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# NCERT Solutions

*Step-by-step solutions for the 2026-27 NCERT  
textbook*

## Chapter 9: Stem Cell Culture and Organ Culture

This 2026-27 NCERT chapter explains stem-cell self-renewal, potency, embryonic and adult stem cells, organ culture, support systems and applications in developmental biology and regenerative medicine.

Also see for this chapter: [Revision Notes](#) | [Exemplar Solutions](#)

## Exercises

**Q 9.1** Briefly describe the stem cells and their properties.

★ **Quick Solution**

Concept: Stem Cell Culture and Organ Culture.

Chapter: Class 12 Biotechnology Chapter 9.

Route: Stem cells are unspecialised cells with self-renewal and potency.

**SOLUTION**

**Concept used.** Stem cells are immature unspecialised cells that can divide and also form specialised cell types.

**Step 1.** Stem cells are not fully specialised, so they can still follow different developmental paths.

**Step 2.** Self-renewal means a stem cell can divide by mitosis and maintain the stem-cell pool.

**Step 3.** Potency means the ability to differentiate into one or more specialised cell types.

**Step 4.** They may be totipotent, pluripotent, multipotent or unipotent according to potency.

**Step 5.** In humans, stem cells occur in early embryos, fetal tissues, umbilical cord,

placenta and some adult tissues.

**Step 6.** Their value comes from tissue repair, disease modelling and drug testing.

**Final Answer:** Stem cells are unspecialised self-renewing cells that can differentiate into specialised cells. Their main properties are self-renewal and potency.

**EXPERT'S SOLUTION** : *Aarav Sharma, M.Sc  
Biotechnology, AIIMS Delhi*

**Strategic angle.** Treat this as a stem-cell and organ-culture concept question. Use the exact NCERT property first, then add the explanation.

**Step 1.** Stem cells are immature unspecialised cells that can divide and also form specialised cell types.

**Step 2.** Identify whether the question asks for a definition, comparison, list or MCQ choice.

**Step 3.** Anchor the answer in the NCERT term: self-renewal, potency, source, support or tissue architecture.

**Step 4.** The final answer is: Stem cells are unspecialised self-renewing cells that can differentiate into specialised cells. Their main properties are self-renewal and potency.

**Step 5.** This route keeps the answer compact enough for exams and complete enough for revision.

**Final Answer:** Stem cells are unspecialised self-renewing cells that can differentiate into specialised cells. Their main properties are self-renewal and potency.

## Q 9.2 Differentiate totipotent, pluripotent and multipotent stem cells.

### ★ Quick Solution

Concept: Stem Cell Culture and Organ Culture.

Chapter: Class 12 Biotechnology Chapter 9.

Route: Totipotent cells form all embryonic and extra-embryonic tissues, pluripotent cells form almost all body cells, and multipotent cells form a related family of cells.

### SOLUTION

**Concept used.** Potency describes how wide the differentiation capacity of a stem cell is.

**Step 1.** Totipotent cells have the highest differentiation capacity.

**Step 2.** A totipotent cell can form all cell types of the embryo and supporting extra-embryonic tissues.

**Step 3.** A zygote and very early blastomeres are standard examples.

**Step 4.** Pluripotent cells can form nearly all cell types of the embryo.

**Step 5.** Pluripotent cells do not form extra-embryonic support tissues in the same way as totipotent cells.

**Step 6.** Multipotent cells form several related

cell types within a tissue lineage.

**Step 7.** Haematopoietic stem cells are multipotent because they form different blood cells.

**Final Answer:** Totipotent cells form the whole organism and support tissues, pluripotent cells form almost all body cells, and multipotent cells form related cell types within one lineage.

**EXPERT'S SOLUTION** : Priya Iyer, M.Sc Stem Cell Biology, JNU

**Strategic angle.** Treat this as a stem-cell and organ-culture concept question. Use the exact NCERT property first, then add the explanation.

**Step 1.** Potency describes how wide the differentiation capacity of a stem cell is.

**Step 2.** Identify whether the question asks for a definition, comparison, list or MCQ choice.

**Step 3.** Anchor the answer in the NCERT term: self-renewal, potency, source, support or tissue architecture.

**Step 4.** The final answer is: Totipotent cells form the whole organism and support tissues, pluripotent cells form almost all body cells, and multipotent cells form related cell types within one lineage.

