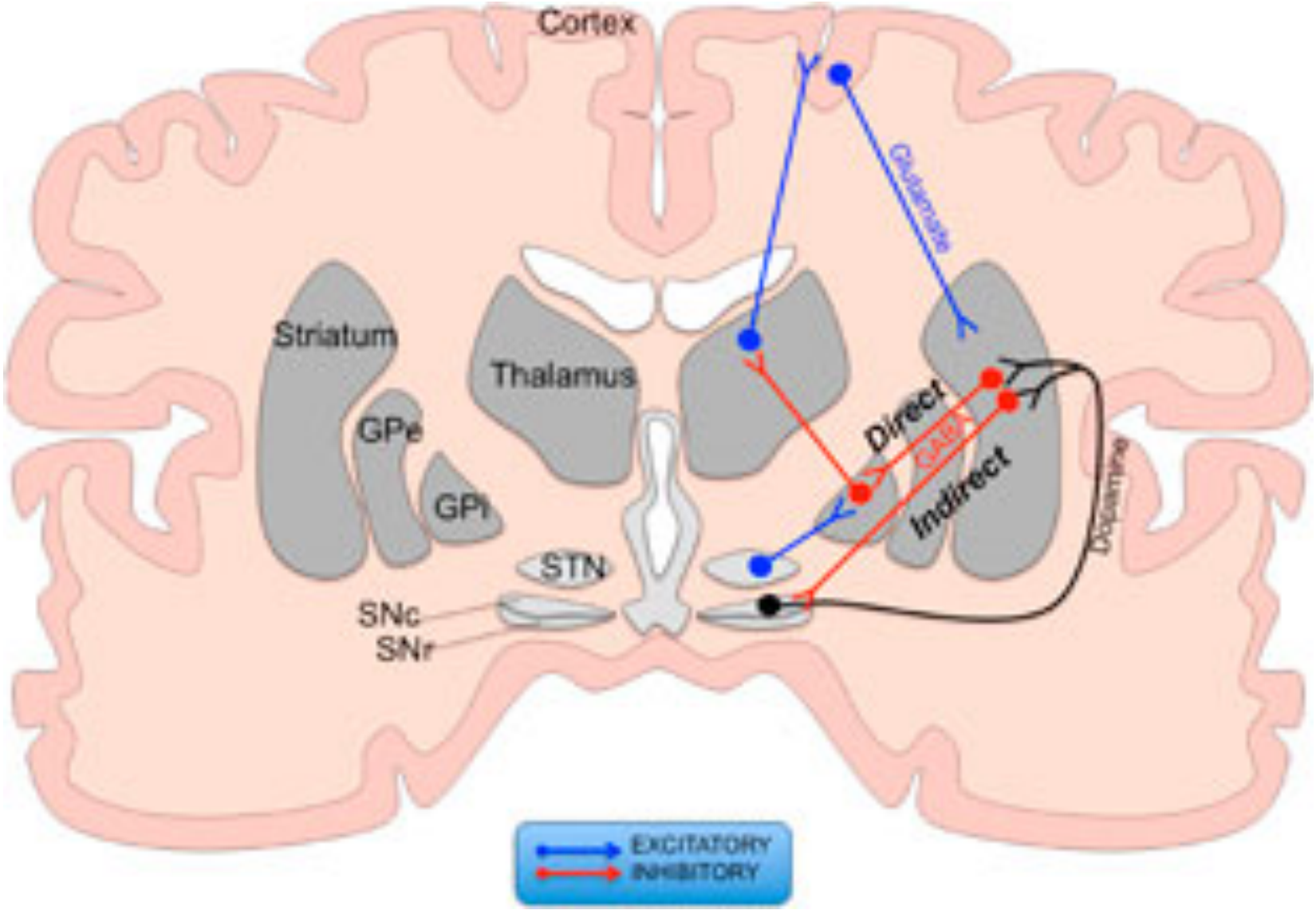
No specific cause pinned down for Parkinson's yet, but doctors list factors responsible and how the disease can be managed

Parkinson's Disease, which afflicts about 1 lakh people in India, is usually detected in those aged above 50. But, at times, it can affect young adults too

Genetic and environmental factors are believed to contribute to degeneration of brain cells that maintain body movements. There is no particular test to detect the disease, with only physical symptoms helping doctors in making the diagnosis

Manage the disease with

- Physical and speech therapy, stretching, strength and balance training to improve gait
- Specific voice training to treat voice- and speech-related disorders
- High-fibre diet in cases of constipation
- Walking and yoga


Cortex
Striatum
Thalamus
GPe
GPi
STN
SNc
SNr
Glutamate
Direct
GABA
Indirect
Dopamine
EXCITATORY
INHIBITORY

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One can call on 0124-4855055 and members of support group Swavlamban will provide guidance on how to identify symptoms and go about getting diagnosed and seeking treatment

Parkinson's Disease and Movement Disorder Society, which can be reached at 9987216057 or www.parkinsonssocietyindia.com also provides help in dealing with the disease

Symptoms

- Being slow while doing daily activities; shaking of lips, hands, arms and legs
- Slurred speech, slowness in thinking/answering questions
- Rigidity, like feet getting stuck, and inability to walk
- Trouble balancing, tremors, uncontrolled body movements and lack of coordination
- In some cases, loss of sense of smell and depression

Ravi Jadhav

Manage the disease with

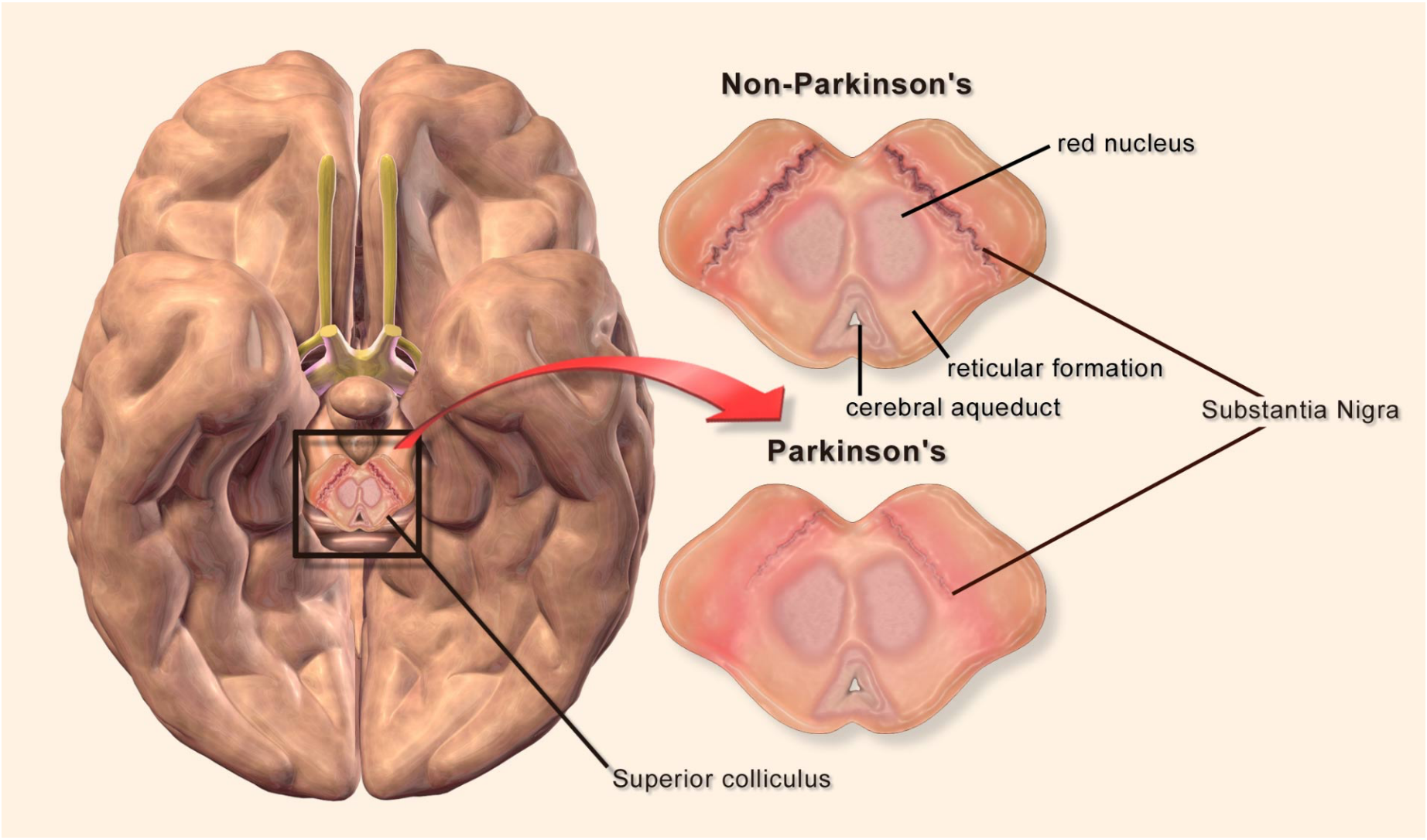
- Physical and speech therapy, stretching, strength and balance training to improve gait
- Specific voice training to treat voice- and speech-related disorders
- High-fibre diet in cases of constipation
- Walking and yoga
- Deep brain stimulation surgery or brain pacemaker for chronic cases
- Keeping stress levels low (stress is known to worsen the disease)

Factors responsible

The specific cause is yet to be pinned down. In some cases, however, it could be due to genetic factors

Aging is a huge risk factor that increases chances of Parkinson's Disease

Other risk factors include head trauma, exposure to pesticides, working in farms and exposure to metals, like manganese and iron. The disease is more common in men than women


Non-Parkinson's
red nucleus
reticular formation
cerebral aqueduct
Substantia Nigra
Parkinson's
Superior colliculus

Brain Stem Cells Help Bring back feelings for Paralyzed

Regen Center September 5, 2012 Blog, Neural Stem Cells 1 Comment

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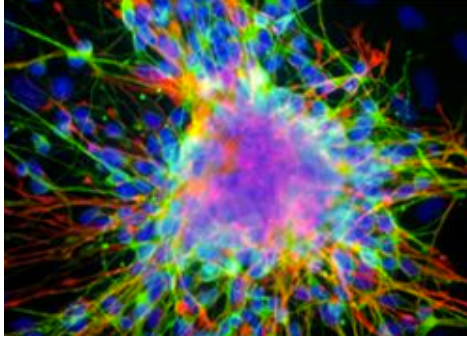
S.

Damaged spinal cord

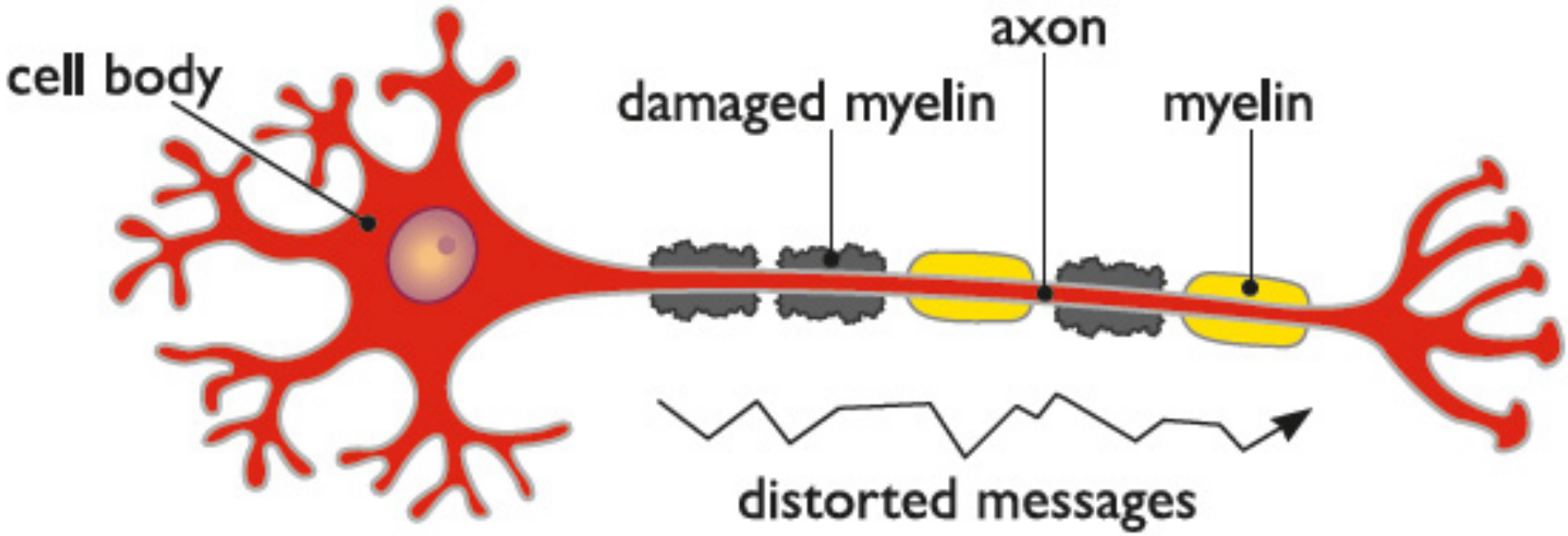


For the very first time, individuals with damaged spinal cords have actually regained sensation in previously paralyzed locations
after getting treatments of neural stem cells.
3 individuals with paralysis got treatments
of 20 million neural stem cells straight into the damaged area of their spinal cord.
The cells, obtained from given away fetal brain tissue, were injected between 4 and eight months after the injuries occurred.
The patients additionally obtained a short-term course of immunosuppressive medications to restrict turndown of the cell.

Stem cell transplants may be effective for people with severe cases of multiple sclerosis (MS),

- according to a study published in the February 11, 2015, online issue of Neurology®, the medical journal of the American Academy of Neurology.
- In MS, the body's immune system attacks its own central nervous system. In this phase II study, all of the participants received medications to suppress immune system activity. Then 12 of the participants received the MS drug mitoxantrone, which reduces immune system activity. For the other nine participants, stem cells were harvested from their bone marrow. After the immune system was suppressed, the stem cells were reintroduced through a vein. Over time, the cells migrate to the bone marrow and produce new cells that become immune cells. The participants were followed for up to four years.
- "This process appears to reset the immune system," said study author Giovanni Mancardi, MD, of the University of Genova in Italy. "With these results, we can speculate that stem cell treatment may profoundly affect the course of the disease."

