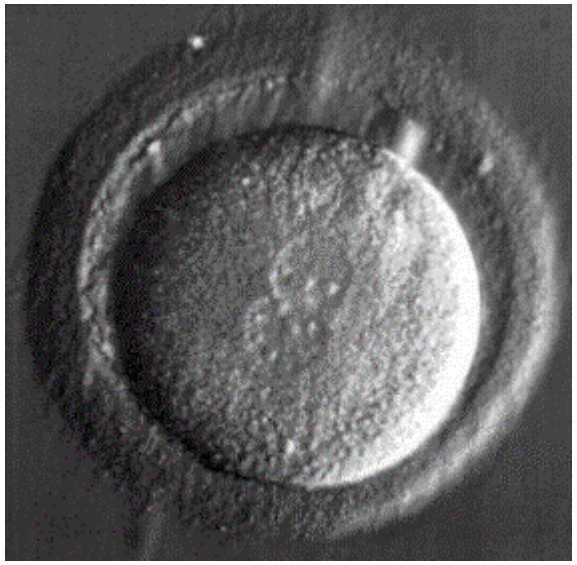
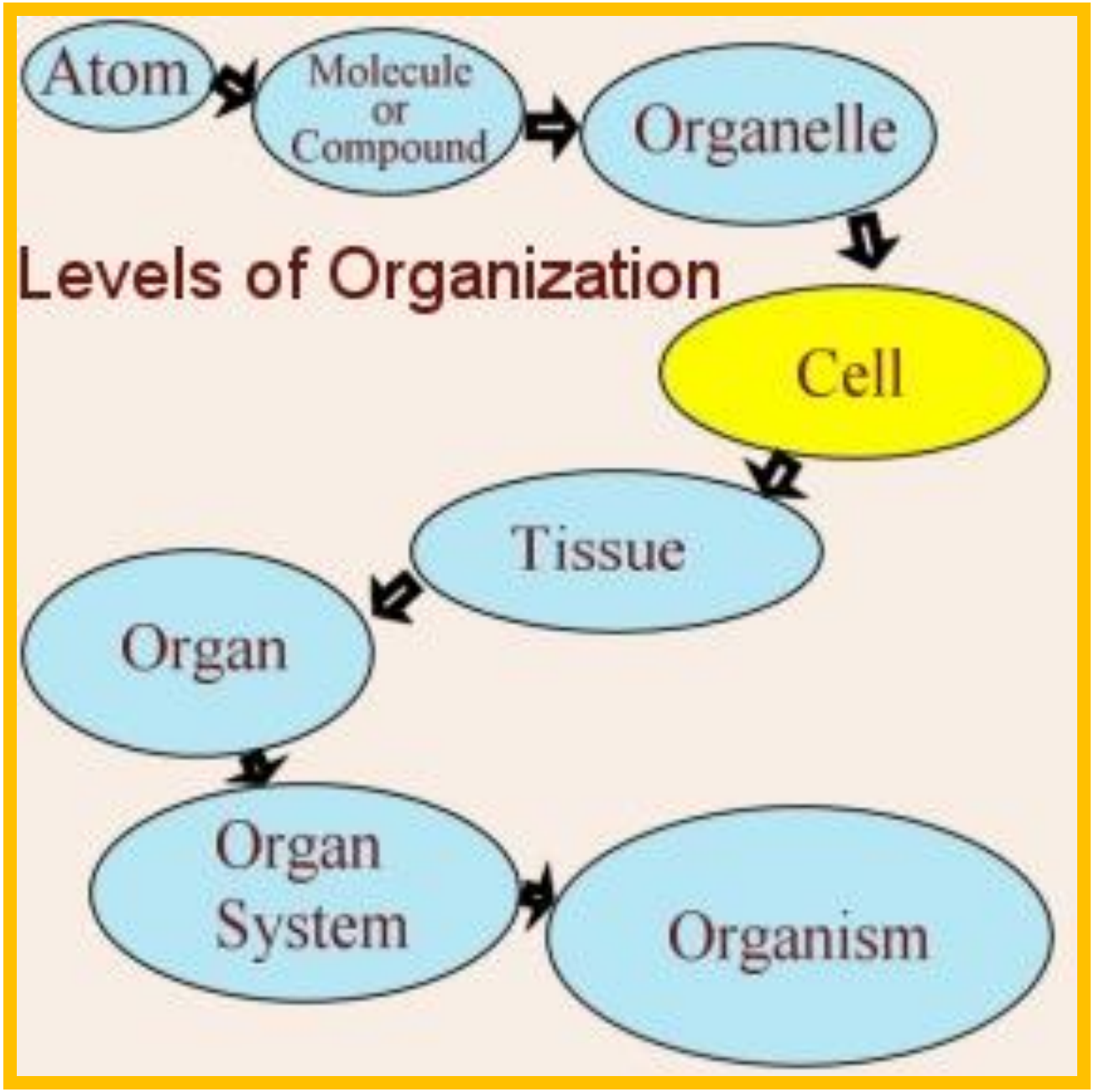
LEVELS OF ORGANIZATION AND CELL DIFFERENTIATION