**Step 5.** This route keeps the answer compact enough for exams and complete enough for revision.

**Final Answer:** Totipotent cells form the whole organism and support tissues, pluripotent cells form almost all body cells, and multipotent cells form related cell types within one lineage.

## What are embryonic stem cells and how do they differ from adult stem cells?

### ★ Quick Solution

Concept: Stem Cell Culture and Organ Culture.

Chapter: Class 12 Biotechnology Chapter 9.

Route: Embryonic stem cells come from the inner cell mass of a blastocyst and are more pluripotent than adult stem cells.

### SOLUTION

**Concept used.** Stem-cell source affects potency, clinical promise and ethical concerns.

**Step 1.** Embryonic stem cells are also called early stem cells.

**Step 2.** They are obtained from the inner cell mass of the blastocyst after about five days of development.

**Step 3.** They are pluripotent and can form many body cell types.

**Step 4.** Adult stem cells are present in mature body tissues and in sources such as umbilical cord and placenta after birth.

**Step 5.** Adult stem cells are usually multipotent or unipotent and support tissue repair.

**Step 6.** Embryonic stem cells have wider differentiation potential but raise safety and ethical concerns.

**Step 7.** Adult stem cells have fewer ethical concerns but usually show narrower differentiation capacity.

**Final Answer:** Embryonic stem cells are pluripotent cells from the blastocyst inner cell mass. Adult stem cells occur in mature tissues and usually have more limited potency.

**EXPERT'S SOLUTION** : *Rohit Patel, Ph.D*  
*Regenerative Biology, NCBS Bangalore*

**Strategic angle.** Treat this as a stem-cell and organ-culture concept question. Use the exact NCERT property first, then add the explanation.

**Step 1.** Stem-cell source affects potency, clinical promise and ethical concerns.

**Step 2.** Identify whether the question asks for a definition, comparison, list or MCQ choice.

**Step 3.** Anchor the answer in the NCERT term: self-renewal, potency, source,

support or tissue architecture.

**Step 4.** The final answer is: Embryonic stem cells are pluripotent cells from the blastocyst inner cell mass. Adult stem cells occur in mature tissues and usually have more limited potency.

**Step 5.** This route keeps the answer compact enough for exams and complete enough for revision.

**Final Answer:** Embryonic stem cells are pluripotent cells from the blastocyst inner cell mass. Adult stem cells occur in mature tissues and usually have more limited potency.

## Q 9.4 Describe some applications of stem cells.

### ★ Quick Solution

Concept: Stem Cell Culture and Organ Culture.

Chapter: Class 12 Biotechnology Chapter 9.

Route: Stem cells are used for regenerative therapy, disease modelling, genetic-defect study and drug testing.

### SOLUTION

**Concept used.** Stem-cell applications depend on their ability to self-renew and produce specialised cells.

**Step 1.** Stem cells can produce new cells in vitro to replace damaged tissues or organs.

**Step 2.** They are explored for conditions such as diabetes, Parkinson's disease, cardiac disease and neurological disorders.

**Step 3.** They help scientists study the causes of genetic defects in cells.

**Step 4.** They allow disease mechanisms to be studied in controlled culture systems.

**Step 5.** They can be used to test new lead molecules as drugs.

**Step 6.** Stem cells also support regenerative medicine by helping repair or replace injured tissue.

**Final Answer:** Stem cells are applied in tissue replacement, regenerative medicine, disease modelling, genetic-defect study and drug testing.

**EXPERT'S SOLUTION** : *Meera Gupta, M.Sc  
Biotechnology, University of Delhi*

**Strategic angle.** Treat this as a stem-cell and organ-culture concept question. Use the exact NCERT property first, then add the explanation.

**Step 1.** Stem-cell applications depend on their ability to self-renew and produce specialised cells.

**Step 2.** Identify whether the question asks for a definition, comparison, list or MCQ choice.

**Step 3.** Anchor the answer in the NCERT term: self-renewal, potency, source, support or tissue architecture.

**Step 4.** The final answer is: Stem cells are applied in tissue replacement,

regenerative medicine, disease modelling, genetic-defect study and drug testing.