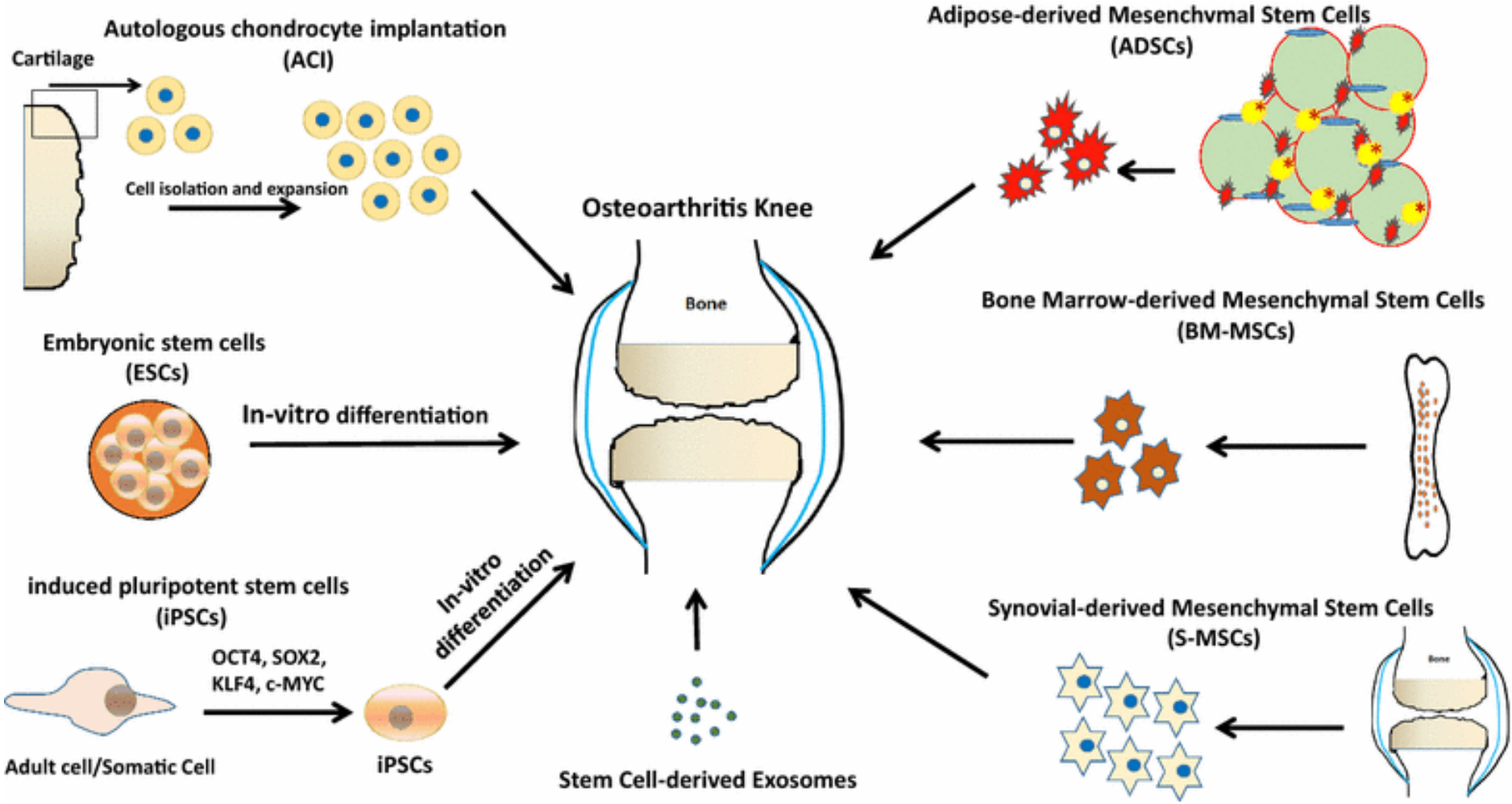
Damaged Neuron in MS



Chances in MS

- No approved stem cell treatments for MS but there are various approaches being tested in clinical trials.
- Multiple sclerosis (MS) is thought to be an immune-mediated disease, most likely auto-immune, in which the immune system attacks the *oligodendrocytes,* causing damage to the myelin sheath. This damage interferes with the neurons' ability to function properly and with time, results in direct damage to the neurons, resulting in permanent disability.

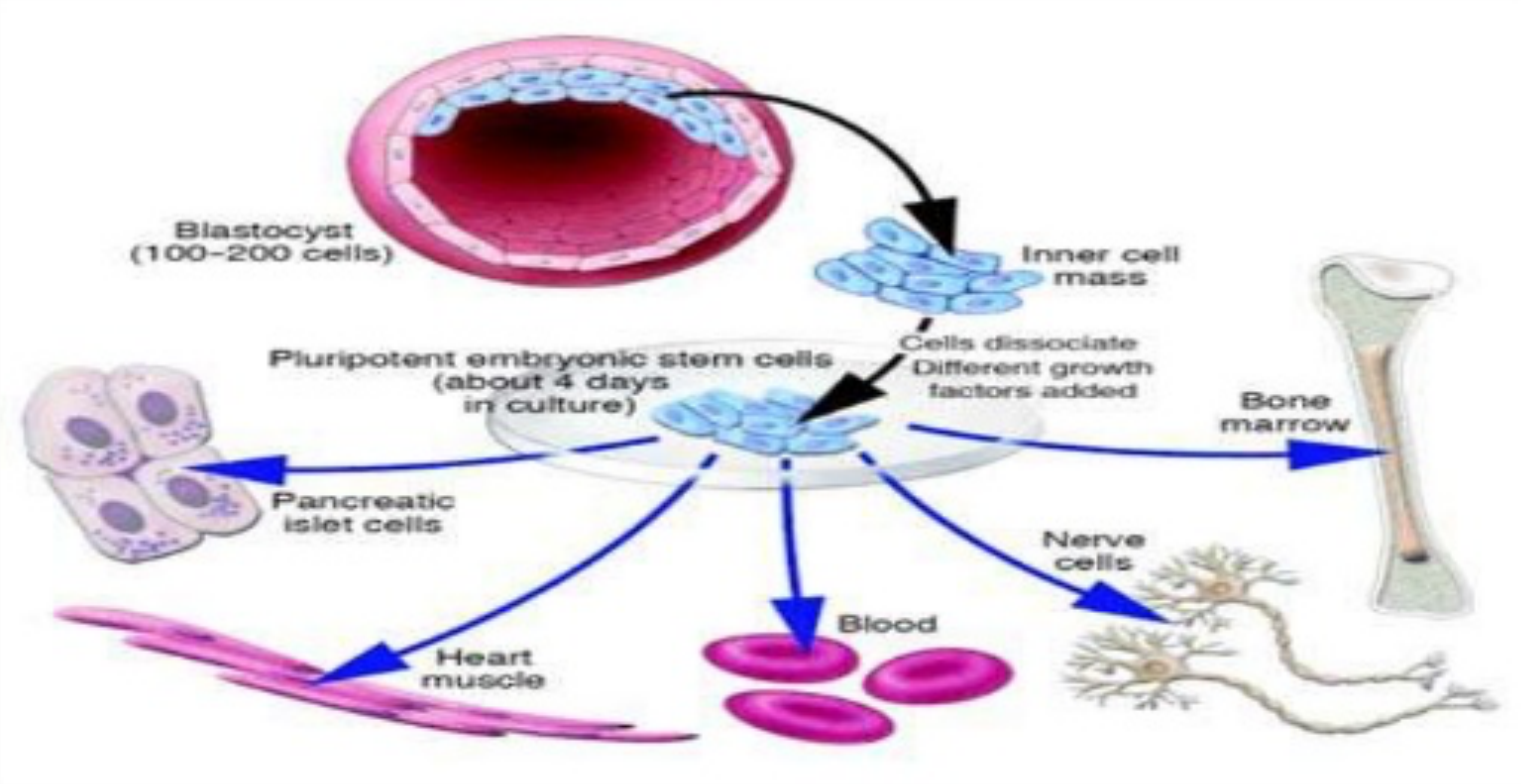
Osteoarthritis

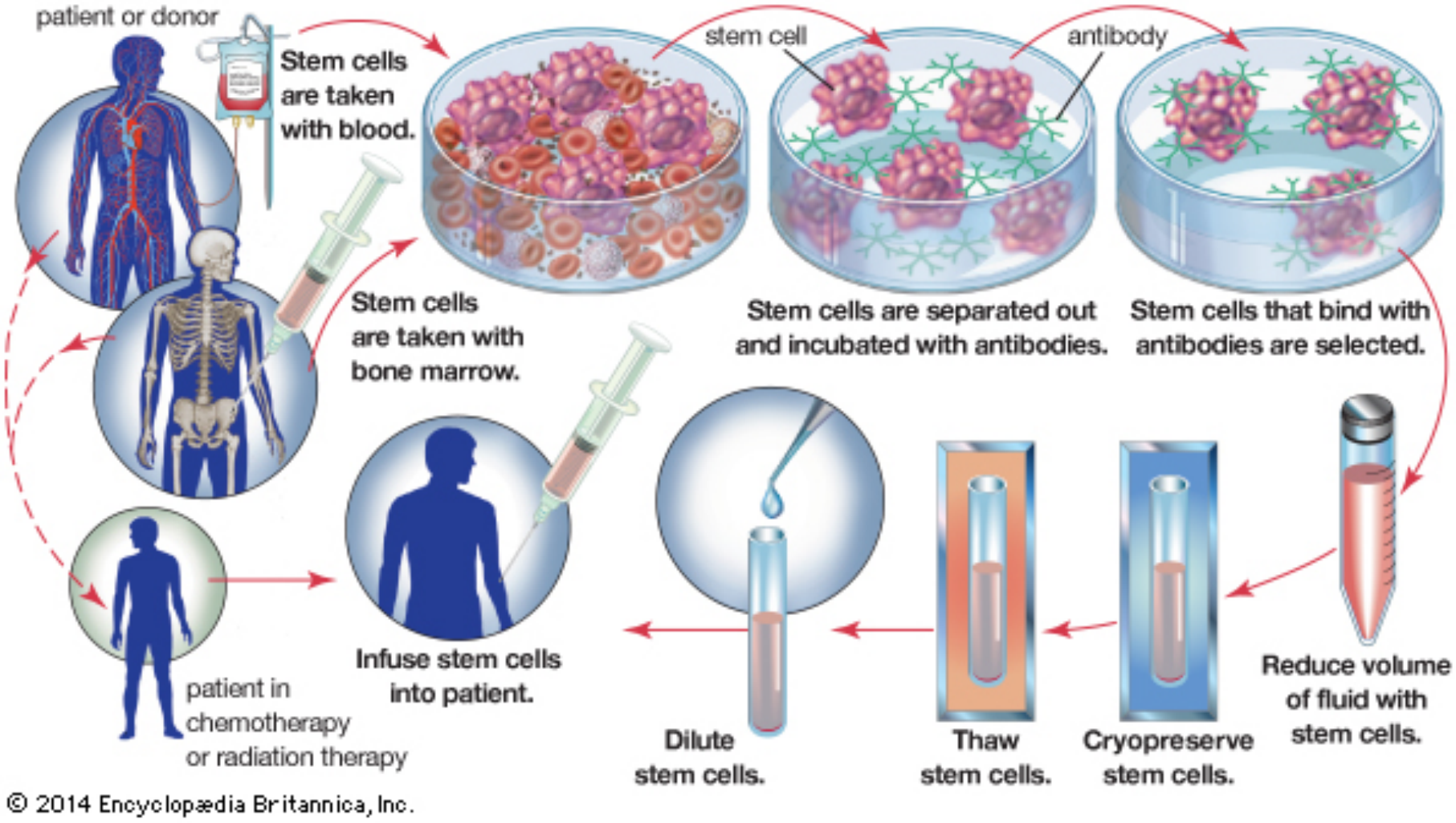


Bone marrow transplant

- Bone marrow transplantation (BMT) or hematopoietic stem cell transplantation (HSCT) is a medical procedure in the field of hematology and oncology that involves transplantation of hematopoietic stem cells (HSC).
- It is most often performed for people with diseases of the blood or bone marrow, or certain types of cancer.