EQ: How can one cell become a multicellular organism?



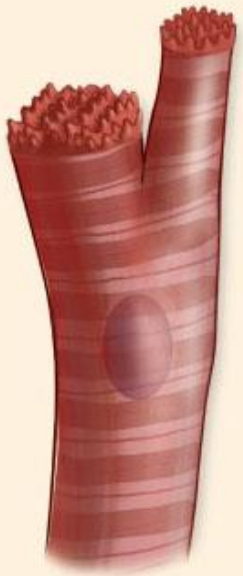

Atom
Molecule or Compound
Organelle
Levels of Organization
Cell
Tissue
Organ
Organ System
Organism

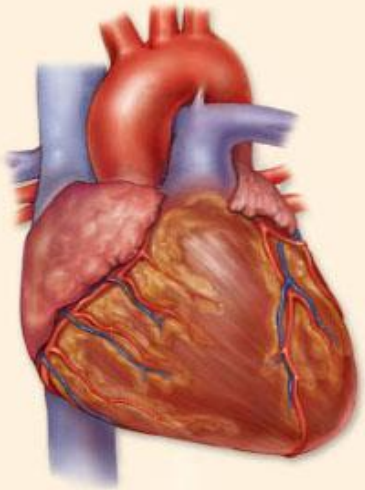
LEVELS OF ORGANIZATION

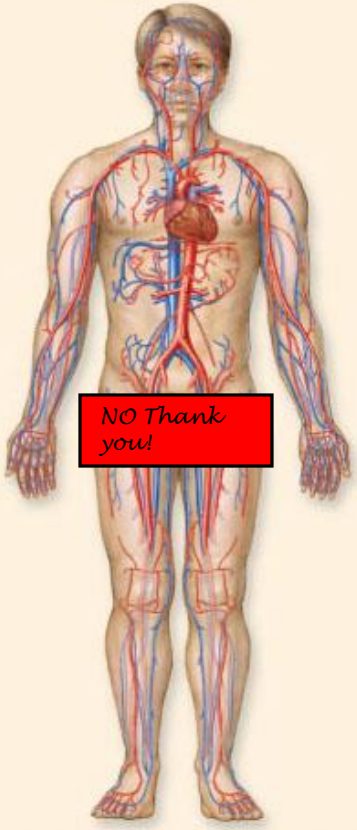
- Cell—Basic unit of structure and function in organisms.
  - Example:
    - Prokaryote
    - Heart Cell
  - Tissues—Groups of similar cells that work together to perform a specific function.
  - Example:
    - Heart tissue
  - Organ- groups of different tissues working together to perform a particular job.
  - Example:
    - Heart
  - Organ Systems—Groups of organs that work together to perform a specific function.
    - Examples:
      - Circulatory system
      - Vascular system in plants

ORGANIZATION OF HUMAN BODY

Cell	Tissue	Organ	Organ System
Cardiac Muscle Cell	Cardiac Muscle	Heart	Circulatory System