**Step 5.** This route keeps the answer compact enough for exams and complete enough for revision.

**Final Answer:** Stem cells are applied in tissue replacement, regenerative medicine, disease modelling, genetic-defect study and drug testing.

**Q 9.5** What parameters should be monitored during stem cell culture?

★ **Quick Solution**

Concept: Stem Cell Culture and Organ Culture.  
Chapter: Class 12 Biotechnology Chapter 9.  
Route: Stem cell culture must monitor self-renewal, potency, morphology, growth, contamination and genetic stability.

**SOLUTION**

**Concept used.** Successful stem-cell culture keeps cells alive while preserving their

defining properties.

**Step 1.** Cell morphology should be checked because shape changes may indicate differentiation or stress.

**Step 2.** Self-renewal should be monitored to ensure the cells keep dividing as stem cells.

**Step 3.** Potency markers should be checked so the culture does not lose differentiation ability.

**Step 4.** Culture medium, pH, temperature and gas conditions must remain stable.

**Step 5.** Contamination by bacteria, fungi or mycoplasma must be avoided and tested.

**Step 6.** Viability and growth rate should be measured during passaging.

**Step 7.** Genetic stability should be checked because long culture can select abnormal cells.

**Final Answer:** Monitor morphology, viability, self-renewal, potency markers, growth rate, contamination, culture conditions and genetic stability during stem cell culture.

**Strategic angle.** Treat this as a stem-cell and organ-culture concept question. Use the exact NCERT property first, then add the explanation.

**Step 1.** Successful stem-cell culture keeps cells alive while preserving their defining properties.

**Step 2.** Identify whether the question asks for a definition, comparison, list or MCQ choice.

**Step 3.** Anchor the answer in the NCERT term: self-renewal, potency, source, support or tissue architecture.

**Step 4.** The final answer is: Monitor morphology, viability, self-renewal, potency markers, growth rate, contamination, culture conditions and genetic stability during stem cell culture.

**Step 5.** This route keeps the answer compact enough for exams and complete enough for revision.

**Final Answer:** Monitor morphology, viability, self-renewal, potency markers, growth rate, contamination, culture conditions and genetic stability during stem cell culture.

### Q 9.6 What is organ culture?

#### ★ Quick Solution

Concept: Stem Cell Culture and Organ Culture.

Chapter: Class 12 Biotechnology Chapter 9.

Route: Organ culture is the development or maintenance of part of an organ or the whole organ in vitro using tissue culture techniques.

#### SOLUTION

**Concept used.** Organ culture keeps tissue organisation more intact than ordinary cell culture.

**Step 1.** A part of an organ or a whole organ is taken from a donor or developing organism.

**Step 2.** The tissue is kept in a suitable in vitro culture environment.

**Step 3.** The method aims to preserve

three-dimensional organisation and tissue interactions.

**Step 4.** Nutrients, oxygen and support systems are supplied by the culture setup.

**Step 5.** The culture can then be used to study development, function, hormones or tissue behaviour.

**Final Answer:** Organ culture is the in vitro maintenance or development of an organ or organ part using tissue culture techniques while preserving tissue organisation.

**EXPERT'S SOLUTION** : *Nisha Rao, Ph.D Cell Biology, IISc Bangalore*

**Strategic angle.** Treat this as a stem-cell and organ-culture concept question. Use the exact NCERT property first, then add the explanation.

**Step 1.** Organ culture keeps tissue organisation more intact than ordinary cell culture.

**Step 2.** Identify whether the question asks for a definition, comparison, list or MCQ

choice.

**Step 3.** Anchor the answer in the NCERT term: self-renewal, potency, source, support or tissue architecture.

**Step 4.** The final answer is: Organ culture is the in vitro maintenance or development of an organ or organ part using tissue culture techniques while preserving tissue organisation.

**Step 5.** This route keeps the answer compact enough for exams and complete enough for revision.

**Final Answer:** Organ culture is the in vitro maintenance or development of an organ or organ part using tissue culture techniques while preserving tissue organisation.

**Q 9.7** Describe the main characteristics of organ culture.

★ **Quick Solution**

Concept: Stem Cell Culture and Organ Culture.

Chapter: Class 12 Biotechnology Chapter 9.

Route: Organ culture preserves structural integrity, nutrient exchange, gas exchange, growth and differentiation.