Differentiation pathways of adult stem cells

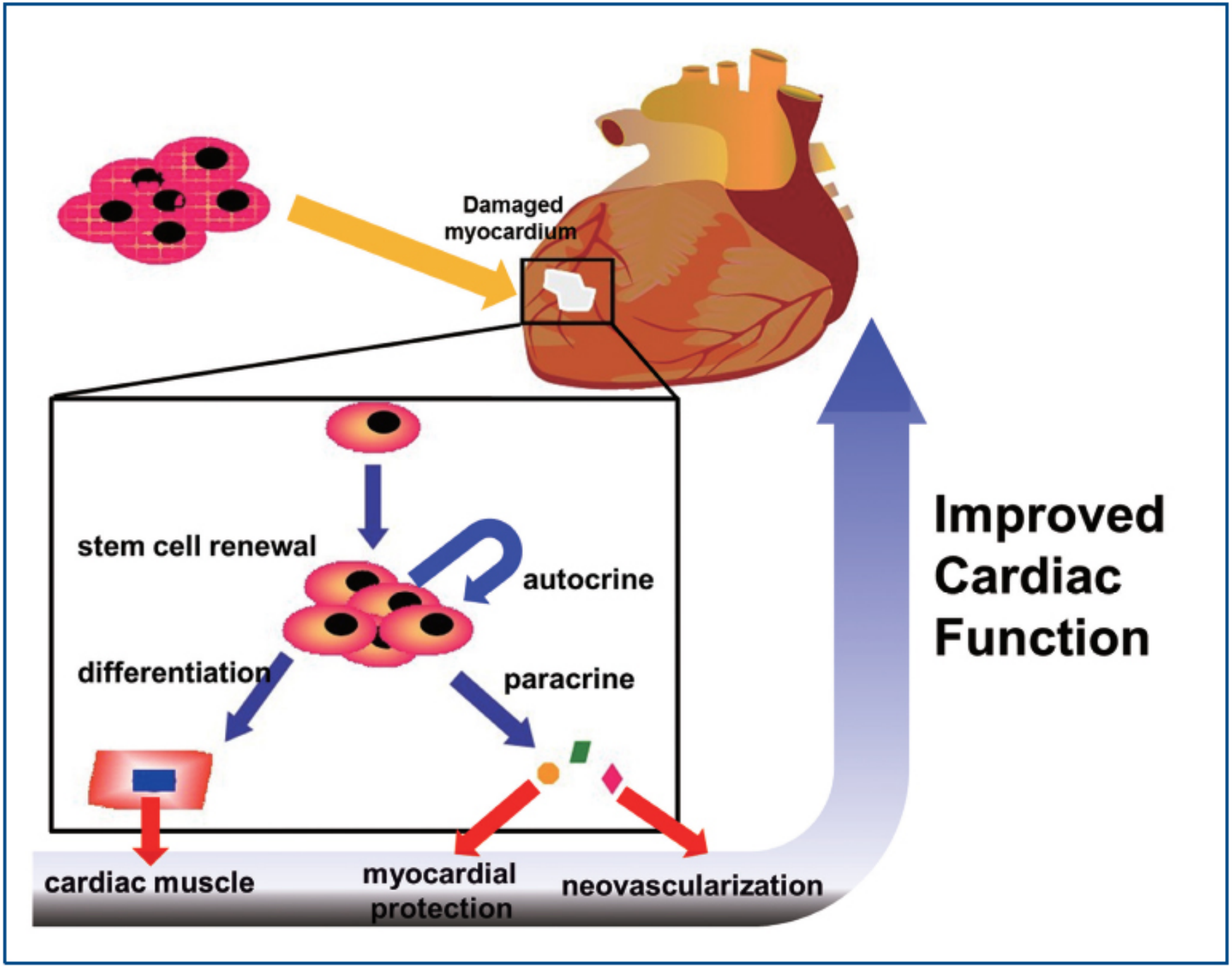




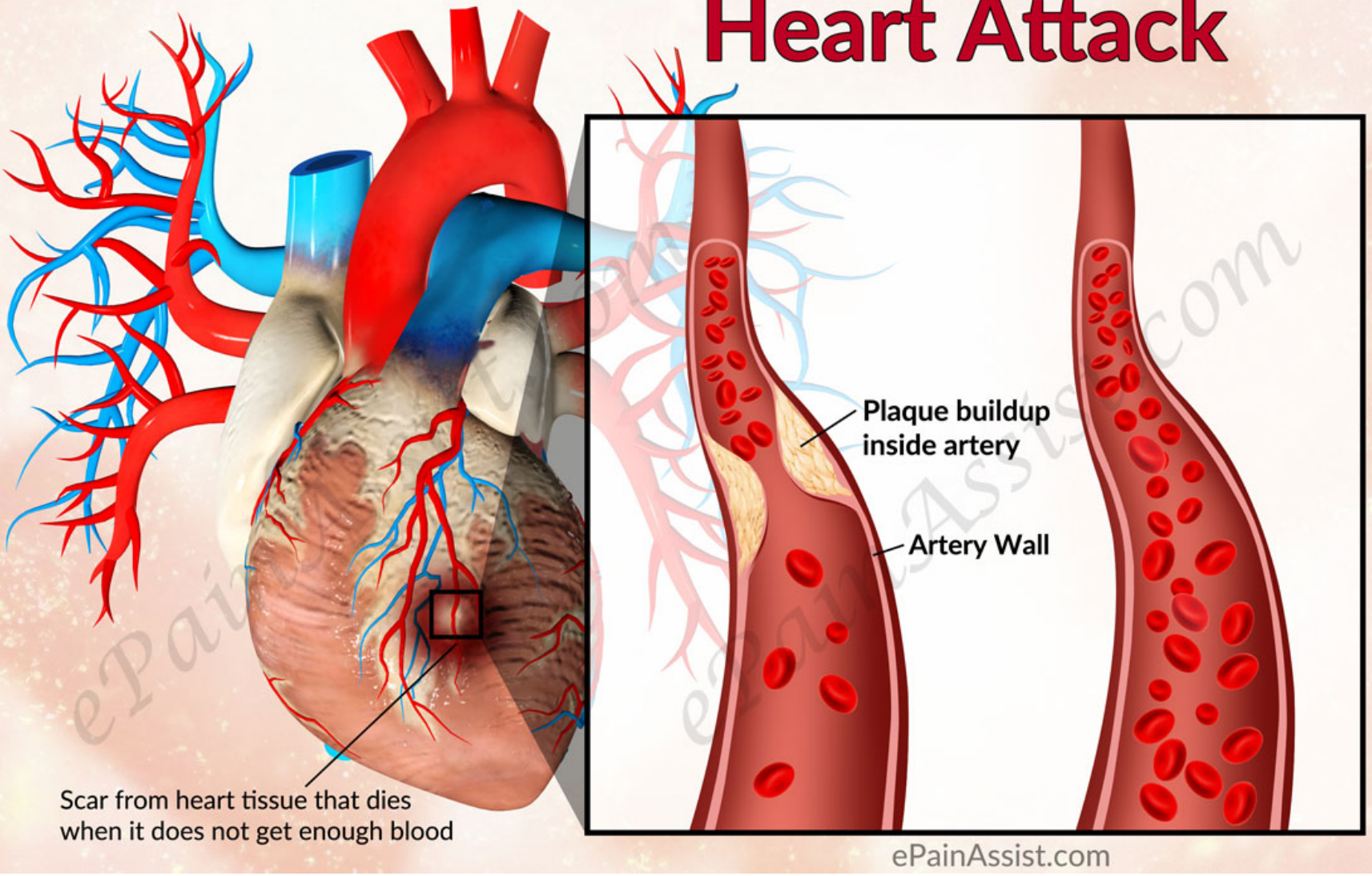
HEART

What are the potential benefits of stem cell research?

- The National Institutes of Health indicates that approximately 1.1 million Americans suffer a heart attack each year, and together cardiovascular diseases and cancers are the top two causes of death according to the CDC, with each killing over half a million Americans each year. Regenerative medicine holds the promise of new ways to repair cardiovascular damage and of improved cancer treatment. Moreover, there are many other diseases and afflictions that stand to be positively impacted by stem cell research including: stroke, respiratory disease, diabetes (respectively 3, 4 and 7 on the CDC list of causes of death), neurological disorders, spinal cord injuries, and some birth defects.
- Potential benefits of stem cell research are numerous and range from development and testing of new drugs to cell-based therapies in which stem cells are used to replace ailing or destroyed tissue or cells. However, there are many technical hurdles between the promise of stem cells and the realization of these uses, which will only be overcome by continued intensive stem cell research.


Damaged
myocardium
stem cell renewal
autocrine
differentiation
paracrine
cardiac muscle
myocardial
protection
neovascularization
Improved
Cardiac
Function

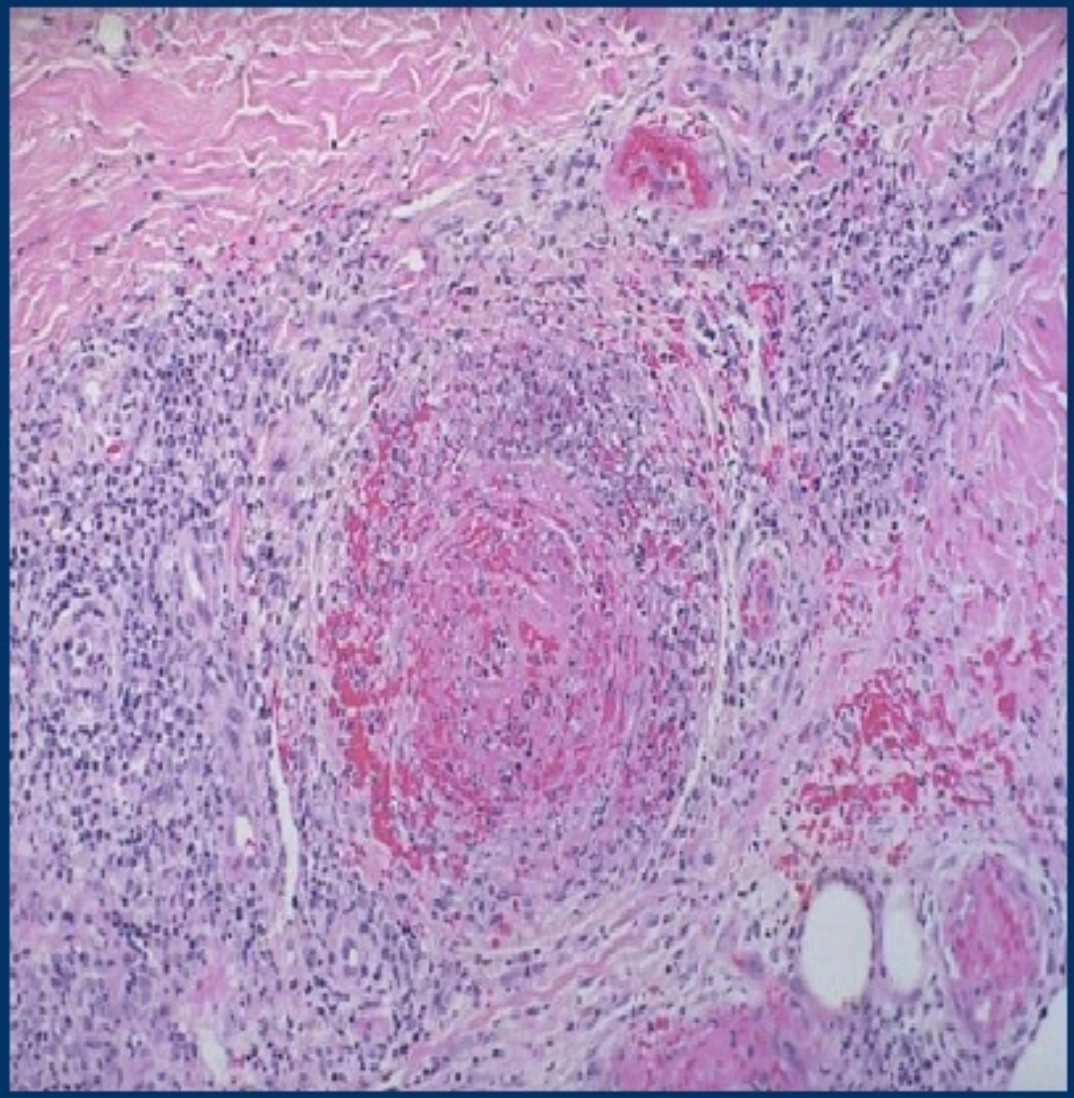
Heart Attack



Myocardial Infarction–Survival

- Factors affecting survival:
  - Size of infarct
  - Age of patient
  - Complications
  - Other diseases
- Mortality rates: 6% for small infarcts without heart failure to ≥ 50% for large infarcts with severe heart failure
- 90% of hospitalized patients survive
- Causes of death following MI: arrhythmia, heart failure, cardiac rupture

COAGULATION NECROSIS



A photomicrograph of the heart in a patient with an acute myocardial infarction.

In the center, the deeply eosinophillic necrotic cells have lost their nuclei.

The necrotic focus is surrounded by paler-staining, viable cardiac myocytes.

Infarct extension

Necrosis
Apoptosis
Arrhythmogenicity

Very early (hours)

Infarct wound healing/ Infarct expansion

Myeloid cell recruitment
Necrotic tissue resorption
Extracellular matrix degradation
Granulation tissue formation
Neoangiogenesis
Collagen-based extracellular matrix formation

Early (hours–days)

Progressive cardiac remodelling

Scar formation
Reactive fibrosis
Myocyte hypertrophy
Left ventricular dilation
Cardiac dysfunction
Arrhythmogenicity
Heart failure

Late (weeks–months)

Molecular signaling

FGF-1, FGF-2, VEGF, insulin, IGF-1, IGF-2, CT-1, urocortin, TGF-β1, thymosin β4, G-CSF, EPO (refs. 5–7)

Cellular proliferation

miR-590, miR-199a (ref. 2)

Transdifferentiation

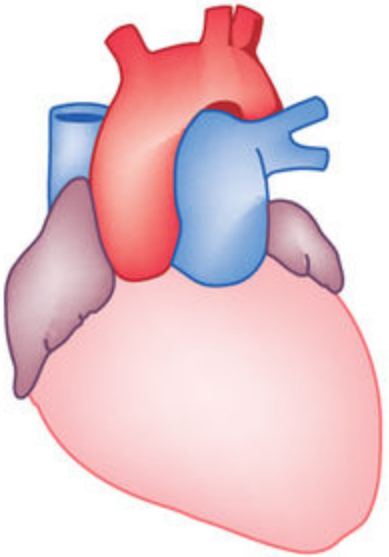
miR-1, miR-133, miR-208, miR499 (ref. 3)
GATA4, HAND2, MEF2C, TBX5 (ref. 9)
GATA4, MEF2C, TBX5 (ref. 10)