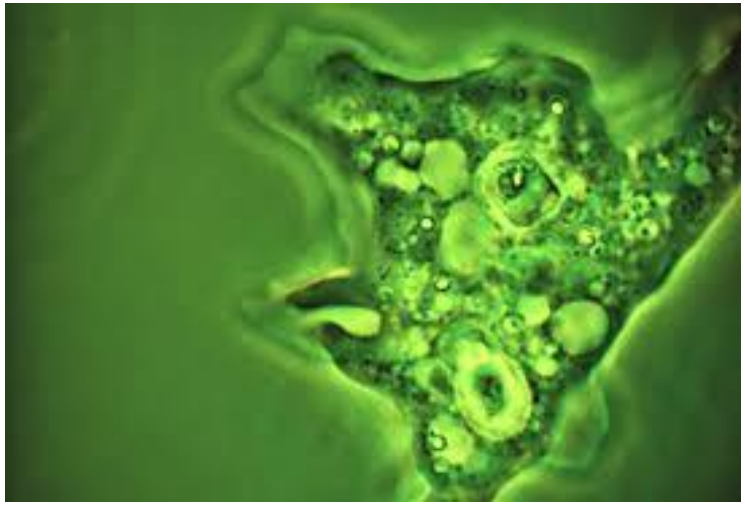






UNICELLULAR ORGANISMS

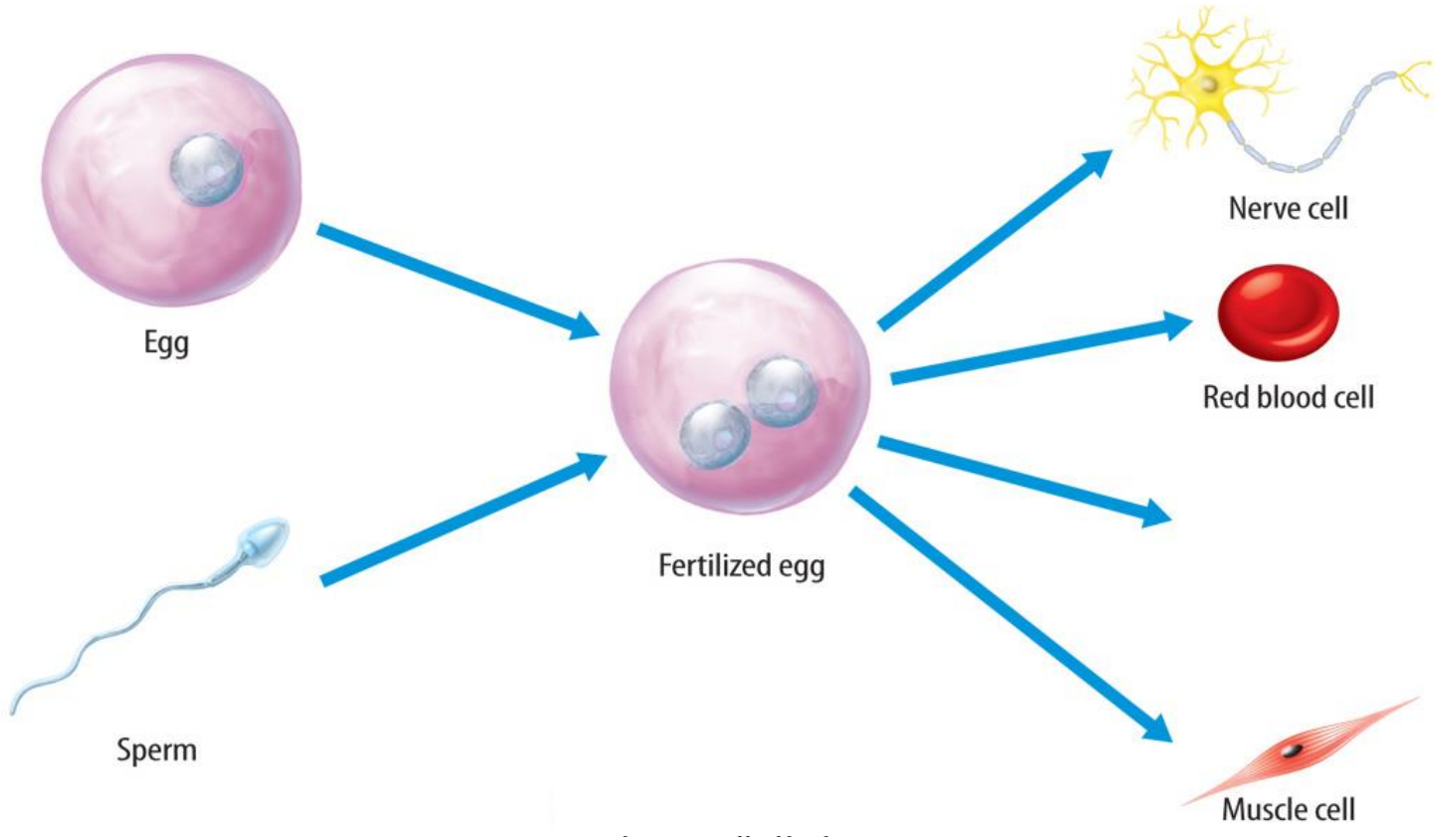
- **Unicellular organisms carry out all life processes, including responding to the environment, getting rid of waste, growing, and reproducing, within one cell.**