**SOLUTION**

**Concept used.** Organ culture is useful because it retains tissue architecture and cell interactions.

**Step 1.** Structural integrity is maintained so the organ's three-dimensional arrangement remains visible.

**Step 2.** Different cell types stay close to their original positions and interactions.

**Step 3.** Nutrient exchange must occur because the organ tissue is thicker than a monolayer culture.

**Step 4.** Gas exchange is needed so cells receive oxygen and remove carbon dioxide.

**Step 5.** Growth and differentiation can continue when the support and

medium are suitable.

**Step 6.** The culture therefore behaves more like an in vivo tissue than isolated cells do.

**Final Answer:** The main characteristics are structural integrity, preserved cell interactions, nutrient and gas exchange, growth and differentiation.

**EXPERT'S SOLUTION** : *Devika Menon, M.Sc  
Biotechnology, University of Hyderabad*

**Strategic angle.** Treat this as a stem-cell and organ-culture concept question. Use the exact NCERT property first, then add the explanation.

**Step 1.** Organ culture is useful because it retains tissue architecture and cell interactions.

**Step 2.** Identify whether the question asks for a definition, comparison, list or MCQ choice.

**Step 3.** Anchor the answer in the NCERT term: self-renewal, potency, source, support or tissue architecture.

**Step 4.** The final answer is: The main characteristics are structural integrity, preserved cell interactions, nutrient and gas exchange, growth and differentiation.

**Step 5.** This route keeps the answer compact enough for exams and complete enough for revision.

**Final Answer:** The main characteristics are structural integrity, preserved cell interactions, nutrient and gas exchange, growth and differentiation.

**Q 9.8** Discuss the various types of organ culture.

★ **Quick Solution**

Concept: Stem Cell Culture and Organ Culture.

Chapter: Class 12 Biotechnology Chapter 9.

Route: The main types are whole embryo culture, histotypic culture and organotypic culture.

**SOLUTION**

**Concept used.** Organ culture types differ in whether the system preserves an embryo, reconstructs tissue-like organisation or maintains organ-like organisation.

**Step 1.** Whole embryo culture maintains an entire embryo outside the body for developmental study.

**Step 2.** It helps observe early growth, differentiation and effects of chemicals or conditions.

**Step 3.** Histotypic culture allows cells to reorganise into tissue-like three-dimensional structures.

**Step 4.** It is useful when researchers want tissue-like behaviour from cultured cells.

- Step 5.** Organotypic culture maintains or reconstructs an organ-like arrangement with interacting cell types.
- Step 6.** It is useful for studying organ development, tissue interaction and response to signals.

**Final Answer:** Organ culture includes whole embryo culture, histotypic culture and organotypic culture.

**EXPERT'S SOLUTION** : *Arjun Nair, Ph.D*  
*Developmental Biology, IIT Bombay*

**Strategic angle.** Treat this as a stem-cell and organ-culture concept question. Use the exact NCERT property first, then add the explanation.

- Step 1.** Organ culture types differ in whether the system preserves an embryo, reconstructs tissue-like organisation or maintains organ-like organisation.
- Step 2.** Identify whether the question asks for a definition, comparison, list or MCQ choice.
- Step 3.** Anchor the answer in the NCERT

term: self-renewal, potency, source, support or tissue architecture.

**Step 4.** The final answer is: Organ culture includes whole embryo culture, histotypic culture and organotypic culture.

**Step 5.** This route keeps the answer compact enough for exams and complete enough for revision.

**Final Answer:** Organ culture includes whole embryo culture, histotypic culture and organotypic culture.

## Q 9.9 What are the advantages of organ culture over cell culture?

### ★ Quick Solution

Concept: Stem Cell Culture and Organ Culture. Chapter: Class 12 Biotechnology Chapter 9. Route: Organ culture preserves three-dimensional tissue structure and cell interaction better than isolated cell culture.

### SOLUTION

**Concept used.** Organ culture is closer to the in vivo state because tissue architecture is not completely broken down.

- Step 1.** Organ culture preserves the three-dimensional structure of the tissue.
- Step 2.** It keeps different cell types in their normal spatial relationship.
- Step 3.** It allows study of tissue behaviour in an in vitro system.
- Step 4.** It helps compare biochemical and functional properties with similar organs in vivo.
- Step 5.** It is useful for studying hormones and their effects on intact tissue.
- Step 6.** It can show cell-cell and tissue-level

interactions that isolated cell cultures may miss.