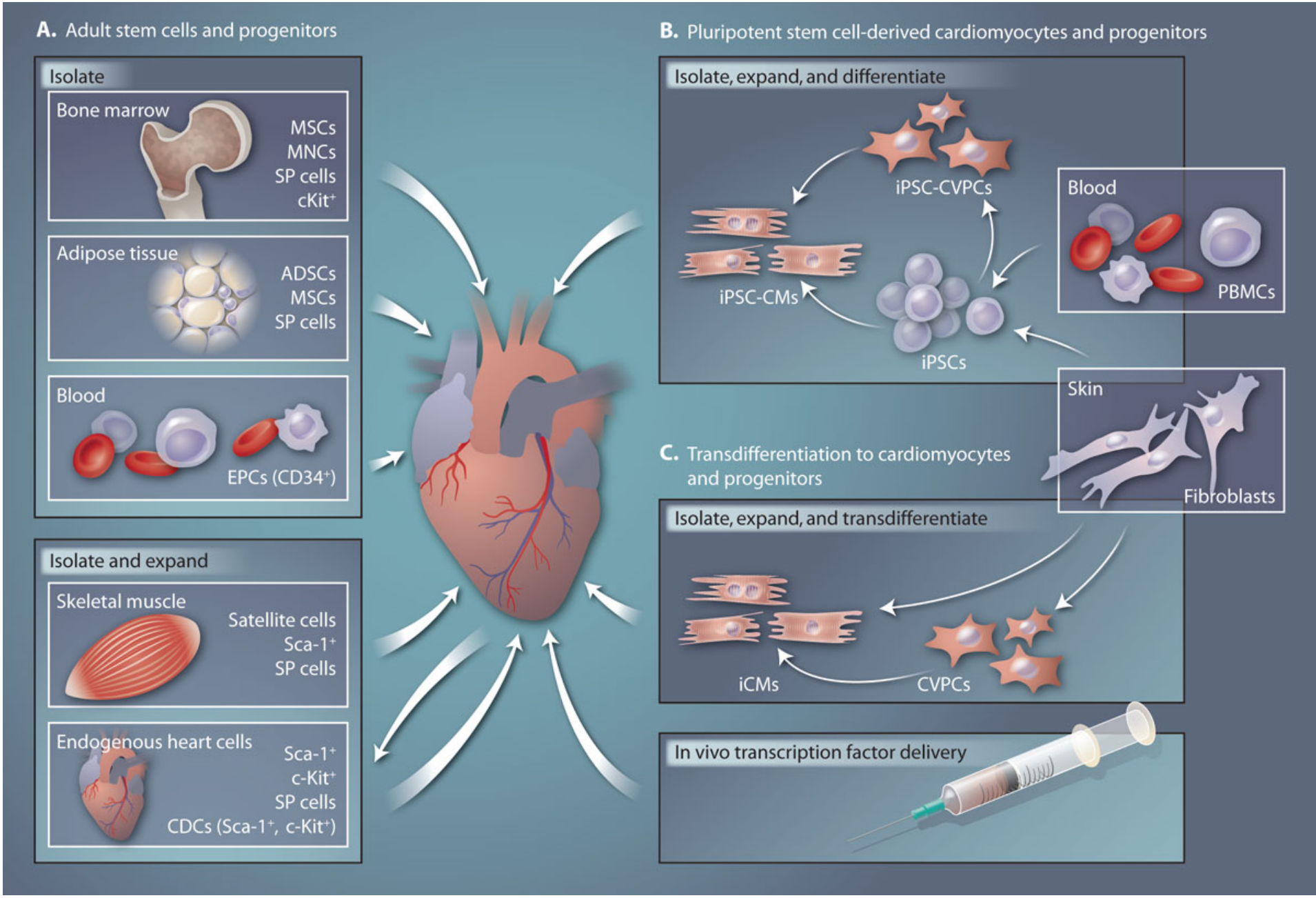
Effects on damaged region

Reduce MI size, enhance cell survival, reduce apoptosis, improve myocardial function

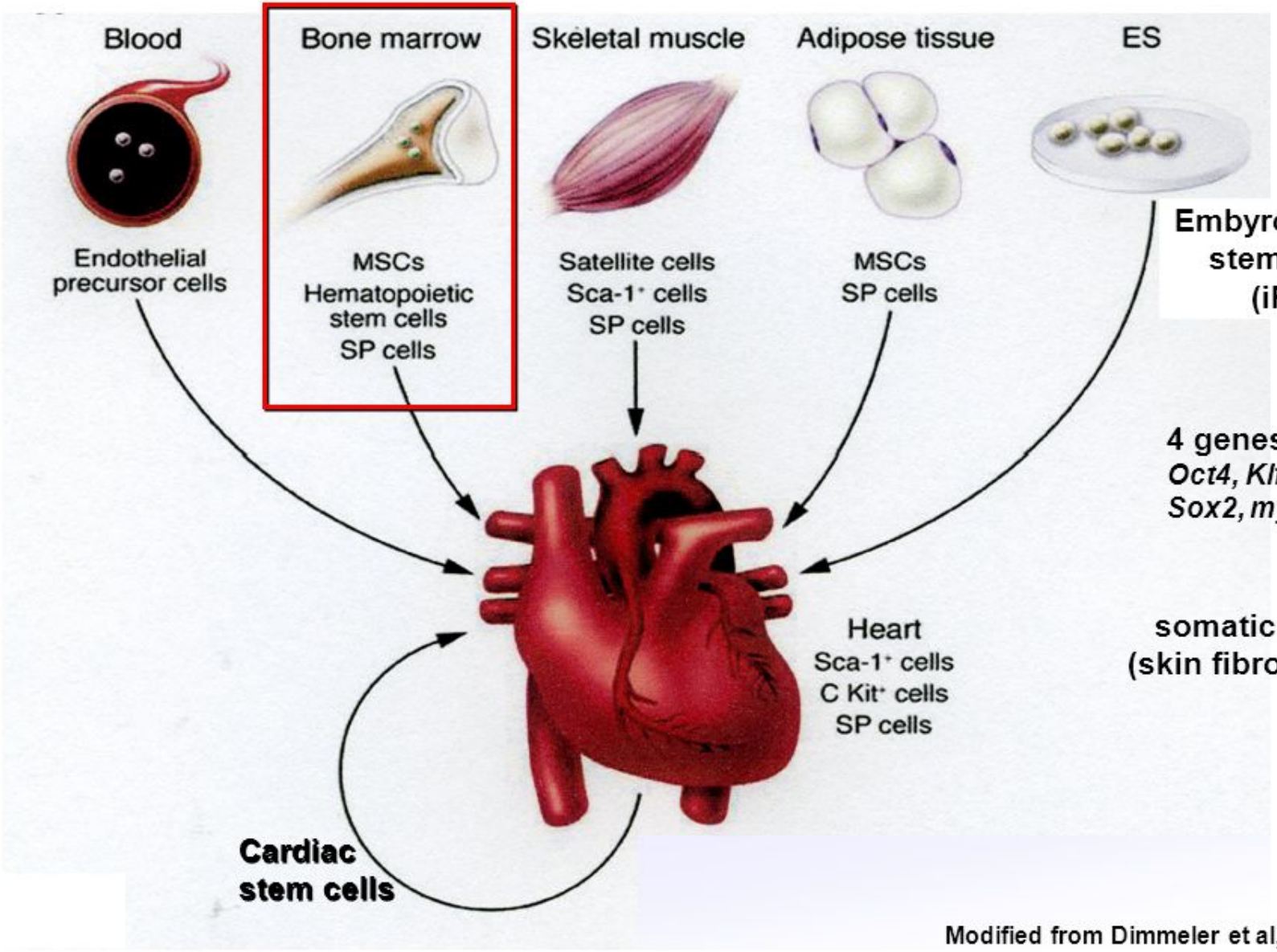
Promote cell cycle re-entry of adult cardiomyocytes

Conversion of cardiac fibroblasts to cardiomyocyte-like cells

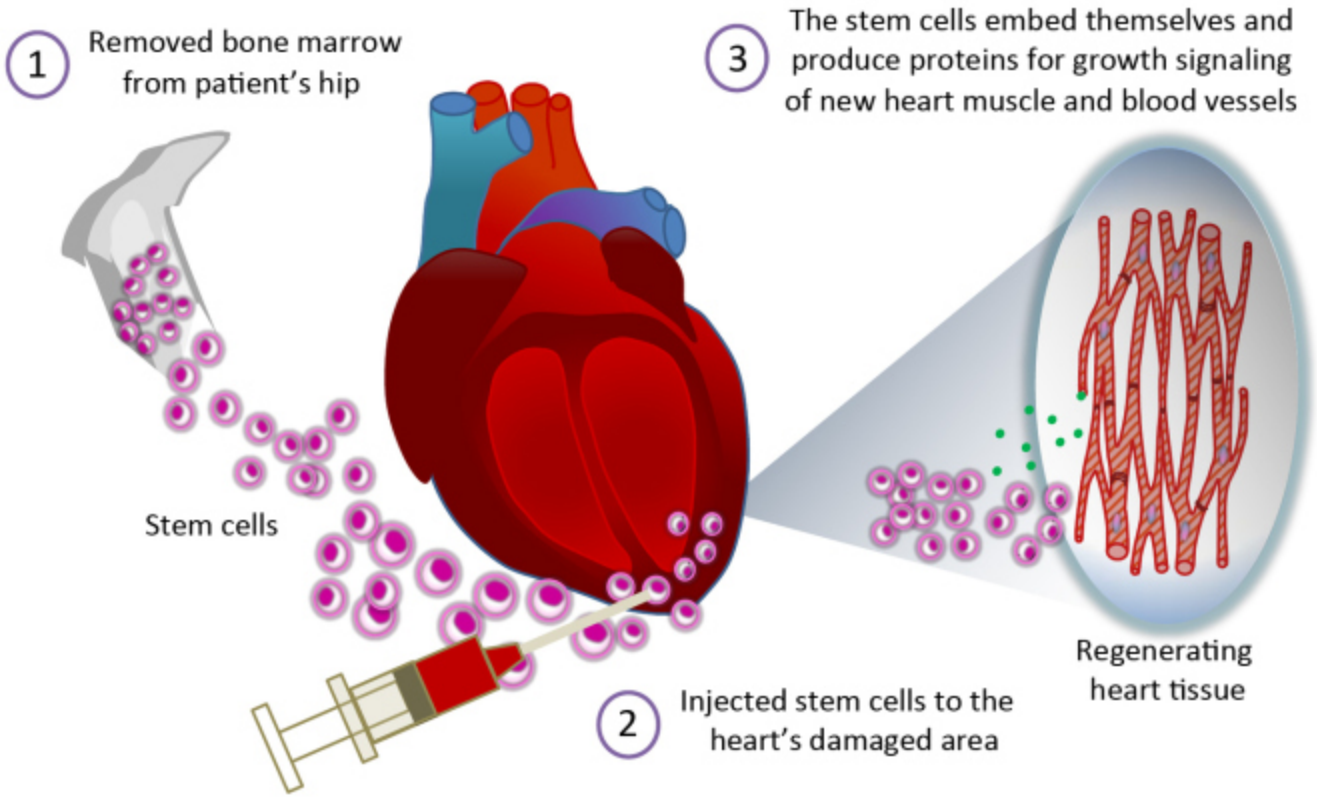


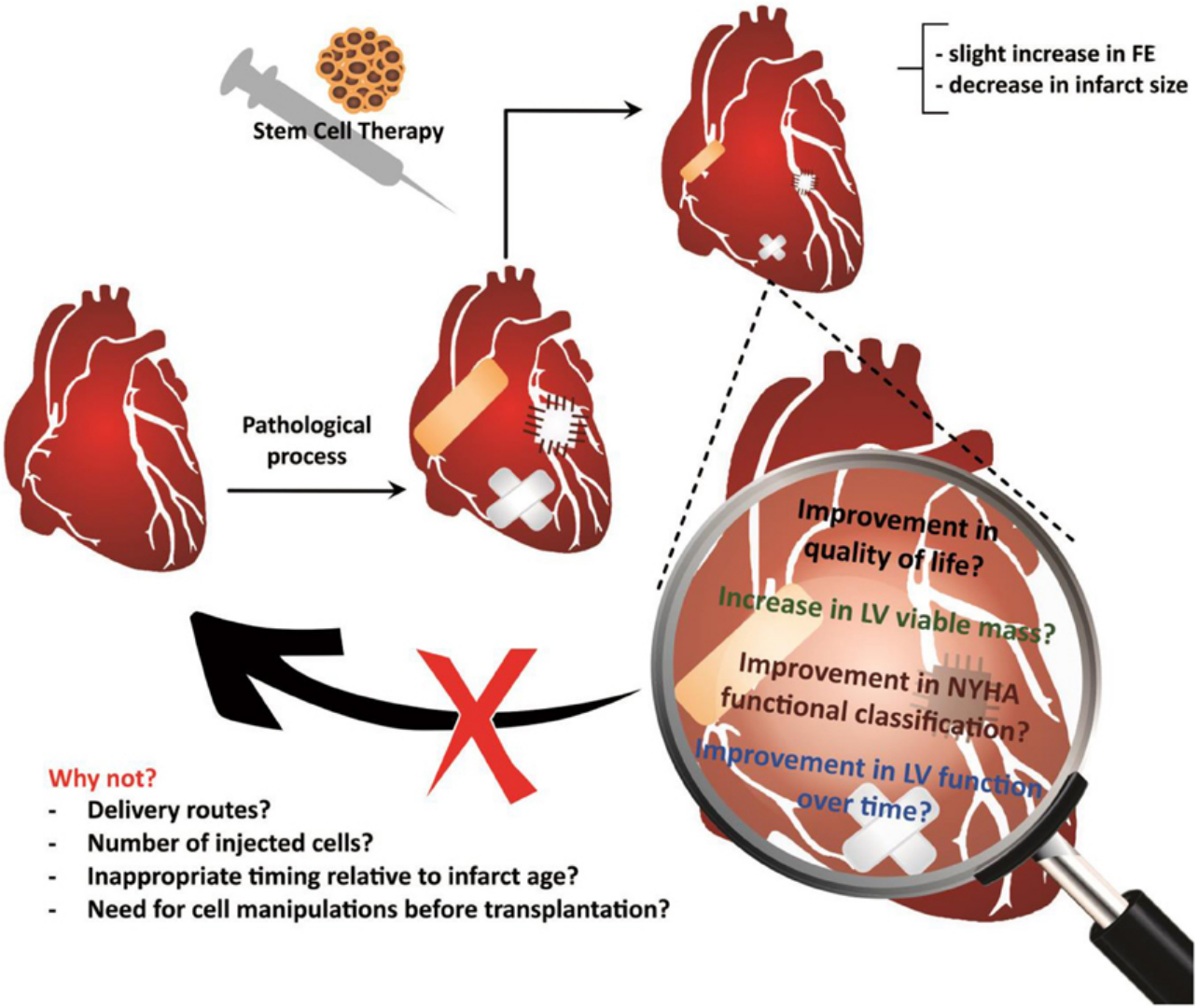

A. Adult stem cells and progenitors
Isolate
Bone marrow
MSCs
MNCs
SP cells
cKit+
Adipose tissue
ADSCs
MSCs
SP cells
Blood
EPCs (CD34+)
Isolate and expand
Skeletal muscle
Satellite cells
Sca-1+
SP cells
Endogenous heart cells
Sca-1+
c-Kit+
SP cells
CDCs (Sca-1+, c-Kit+)
B. Pluripotent stem cell-derived cardiomyocytes and progenitors
Isolate, expand, and differentiate
iPSC-CVPCs
iPSC-CMs
iPSCs
Blood
PBMCs
Skin
Fibroblasts
C. Transdifferentiation to cardiomyocytes and progenitors
Isolate, expand, and transdifferentiate
iCMs
CVPCs
In vivo transcription factor delivery

Cells for functional cardiac repair



Modified from Dimmeler et al, JCI 2005


1
Removed bone marrow from patient's hip
3
The stem cells embed themselves and produce proteins for growth signaling of new heart muscle and blood vessels
Stem cells
2
Injected stem cells to the heart's damaged area
Regenerating heart tissue


Stem Cell Therapy
- slight increase in FE
- decrease in infarct size
Pathological process
Improvement in quality of life?
Increase in LV viable mass?
Improvement in NYHA functional classification?
Improvement in LV function over time?
Why not?
- Delivery routes?
- Number of injected cells?
- Inappropriate timing relative to infarct age?
- Need for cell manipulations before transplantation?