MULTICELLULAR ORGANISMS

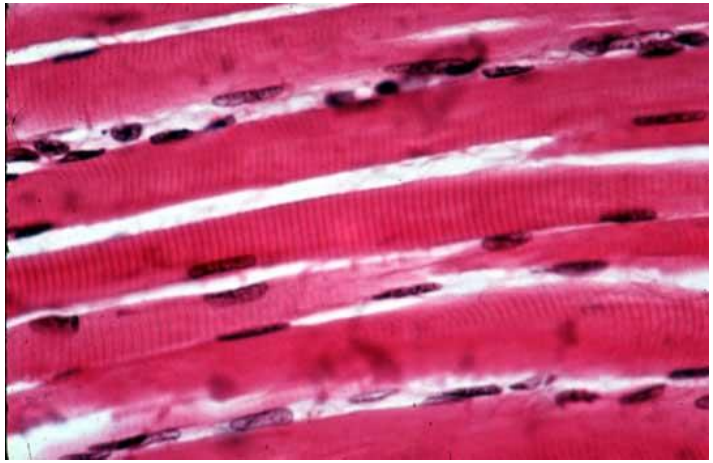
- Multicellular organisms are made of many types of eukaryotic cells working together, each with a specialized function.
- Cells in a multi-cellular organism become specialized by turning different genes on and off
- This is known as Cell Differentiation.