**Final Answer:** Organ culture is advantageous because it preserves three-dimensional tissue architecture, cell interactions and organ-level responses better than ordinary cell culture.

**EXPERT'S SOLUTION** : *Tanya Kapoor, M.Sc  
Biochemistry, Jamia Millia Islamia*

**Strategic angle.** Treat this as a stem-cell and organ-culture concept question. Use the exact NCERT property first, then add the explanation.

**Step 1.** Organ culture is closer to the in vivo state because tissue architecture is not completely broken down.

**Step 2.** Identify whether the question asks for a definition, comparison, list or MCQ choice.

**Step 3.** Anchor the answer in the NCERT term: self-renewal, potency, source, support or tissue architecture.

**Step 4.** The final answer is: Organ culture is

advantageous because it preserves three-dimensional tissue architecture, cell interactions and organ-level responses better than ordinary cell culture.

**Step 5.** This route keeps the answer compact enough for exams and complete enough for revision.

**Final Answer:** Organ culture is advantageous because it preserves three-dimensional tissue architecture, cell interactions and organ-level responses better than ordinary cell culture.

**Q 9.10** Describe the applications of organ culture.

★ **Quick Solution**

Concept: Stem Cell Culture and Organ Culture.

Chapter: Class 12 Biotechnology Chapter

9. Route: Organ culture is used to study development, tissue behaviour, hormone effects, organ function and disease models.

**SOLUTION**

**Concept used.** Because organ culture preserves tissue organisation, it can answer questions that isolated cells cannot answer well.

**Step 1.** It helps study the actual behaviour of a tissue in vitro.

**Step 2.** It allows comparison of cultured organs with similar organs in vivo.

**Step 3.** It is useful in developmental biology because growth and differentiation can be followed.

**Step 4.** It helps study tissue interactions and organ-level responses.

**Step 5.** It can test the effects of individual hormones or combinations of hormones.

**Step 6.** A mammary gland of mouse is one example of an organ commonly cultured for such studies.

**Final Answer:** Organ culture is applied in developmental biology, tissue interaction studies, hormone-effect studies, disease modelling and organ-level functional analysis.

**EXPERT'S SOLUTION** : *Sahil Verma, Ph.D*  
*Biotechnology, University of Pune*

**Strategic angle.** Treat this as a stem-cell and organ-culture concept question. Use the exact NCERT property first, then add the explanation.

**Step 1.** Because organ culture preserves tissue organisation, it can answer questions that isolated cells cannot answer well.

**Step 2.** Identify whether the question asks for a definition, comparison, list or MCQ choice.

**Step 3.** Anchor the answer in the NCERT term: self-renewal, potency, source, support or tissue architecture.

**Step 4.** The final answer is: Organ culture is

applied in developmental biology, tissue interaction studies, hormone-effect studies, disease modelling and organ-level functional analysis.

**Step 5.** This route keeps the answer compact enough for exams and complete enough for revision.

**Final Answer:** Organ culture is applied in developmental biology, tissue interaction studies, hormone-effect studies, disease modelling and organ-level functional analysis.

**Describe the various support systems used in organ culture.**

★ **Quick Solution**

**Concept:** Stem Cell Culture and Organ Culture.

**Chapter:** Class 12 Biotechnology Chapter 9.

**Route:** Support systems include plasma clot, agar gel, filter paper rafts, grids, lens paper and modern 3D matrices.

**SOLUTION**

**Concept used.** Organ culture needs a support that holds tissue at the medium interface while allowing nutrients and gases to reach cells.

**Step 1.** A support system keeps the tissue in place without crushing its structure.

**Step 2.** Plasma clot support can hold small organ pieces while supplying a soft matrix.

**Step 3.** Agar gel can provide a semi-solid support for explants.

**Step 4.** Filter paper or lens paper rafts can keep tissue at the air-medium interface.

**Step 5.** Metal grids or mesh supports can hold organ pieces above the medium.

**Step 6.** Modern systems may use collagen

gels, hydrogels, organoids, microfluidics and organ-on-chip setups.