Liver transplantation

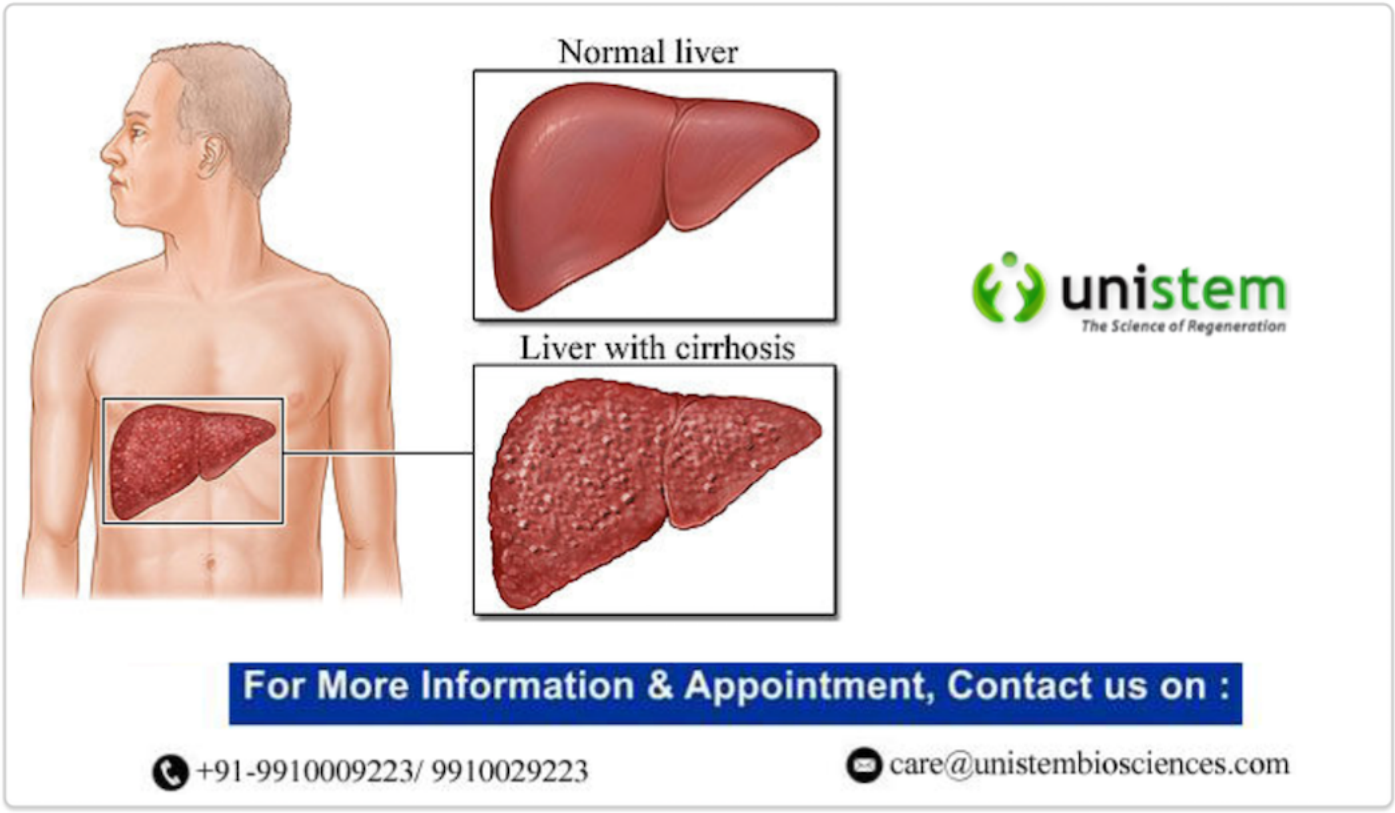
Date: 01 Jul 2013

Critical shortage of donor organs for treating end-stage organ failure highlights the urgent need for generating organs from pluripotent stem cells. Despite many reports describing functional “cell” differentiation, no studies have succeeded in generating a three-dimensional vascularized “organ” such as liver so far.
Takanori Takebe and Hideki Taniguchi at Yokohama City University showed the generation of vascularized and functional human liver from human induced pluripotent stem cells (hiPSCs) by transplantation of in vitro grown liver buds (rudimentary liver). This study demonstrates a proof-of-concept that organ bud transplantation offers an alternative approach for treating organ failure by generating a 3D and vascularized organ.

This study was published in the journal Nature (6 pm London time Wednesday 3rd July) .
Nature 499, 481–484 (25 July 2013) doi:10.1038/nature12271

Signs and symptoms of liver cirrhosis

- Excessive alcohol consumption- The liver breaks down alcohol into carbon dioxide and water, causing fatty liver.
- Genetic diseases- Some genetic conditions like Hemochromatosis, Wilson's disease.
- Chronic Viral Hepatitis- hepatitis B and D, can also cause cirrhosis.



The encouraging advances in stem cell research have paved the way towards the treatment of the end-stage of chronic liver disease. Stem cell therapy has been found best treatment for liver disease.

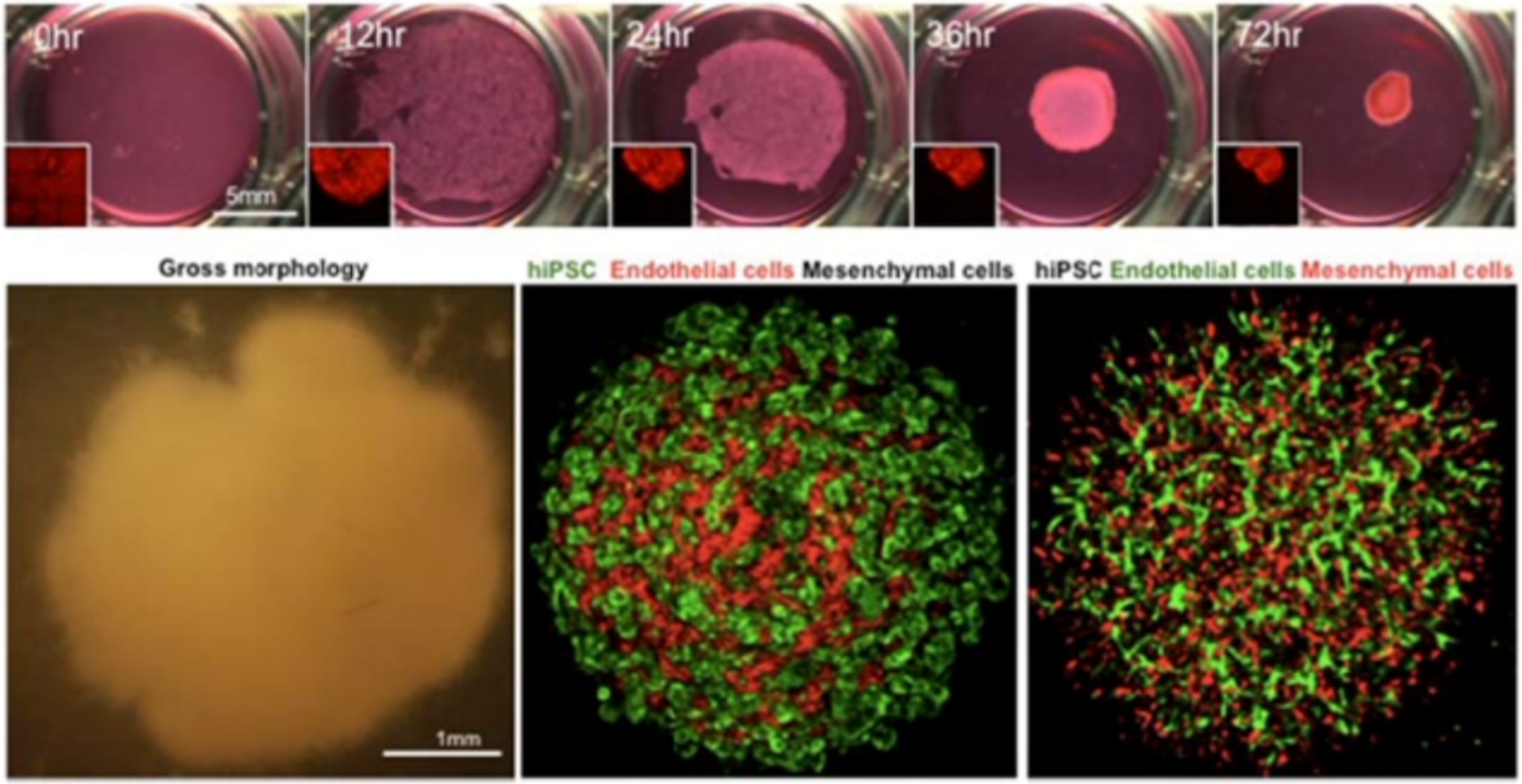


Figure 2. Self-formation of three-dimensional liver bud from human iPSC in vitro.

Here, we found that, although cells were plated on 2D conditions, hiPSC-derived liver progenitos organised into macroscopically visible 3D liver bud (hiPSC-LBs, or “rudimentary liver”) by cultivating with human endothelial cells and human mesenchymal cells, presumably mimicking the above stated early developmental interactions (Figure2, upper). Surprisingly, we observed a formation of developing endothelial networks along with homogenously distributed hiPSC-liver progenitors even in vitro (Figure2, lower). Immunostaining and gene expression analyses revealed resemblance between in vitro grown hiPSC-LBs and in vivo liver buds.

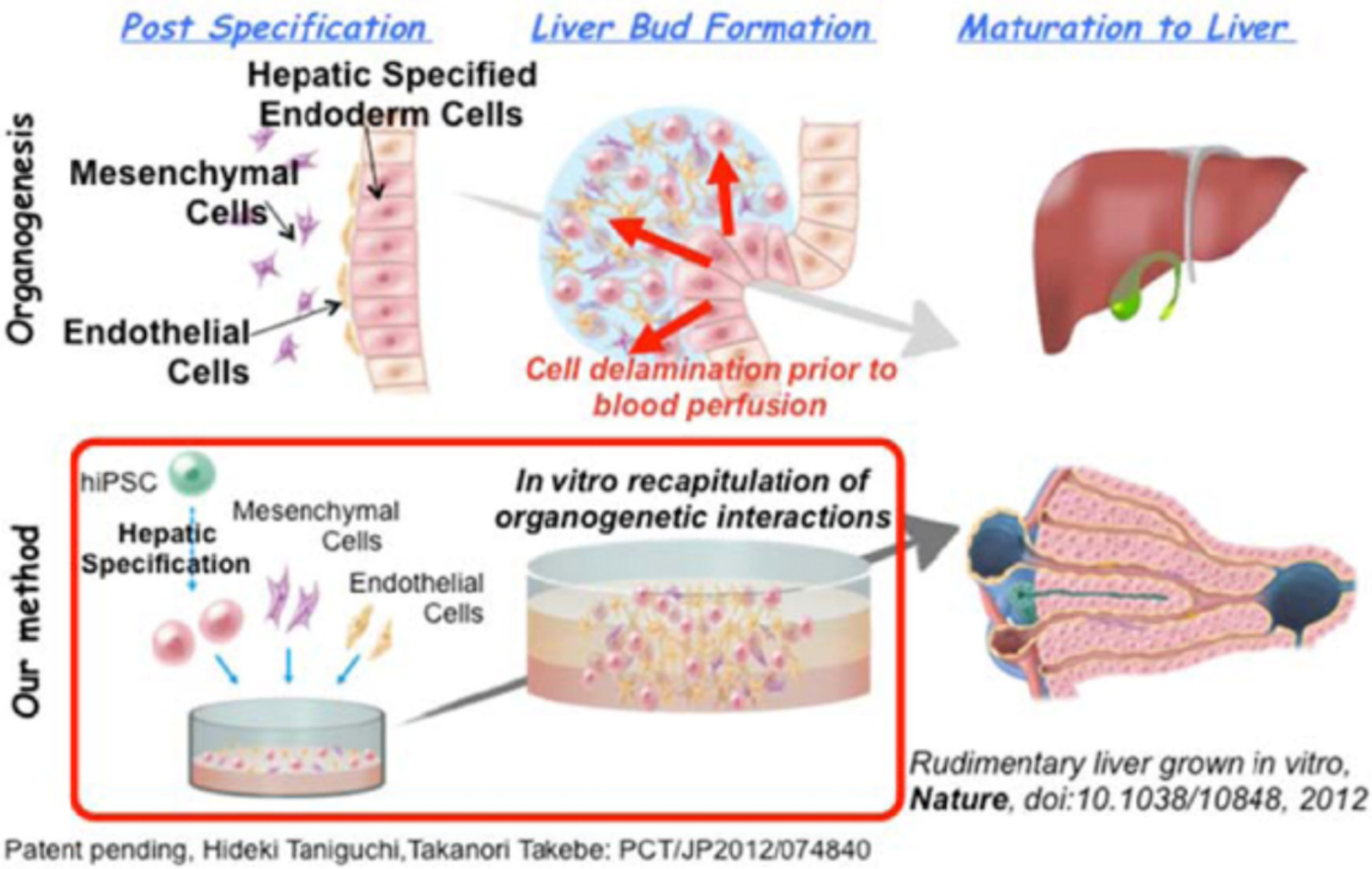


Figure 1. Generation of Liver Bud from pluripotent stem cells by mimicking early organogenesis. During the early liver organogenesis, liver progenitor cells delaminate from the foregut endodermal sheet and form a three-dimensional liver bud (LB) (Figure1), a condensed tissue mass that is soon

Diabetes

These challenges have led researchers to explore the use of stem cells a possible therapeutic option. Type 1 diabetes is an appropriate candidate disease for stem cell therapy, as the causative damage is localized to a particular cell type. In theory, stem cells that can differentiate into b-cells in response to molecular signals in the local pancreatic environment could be introduced into the body, where they would migrate to the damaged tissue and differentiate as necessary to maintain the appropriate b-cell mass. Alternately, methods could be developed to coax stem cells grown in the laboratory to differentiate into insulin-producing b-cells. Once isolated from other cells, these differentiated cells could be transplanted into a patient. As such, stem cell therapy would directly benefit persons with type 1 diabetes by replenishing b-cells that are destroyed by autoimmune processes, although it would still be necessary to mitigate the autoimmune destruction of b-cells. The strategy would also benefit those with type 2 diabetes to a lesser extent by replacing failing b-cells, although the insulin resistance in peripheral tissues would remain present. As discussed in the following sections, however, debate continues about potential source(s) of pancreatic stem cells.

