



Lab Grown Human Embryo Model

For Prelims: Human Embryo, [In Vitro fertilization](#), Stem Cells

For Mains: Ethical considerations surrounding embryo research, Importance of research and study of embryo models.

Source: [IE](#)

Why in News?

Recently, Scientists have achieved a remarkable feat by creating a **lab-grown "human embryo" model** using [stem cells](#) and chemicals, **without using an egg or sperm** shedding light on **early embryo development**.

How Was the Embryo Model Created?

- Researchers from Israel utilized a combination of **stem cells and chemicals to create a model of a 14-day-old human embryo**.
 - This mix of stem cells and chemicals was a **crucial starting point for creating an embryo-like structure**.
- The Israeli researchers' model was able to spontaneously assemble into different types of cells that **form the fetus**, provide nutrients to the fetus, lay out the **plan for body development, and create structures like the placenta and umbilical cord to support the fetus**.
- A challenge faced was that only **1% of the mixture came together on its own, showing a need for better efficiency**.

What Have These Models Revealed About Early Development?

- Models help uncover errors in [Deoxyribonucleic acid\(DNA\)](#) **duplication and chromosome distribution**.
 - Researchers found that DNA duplication abnormalities occur early in the process, affecting cell division.
- These models enable the study of [gene functions](#) and their roles in fetal development.

Why Are Embryo Models and Research Important?

- Studying early embryo development is ethically challenging once implantation in the uterus occurs.
- Research during these initial stages is vital as **most miscarriages and birth defects happen in this period**.
- Understanding normal embryo development and genetic factors can improve [invitro fertilization outcomes](#).
- It helps researchers **grasp genetic, epigenetic, and environmental influences on**

embryonic development.

Can Lab-Grown Embryos Be Used for Pregnancy?

- **No**, these models are intended **solely for studying early fetal development**.
- They are generally destroyed after 14 days, and implantation is not permitted.
 - The **14-day limit was proposed in 1979 in the UK, equivalent to when natural embryo implantation finishes**.
 - It marks the point when **cells begin forming an "individual," and breaking off into a twin is not possible**.
 - Ethical considerations change as embryos transition from cell clusters to individuals.
- The ethical considerations become different when it is a clump of cells and when it becomes an individual, often related to what is referred to as **the Primitive Streak**.
 - Primitive Streak is a **linear structure** that appears in the embryo that marks its **transition from having a radial symmetry (like an egg) to the bilateral symmetry of our bodies** (marked by left and right hands and legs).

Human Embryo:

- A human embryo is a **developing human being from the moment of fertilization until the end of the eighth week of gestation**.
- A human embryo has three main stages of development: **the pre-implantation stage, the implantation stage, and the organogenesis stage**.
- A human embryo is composed of different types of cells that differentiate into various tissues and organs.
- A human embryo is normally created by the fertilization of a **human egg (oocyte) by a human sperm in the female reproductive tract or in a laboratory**.

Stem Cell:

- A stem cell is a cell with the unique **ability to develop into specialized cell types in the body**.
 - In the future they may be **used to replace cells and tissues that have been damaged or lost due to disease**.
- They have two unique properties that enable them to do this:
 - They **can divide over and over again to produce new cells**.
 - As they divide, they **can change into the other types of cell that make up the body**.

Type of Stem Cell	Source	Potential of the Stem Cell
Embryonic Totipotent Stem Cells	These stem cells are found in the very early stages of a fertilized embryo, typically within the first few days after fertilization.	Can become any cell in the body even form the placenta(an organ in the uterus during pregnancy that provides oxygen and nutrients to the growing baby)
Embryonic Pluripotent Stem Cells	Derived from the inner cell mass of a slightly more developed embryo (around 4-5 days after fertilization).	Can become many different cell types in the body but cannot form the placenta.
Adult Multipotent Stem Cells	Found in various tissues in the human body, like bone marrow or skin.	Multipotent stem cells are more specialized.They can only differentiate into a limited range of cell types specific to the tissue they are found in. For example, bone marrow stem cells can develop into different blood

	cell types, but not into skin cells.
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UPSC Civil Services Examination, Previous Year Questions (PYQs)

Prelims

Q2. With reference to 'stem cells', frequently in the news, which of the following statements is/are correct? (2012)

1. Stem cells can be derived from mammals only
2. Stem cells can be used for screening new drugs
3. Stem cells can be used for medical therapies

Select the correct answer using the codes given below:

- (a) 1 and 2 only
(b) 2 and 3 only
(c) 3 only
(d) 1, 2 and 3

Ans: (b)

Exp:

- Stem cells are undifferentiated or “blank,” cells capable of developing into cells that serve numerous functions in different parts of the body. Most cells in the body are differentiated cells. These cells can only serve a specific purpose in a particular organ. For example, red blood cells are specifically designed to carry oxygen through the blood.
- Stem cells are not only found in mammals, but also found in plants and other organisms. **Hence, statement 1 is not correct.**
- Since stem cells have the ability to turn into various other types of cells, scientists believe that they can be useful for treating and understanding diseases. According to the scientists, stem cells can be used to:
 - Grow new cells in a laboratory to replace damaged organs or tissues.
 - Correct parts of organs that do not work properly
 - Research causes of genetic defects in cells.
 - Research how diseases occur or why certain cells develop into cancer cells.
 - Test new drugs for safety and effectiveness. **Hence, statement 2 is correct.**
 - To carry out medical therapies. **Hence, statement 3 is correct.**
- **Therefore, option (b) is the correct answer.**