**Step 7.** The chosen support should permit nutrient diffusion and gas exchange.

**Final Answer:** Organ culture support systems include plasma clot, agar gel, paper raft, grid or mesh supports and modern 3D matrices such as collagen gels, hydrogels and organ-on-chip systems.

**EXPERT'S SOLUTION** : Riya Thomas, M.Sc Tissue Engineering, Madras University

**Strategic angle.** Treat this as a stem-cell and organ-culture concept question. Use the exact NCERT property first, then add the explanation.

**Step 1.** Organ culture needs a support that holds tissue at the medium interface while allowing nutrients and gases to reach cells.

**Step 2.** Identify whether the question asks for a definition, comparison, list or MCQ choice.

- Step 3.** Anchor the answer in the NCERT term: self-renewal, potency, source, support or tissue architecture.
- Step 4.** The final answer is: Organ culture support systems include plasma clot, agar gel, paper raft, grid or mesh supports and modern 3D matrices such as collagen gels, hydrogels and organ-on-chip systems.
- Step 5.** This route keeps the answer compact enough for exams and complete enough for revision.

**Final Answer:** Organ culture support systems include plasma clot, agar gel, paper raft, grid or mesh supports and modern 3D matrices such as collagen gels, hydrogels and organ-on-chip systems.

**Q 9.12** Stem cells are present in:

- (a) unicellular organisms
- (b) multicellular organisms
- (c) non-living things
- (d) viruses

★ **Quick Solution**

Concept: Stem Cell Culture and Organ Culture.

Chapter: Class 12 Biotechnology Chapter

9. Route: Stem cells occur in multicellular organisms.

**SOLUTION**

**Concept used.** Stem cells are undifferentiated cells that help multicellular organisms grow, repair and maintain tissues.

**Step 1.** The NCERT text states that stem cells are present in most multicellular organisms.

**Step 2.** Unicellular organisms do not have specialised tissues needing stem-cell lineages.

**Step 3.** Non-living things and viruses do not have cellular tissue systems.

**Step 4.** Therefore the only correct option is multicellular organisms.

**Final Answer:** The correct option is (b) multicellular organisms.

**EXPERT'S SOLUTION** : *Neel Joshi, Ph.D Molecular Biology, IISER Pune*

**Strategic angle.** Treat this as a stem-cell and organ-culture concept question. Use the exact NCERT property first, then add the explanation.

**Step 1.** Stem cells are undifferentiated cells that help multicellular organisms grow, repair and maintain tissues.

**Step 2.** Identify whether the question asks for a definition, comparison, list or MCQ choice.

**Step 3.** Anchor the answer in the NCERT term: self-renewal, potency, source, support or tissue architecture.

**Step 4.** The final answer is: The correct option is (b) multicellular organisms.

**Step 5.** This route keeps the answer compact enough for exams and complete enough for revision.

**Final Answer:** The correct option is (b) multicellular organisms.

**Q 9.13** Differentiation potential of stem cells specifies:

- (a) Stochastic differentiation
- (b) Asymmetric replication
- (c) Potency
- (d) Self-renewal

★ **Quick Solution**

Concept: Stem Cell Culture and Organ Culture.

Chapter: Class 12 Biotechnology Chapter 9.

Route: Differentiation potential is called potency.

**SOLUTION**

**Concept used.** Potency is the capacity of a stem cell to differentiate into different cell types.

**Step 1.** Self-renewal means making more stem cells by division.

**Step 2.** Asymmetric replication is a division pattern that can produce one stem cell and one differentiating cell.

**Step 3.** Stochastic differentiation refers to chance-linked differentiation behaviour.

**Step 4.** The term for differentiation potential is potency.

**Final Answer:** The correct option is (c) Potency.

**EXPERT'S SOLUTION** : *Ishita Das, M.Sc*  
*Biotechnology, Calcutta University*

**Strategic angle.** Treat this as a stem-cell and organ-culture concept question. Use the exact NCERT property first, then add the explanation.

**Step 1.** Potency is the capacity of a stem cell to differentiate into different cell types.

**Step 2.** Identify whether the question asks for a definition, comparison, list or MCQ choice.

**Step 3.** Anchor the answer in the NCERT term: self-renewal, potency, source, support or tissue architecture.

**Step 4.** The final answer is: The correct

option is (c) Potency.