CELL DIFFERENTIATION



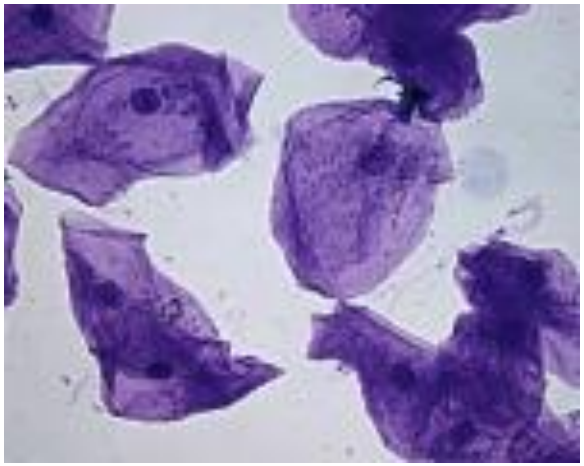
SPECIALIZED ANIMAL CELLS

Muscle cells



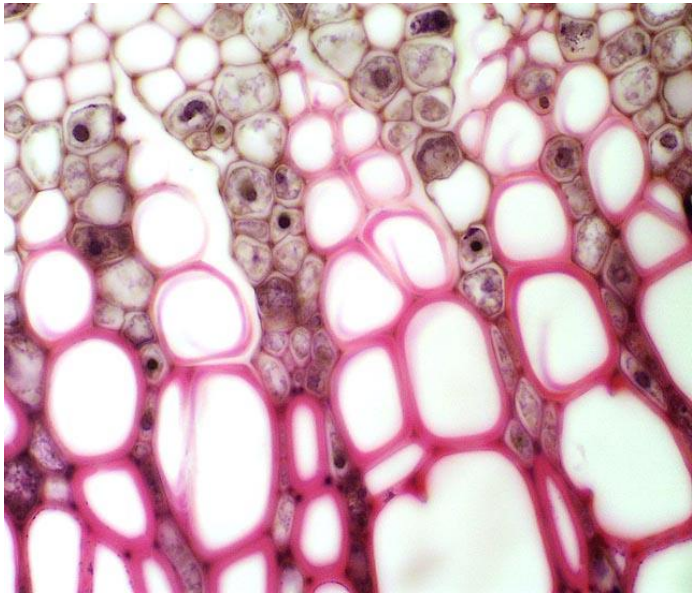
Red blood cells

Cheek cells



SPECIALIZED PLANT CELLS

Guard Cells

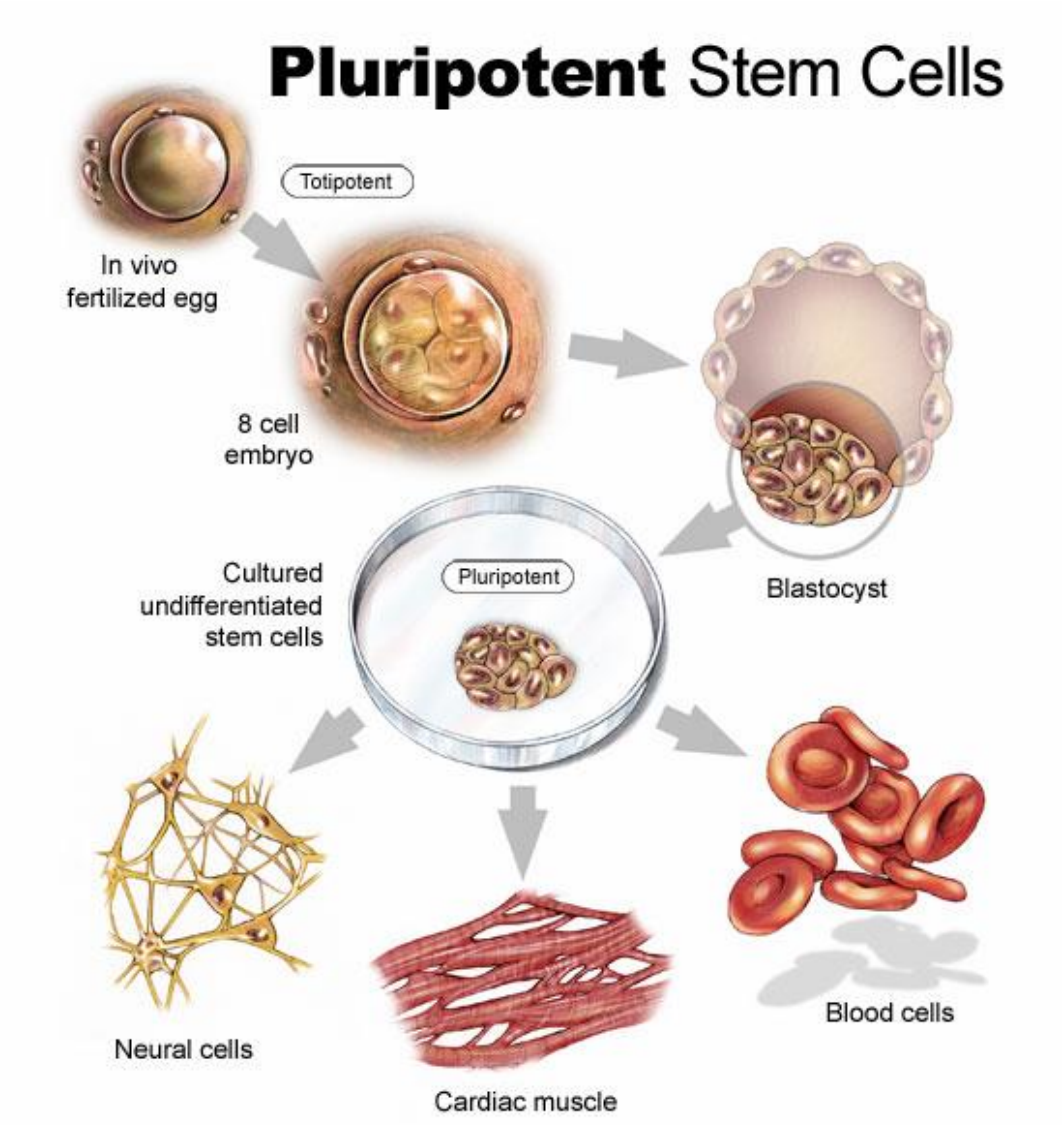


Xylem cells

Pollen

STEM CELLS

- **Stem cells** are unspecialized animal cells that are able to develop into many different cell types.



TYPES OF STEM CELLS

1. **Embryonic Stem Cells**
   - Differentiates into any cell type.
2. **Adult Stem Cells**
   - Exists in some tissues but can only form specific types of cells.
   - E.g., bone marrow stem cells form white blood cells, red blood cells and platelets.

Adult Stem Cells

Bone Marrow

Marrow
Bone
Cartilage
Tendon
Muscle
Fat
Liver
Brain/Nerve
Blood cells
Heart
All Tissues

Stem Cells from Fat

Bone
Cartilage
Muscle
Nerves

Peripheral Blood

Bone Marrow
Blood cells
Nerves

Hair Follicle

Skin Brain
Smooth Muscle Fat

Gastrointestinal

Esophagus Small Intestine
Stomach Large Intestine/Colon

Placenta

Bone Nerve
Cartilage Muscle Tendon
Bone Marrow Blood vessel

Skeletal Muscle

Skeletal muscle
Smooth muscle
Bone
Cartilage
Fat
Heart

Brain

Brain
Nerves
Blood cells
Muscle
All Tissues
Cornea
Retina
Pancreas
Liver
Heart
Lung
Spermatogonia
Amniotic Fluid
Umbilical Cord Matrix