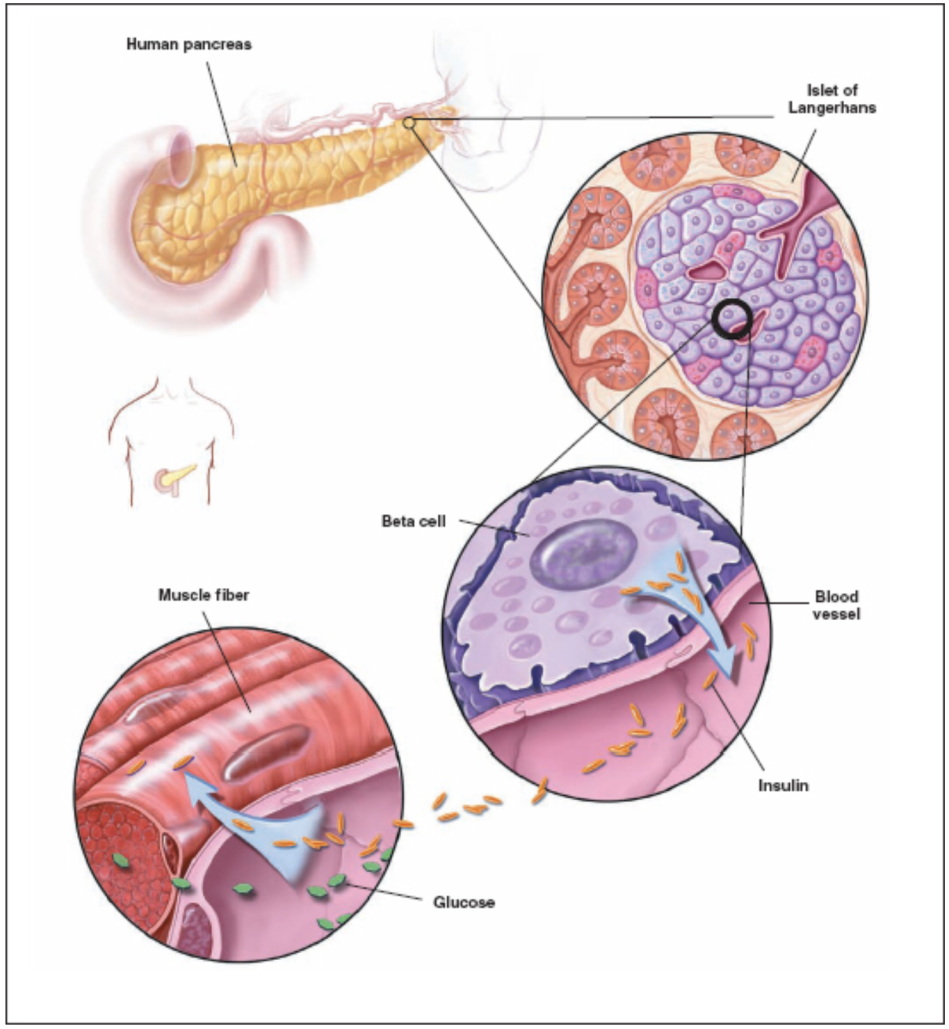
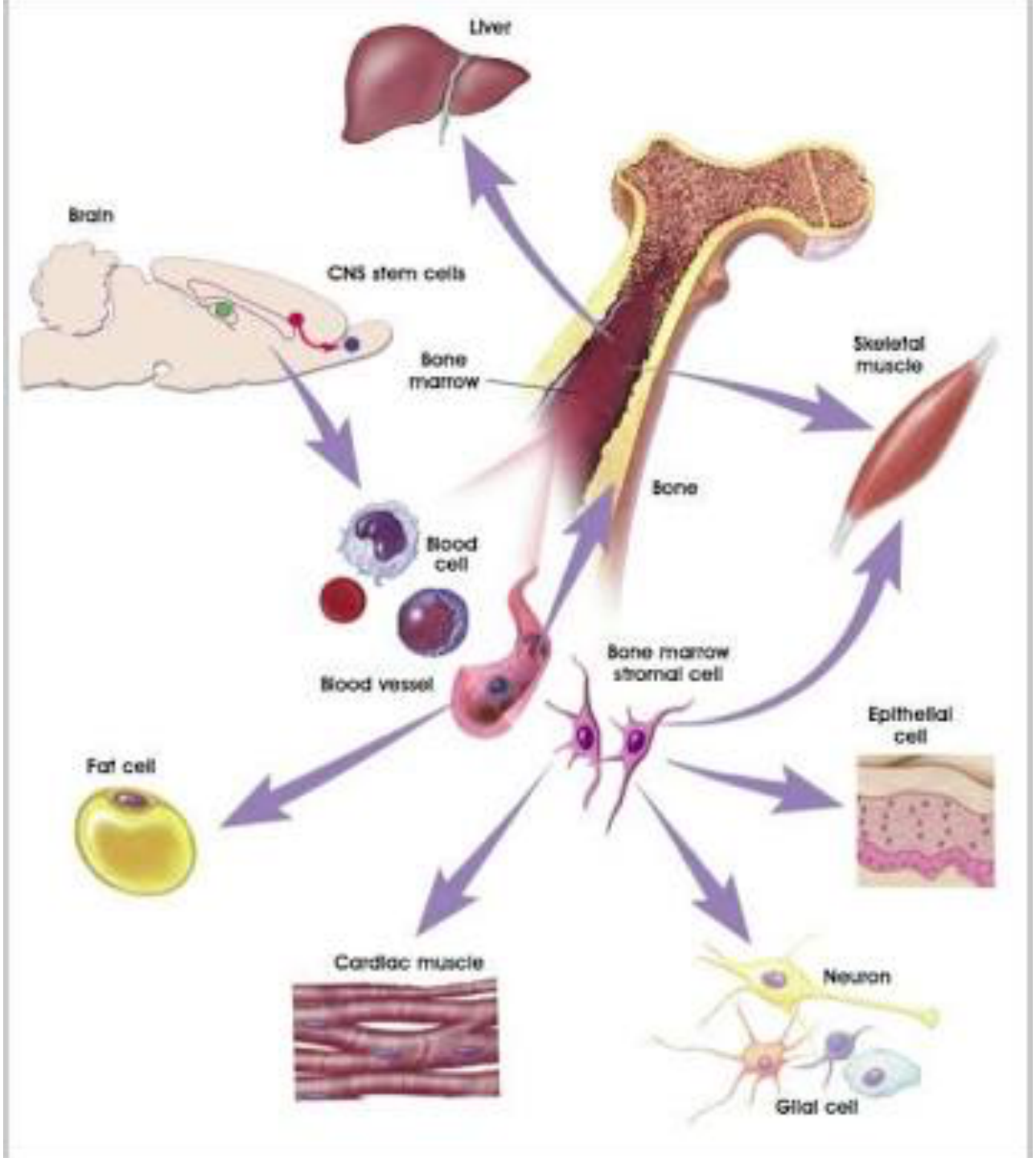


Figure 7.1.The pancreas is located in the abdomen, adjacent to the duodenum (the first portion of the small intestine). A cross-section of the pancreas shows the islet of Langerhans which is the functional unit of the endocrine pancreas. Encircled is the beta cell that synthesizes and secretes insulin. Beta cells are located adjacent to blood vessels and can easily respond to changes in blood glucose concentration by adjusting insulin production. Insulin facilitates uptake of glucose, the main fuel source, into cells of tissues such as muscle.

HOWEVER

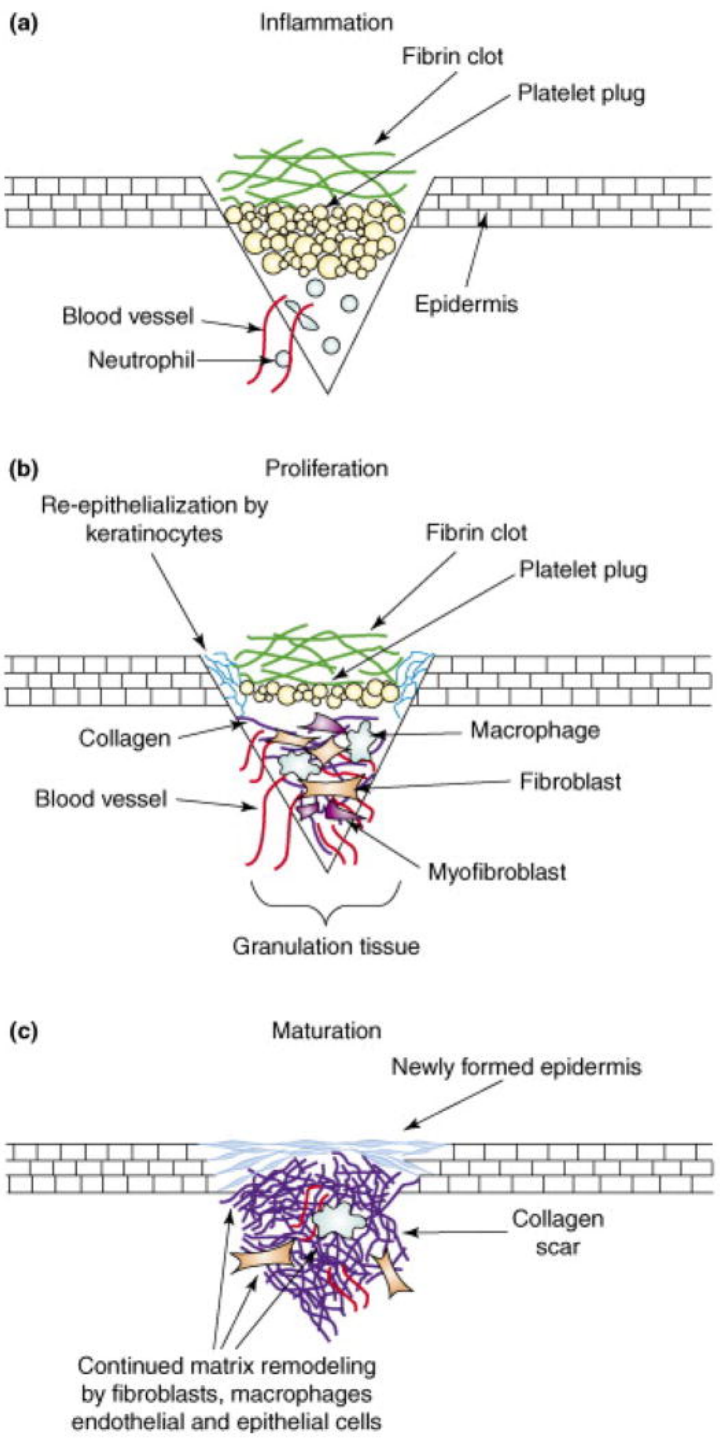
- After twenty years of research, there are no approved treatments or successful human trials utilizing embryonic stem cells.
- Their tendency to produce teratomas and malignant carcinomas, cause transplant rejection and form random undirected types of cells are just a few of the hurdles that embryonic stem cell researchers still face.
- Many nations currently have governmentally-imposed restrictions on either embryonic stem cell research or the production of new embryonic stem cell lines.
- Because of their combined abilities of unlimited expansion and pluripotency, embryonic stem cells remain a theoretically potential source for regenerative medicine and tissue replacement after injury or disease.