CORD BLOOD

Various Tissues

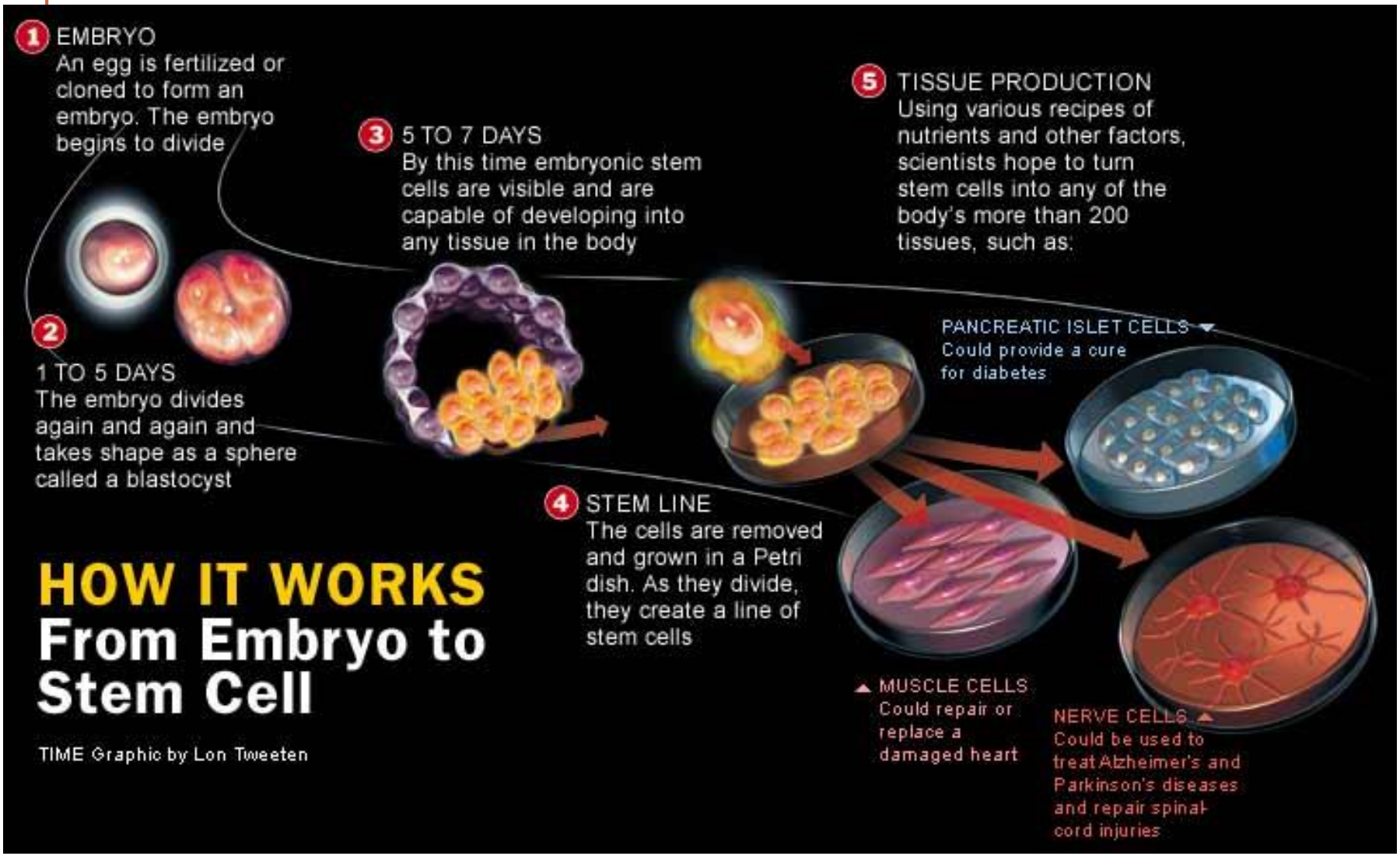
WHY IS STEM CELL RESEARCH SO IMPORTANT TO ALL OF US?

- Stem cells allow us to study how organisms grow and develop over time.
- Stem cells can replace diseased or damaged cells that can not heal or renew themselves.
- We can test different substances (drugs and chemicals) on stem cells.
- We can get a better understanding of our “genetic machinery.”

WHAT HUMAN DISEASES ARE CURRENTLY EXPERIMENTALLY BEING TREATED WITH STEM CELLS?

- Parkinson's Disease
- Multiple Sclerosis (MS)
- Leukemia
- Skin Grafts resulting from severe burns
- Diabetes
- Macular Dystrophy
- Spinal Injuries

STEM CELL RESEARCH



ADVANTAGES AND DISADVANTAGES TO EMBRYONIC AND ADULT STEM CELLS.

Embryonic S.C.	**Adult S.C.**
Can become any cell	Can become many but not any
Stable. Can undergo many cell divisions.	Less stable. Capacity for cell division is limited.
Easy to obtain but blastocyst is destroyed (medical ethics problem).	Difficult to isolate in adult tissue.
Possibility of rejection??	Host rejection minimized

WHY THE CONTROVERSY OVER STEM CELLS?

- Embryonic Stem cells are derived from extra blastocysts that would otherwise be discarded following IVF.
- Extracting embryotic stem cells destroys the developing blastocyst (embryo).

-Questions for Consideration-

- Is an embryo a person?
- Is it morally acceptable to use embryos for research?
- When do we become “human beings?”