Liver
Brain
CNS stem cells
Bone marrow
Skeletal muscle
Bone
Blood cell
Blood vessel
Bone marrow stromal cell
Epithelial cell
Fat cell
Cardiac muscle
Neuron
Glial cell

SKIN

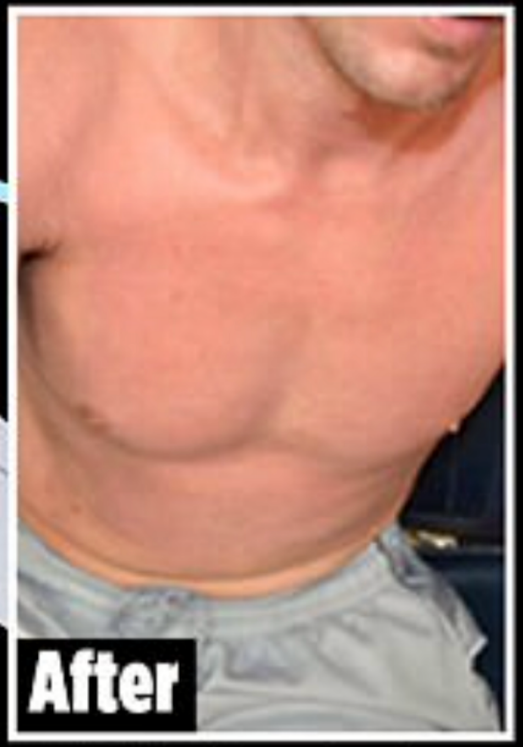

Hot Water Scald
Before
After


Electrical Burn
Before
After


(a)
Inflammation
Fibrin clot
Platelet plug
Blood vessel
Neutrophil
Epidermis
(b)
Proliferation
Re-epithelialization by keratinocytes
Fibrin clot
Platelet plug
Collagen
Macrophage
Fibroblast
Blood vessel
Myofibroblast
Granulation tissue
(c)
Maturation
Newly formed epidermis
Collagen scar
Continued matrix remodeling by fibroblasts, macrophages endothelial and epithelial cells

SEVERE: This man suffered extensive burns after he touched a live electrical wire

Miracle new stem-cell treatment cuts skin graft agony



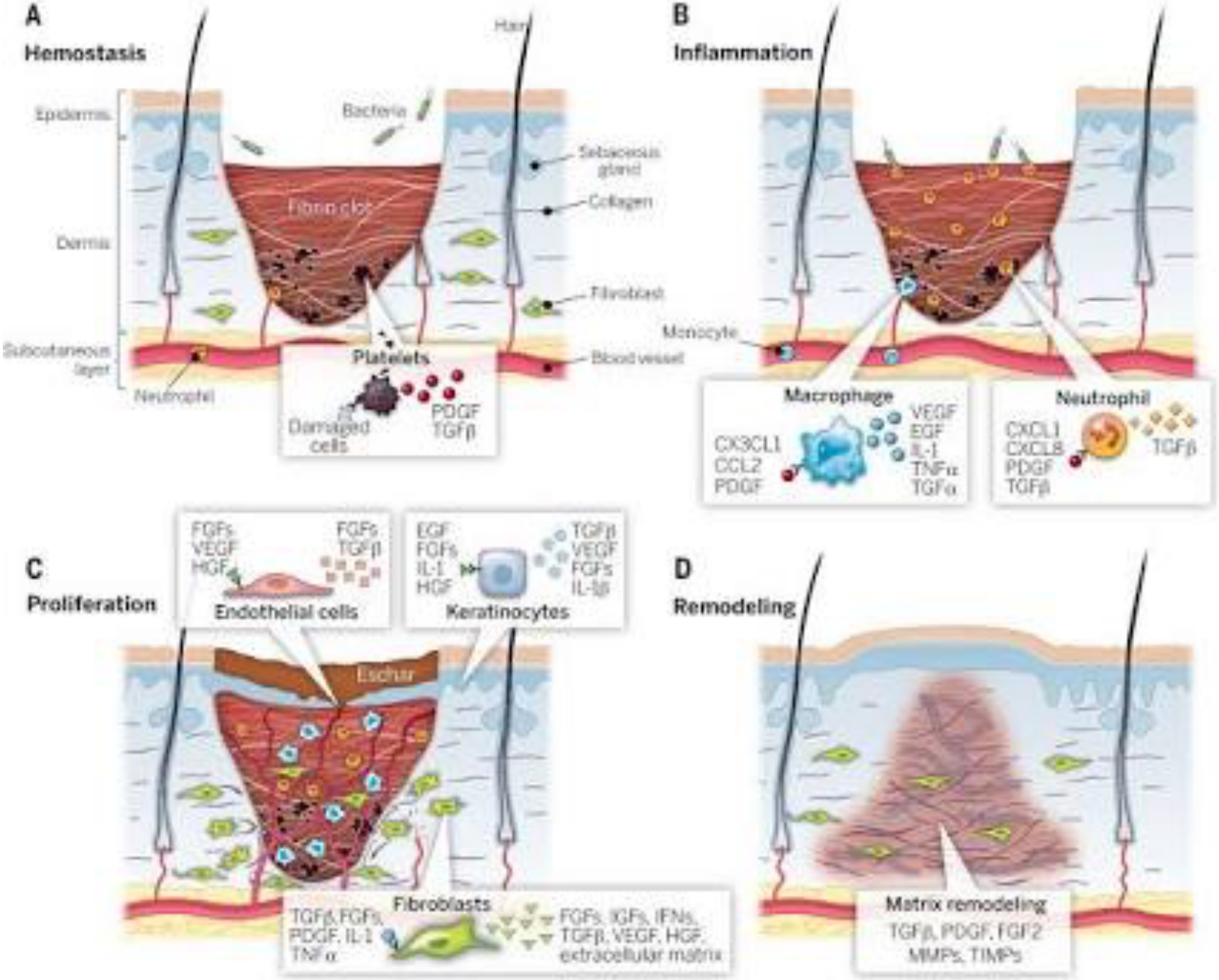
SCAR-FREE: 20 days later, he was completely healed, thanks to the SkinGun

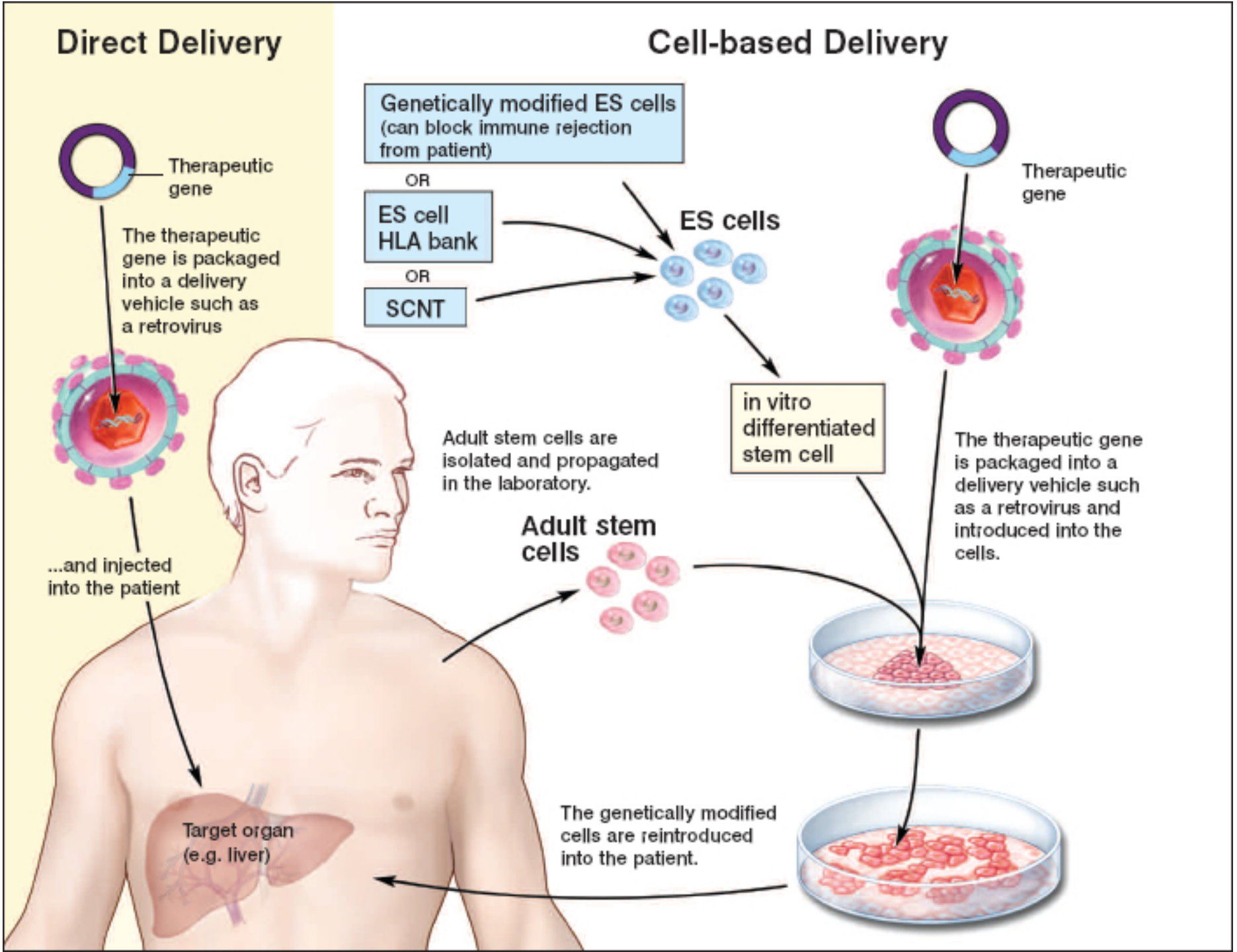
Burns victims are making incredible recoveries thanks to a revolutionary 'gun' that sprays stem cells on to their wounds, enabling them to rapidly grow new skin


jk Medical Group
New Face
New Dream
BEFORE
ACCIDENT
NOW


a

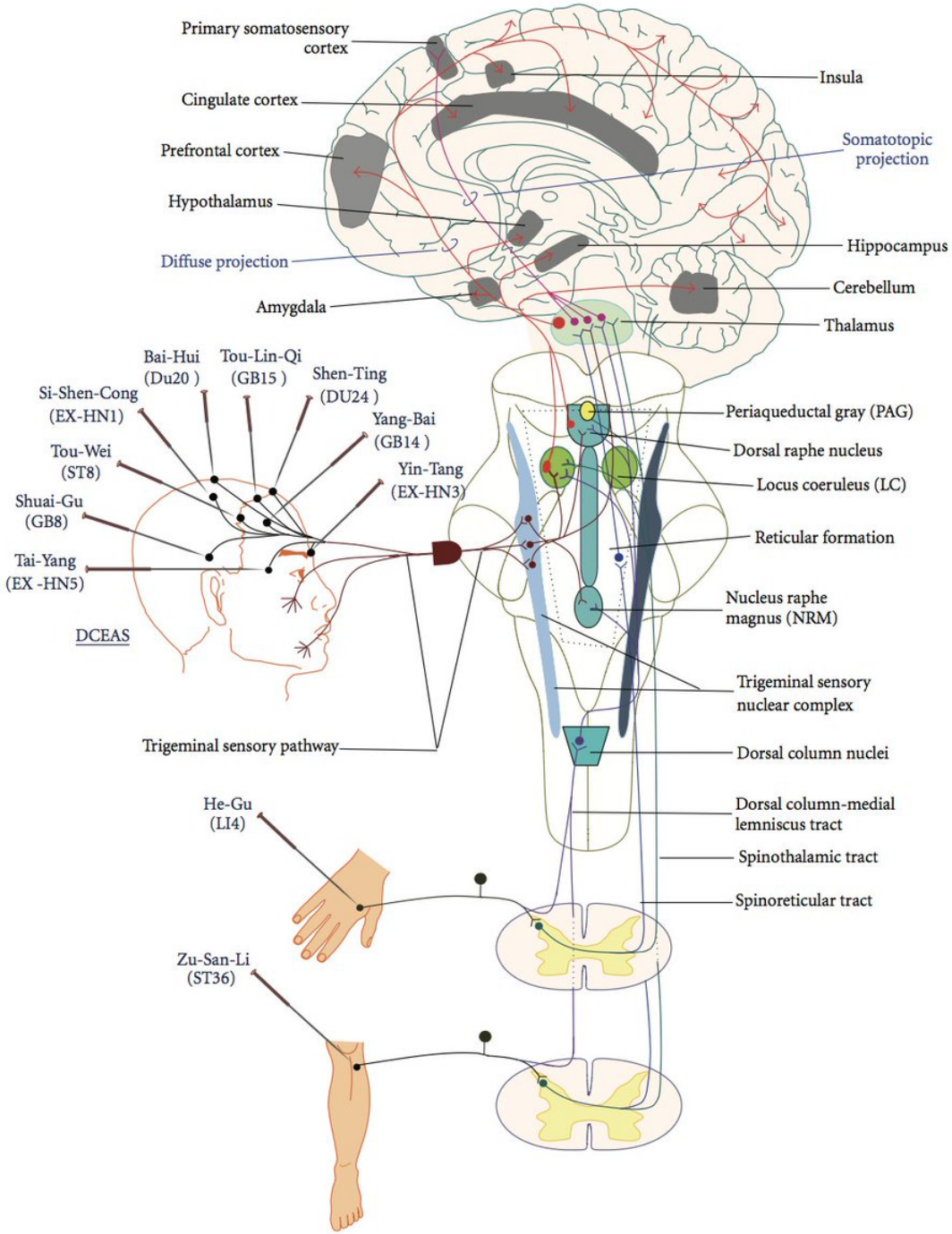

b

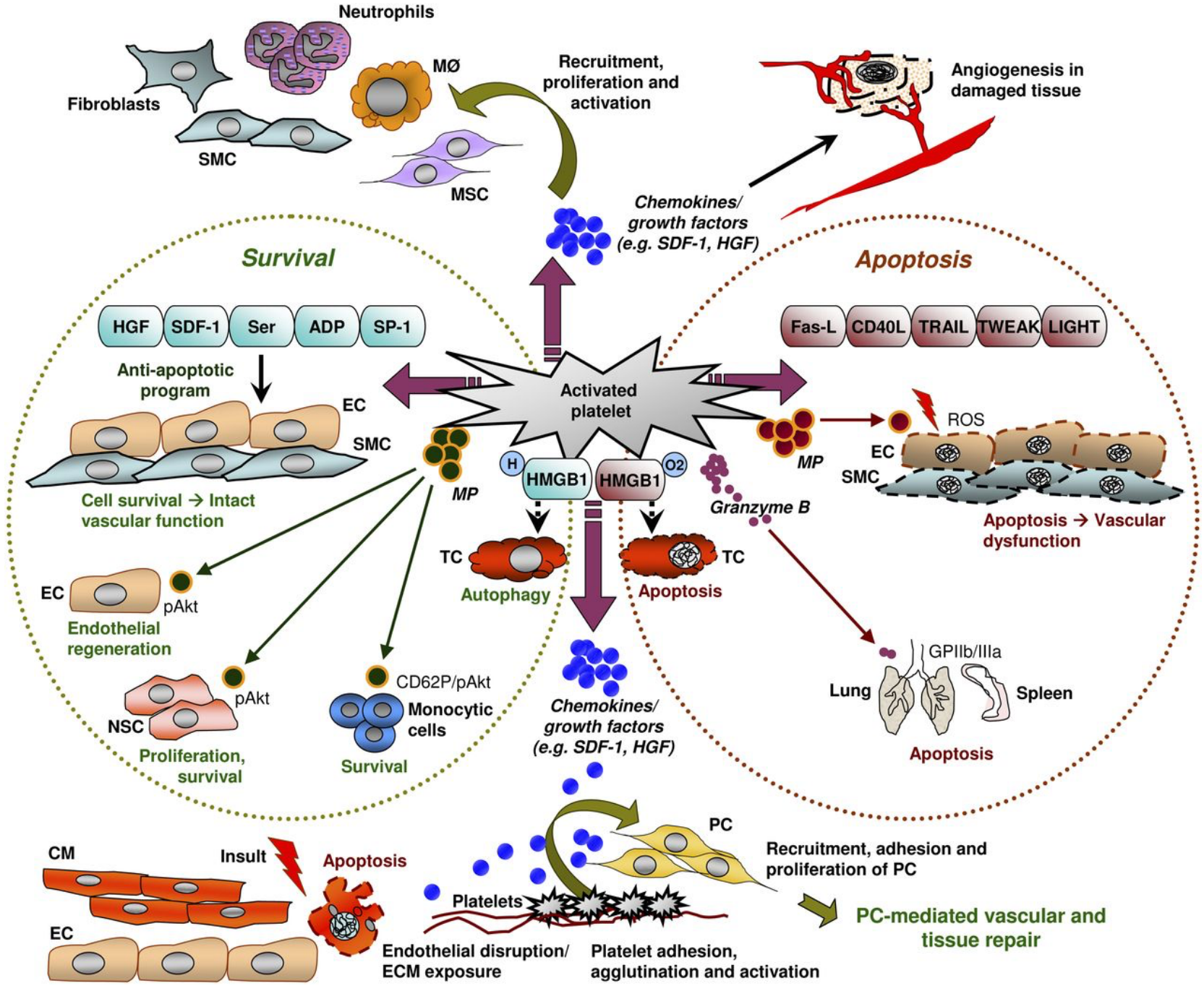

A
Hemostasis
Epidermis
Dermis
Subcutaneous layer
Hair
Bacteria
Sebaceous gland
Collagen
Fibrin clot
Fibroblast
Blood vessel
Neutrophil
Platelets
Damaged cells
PDGF
TGFβ
B
Inflammation
Monocyte
Macrophage
CX3CL1
CCL2
PDGF
VEGF
EGF
IL-1
TNFα
TGFα
Neutrophil
CXCL1
CXCL8
PDGF
TGFβ
TGFβ
C
Proliferation
FGFs
VEGF
HGF
FGFs
TGFβ
Endothelial cells
EGF
FGFs
IL-1
HGF
TGFβ
VEGF
FGFs
IL-1β
Keratinocytes
Eschar
Fibroblasts
TGFβ, FGFs, PDGF, IL-1 TNFα
FGFs, IGFs, IFNs, TGFβ, VEGF, HGF, extracellular matrix
D
Remodeling
Matrix remodeling
TGFβ, PDGF, FGF2
MMPs, TIMPs


Direct Delivery
Cell-based Delivery
Genetically modified ES cells
(can block immune rejection
from patient)
OR
ES cell
HLA bank
OR
SCNT
ES cells
Therapeutic
gene
Therapeutic
gene
The therapeutic
gene is packaged
into a delivery
vehicle such as
a retrovirus
in vitro
differentiated
stem cell
Adult stem cells are
isolated and propagated
in the laboratory.
The therapeutic gene
is packaged into a
delivery vehicle such
as a retrovirus and
introduced into the
cells.
Adult stem
cells
...and injected
into the patient
Target organ
(e.g. liver)
The genetically modified
cells are reintroduced
into the patient.


THE FOUNTAIN
OF YOUTH
NEXT EXIT

Underestimated complexity


Primary somatosensory cortex
Insula
Cingulate cortex
Somatotopic projection
Prefrontal cortex
Hypothalamus
Hippocampus
Diffuse projection
Cerebellum
Amygdala
Thalamus
Bai-Hui (Du20)
Tou-Lin-Qi (GB15)
Shen-Ting (DU24)
Si-Shen-Cong (EX-HN1)
Yang-Bai (GB14)
Periaqueductal gray (PAG)
Tou-Wei (ST8)
Dorsal raphe nucleus
Yin-Tang (EX-HN3)
Locus coeruleus (LC)
Shuai-Gu (GB8)
Reticular formation
Tai-Yang (EX -HN5)
Nucleus raphe magnus (NRM)
DCEAS
Trigeminal sensory nuclear complex
Trigeminal sensory pathway
Dorsal column nuclei
He-Gu (LI4)
Dorsal column-medial lemniscus tract
Spinothalamic tract
Spinoreticular tract
Zu-San-Li (ST36)


Neutrophils
Fibroblasts
MØ
SMC
MSC
Recruitment, proliferation and activation
Angiogenesis in damaged tissue
Chemokines/ growth factors (e.g. SDF-1, HGF)
Survival
Apoptosis
HGF
SDF-1
Ser
ADP
SP-1
Fas-L
CD40L
TRAIL
TWEAK
LIGHT
Anti-apoptotic program
Activated platelet
EC
SMC
MP
H
HMGB1
HMGB1
O2
ROS
Granzyme B
Cell survival → Intact vascular function
Apoptosis → Vascular dysfunction
TC
Autophagy
Apoptosis
EC
pAkt
Endothelial regeneration
NSC
pAkt
Proliferation, survival
CD62P/pAkt
Monocytic cells
Survival
Chemokines/ growth factors (e.g. SDF-1, HGF)
GPIIb/IIIa
Lung
Spleen
Apoptosis
CM
Insult
Apoptosis
EC
Endothelial disruption/ ECM exposure
Platelets
PC
Recruitment, adhesion and proliferation of PC
Platelet adhesion, agglutination and activation
PC-mediated vascular and tissue repair

RAISING HOPES

- For beauty, survival
- For raising research money


水感肌®
SUIKAN HADA
Stem Cell
Culture

Breakthrough Benefits of Stem Cell Therapy for Stroke, Alzheimer's, Parkinson's, and More

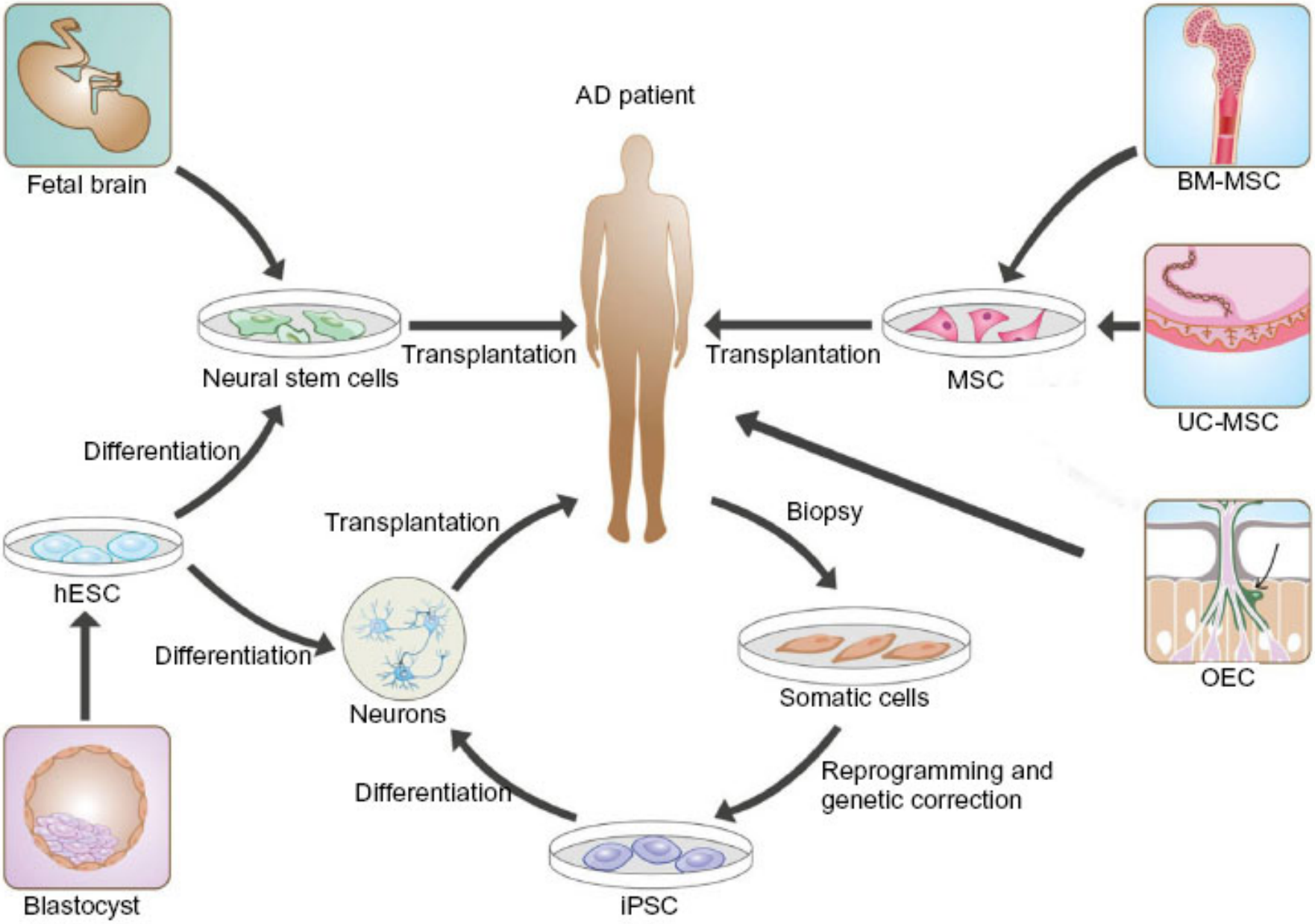
October 24, 2014

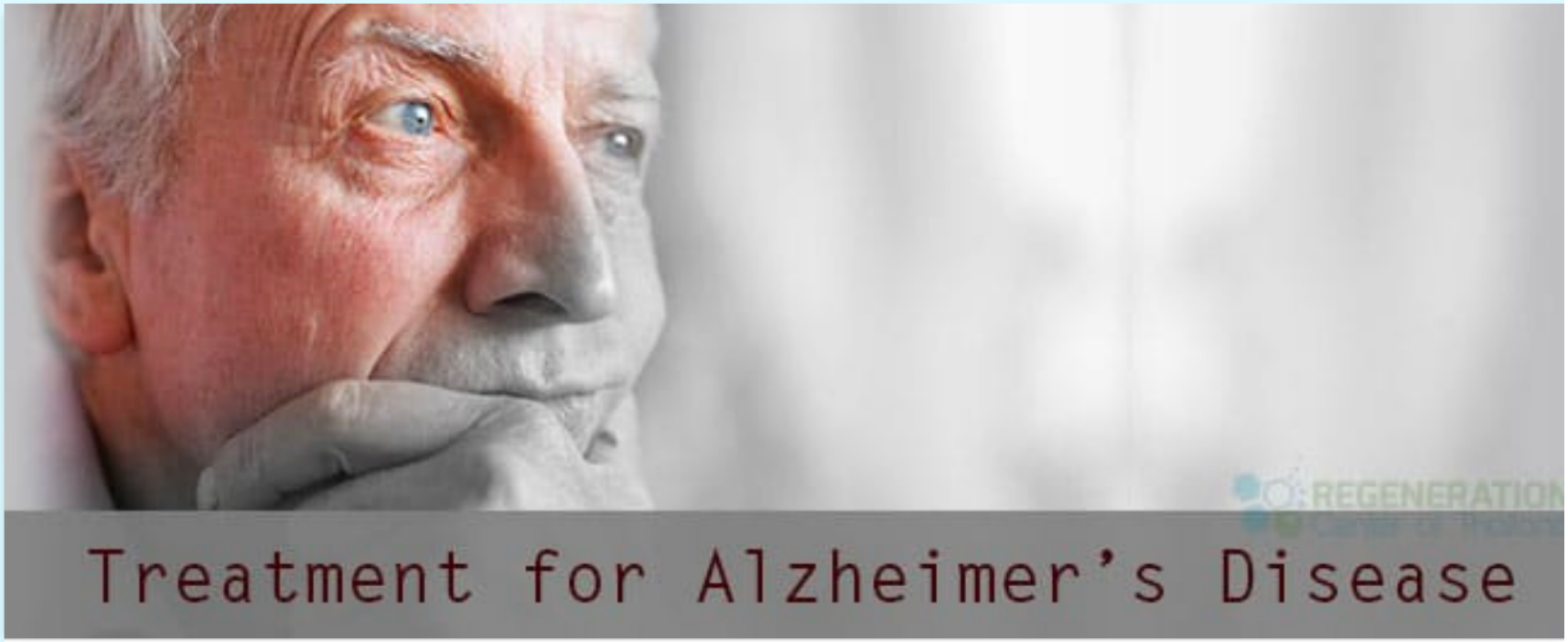
Breakthrough benefits of stem cell therapy are reported weekly, and recent successes include improving vision in patients with severe retinopathy, creating insulin-producing beta cells, and growing new esophageal tissue. The problem is, most of these applications of stem cell therapy are still in the research stages, and unless you're enrolled in a clinical trial, they just aren't available.

That's why the Whitaker Wellness Institute is pleased to announce a breakthrough in adult stem cell therapy for degenerative and traumatic brain and central nervous system disorders—and it's available today.

Benefits of Stem Cell Therapy for Neurodegenerative Disorders

As you know, stroke, Alzheimer's disease, Parkinson's disease, multiple sclerosis, ALS (Lou Gehrig's disease), and spinal cord and traumatic brain injuries have devastating consequences, and conventional medicine offers few effective treatments for these neurological conditions. Harnessing the healing powers of stem cells, which have the ability to differentiate, or change into various cell types and kick-start the body's natural reparative process, is the most promising treatment for these difficult and progressive disorders.


AD patient
Fetal brain
BM-MSC
Neural stem cells
Transplantation
Transplantation
MSC
UC-MSC
Differentiation
Transplantation
Biopsy
hESC
Differentiation
Neurons
Somatic cells
OEC
Reprogramming and
genetic correction
Differentiation
Blastocyst
iPSC



Neural Stem Cell Treatment for Alzheimers & Dementia Brain Disease

UPDATED January 19, 2017 Alzheimer's is also known in medical literature as Alzheimer's Disease (AD) is the most common type of dementia. As of Today, there are no effective pharmaceutical based therapies for the illness.

Thank you for your interest