**Step 5.** This route keeps the answer compact enough for exams and complete enough for revision.

**Final Answer:** The correct option is (c) Potency.

**Q 9.14** Which of the following cells is a multipotent cell?

- (a) T-cell
- (b) B-cell
- (c) HSC
- (d) Monocytes

★ **Quick Solution**

Concept: Stem Cell Culture and Organ Culture.  
Chapter: Class 12 Biotechnology Chapter 9.  
Route: HSC, or haematopoietic stem cell, is multipotent.

**SOLUTION**

**Concept used.** A multipotent stem cell can produce several related specialised cell types

within one lineage.

**Step 1.** T-cells, B-cells and monocytes are differentiated immune or blood cells.

**Step 2.** HSC stands for haematopoietic stem cell.

**Step 3.** Haematopoietic stem cells can produce different blood cell lineages.

**Step 4.** That capacity makes HSC a multipotent stem cell.

**Final Answer:** The correct option is (c) HSC.

**EXPERT'S SOLUTION** : *Varun Mehta, Ph.D Cell Biology, JNU*

**Strategic angle.** Treat this as a stem-cell and organ-culture concept question. Use the exact NCERT property first, then add the explanation.

**Step 1.** A multipotent stem cell can produce several related specialised cell types within one lineage.

**Step 2.** Identify whether the question asks for a definition, comparison, list or MCQ choice.

- Step 3.** Anchor the answer in the NCERT term: self-renewal, potency, source, support or tissue architecture.
- Step 4.** The final answer is: The correct option is (c) HSC.
- Step 5.** This route keeps the answer compact enough for exams and complete enough for revision.

**Final Answer:** The correct option is (c) HSC.

**Q9.15** A stem cell is:

- (a) a cell out of which the stem of the tree is made up of
- (b) a part of the tissue that forms the outer layer of the skin in human beings.
- (c) it is a cell that can divide and give rise to specialised cells.
- (d) a type of specialised cell

**★ Quick Solution**

Concept: Stem Cell Culture and Organ Culture.  
Chapter: Class 12 Biotechnology Chapter 9.

Route: A stem cell can divide and give rise to specialised cells.

## SOLUTION

**Concept used.** The defining features of stem cells are self-renewal and differentiation.

**Step 1.** A stem cell is not related to the stem of a plant in this question.

**Step 2.** It is also not merely the outer layer of skin.

**Step 3.** It is not already a specialised cell.

**Step 4.** It can divide and form specialised cells, which matches option (c).

**Final Answer:** The correct option is (c) it is a cell that can divide and give rise to specialised cells.

**EXPERT'S SOLUTION** : Aditi Rao, M.Sc  
Biotechnology, Delhi University

**Strategic angle.** Treat this as a stem-cell and organ-culture concept question. Use the exact NCERT property first, then add the explanation.

**Step 1.** The defining features of stem cells are self-renewal and differentiation.

- Step 2.** Identify whether the question asks for a definition, comparison, list or MCQ choice.
- Step 3.** Anchor the answer in the NCERT term: self-renewal, potency, source, support or tissue architecture.
- Step 4.** The final answer is: The correct option is (c) it is a cell that can divide and give rise to specialised cells.
- Step 5.** This route keeps the answer compact enough for exams and complete enough for revision.

**Final Answer:** The correct option is (c) it is a cell that can divide and give rise to specialised cells.

\_\_\_\_\_ can be cured with stem cells.

- (a) Spinal cord injuries
- (b) Type 1 diabetes
- (c) Both (a) and (b)
- (d) None of these

### ★ Quick Solution

Concept: Stem Cell Culture and Organ Culture.

Chapter: Class 12 Biotechnology Chapter 9.

Route: Both spinal cord injuries and Type 1 diabetes are stem-cell application areas.

### SOLUTION

**Concept used.** Stem cells are studied for replacing damaged tissues and treating diseases with limited current therapy.

**Step 1.** Stem cells can form specialised cell types in culture.

**Step 2.** They are explored for tissue repair, including nervous tissue injury.

**Step 3.** They are also explored for Type 1 diabetes through replacement or support of insulin-producing cells.

**Step 4.** Since both listed conditions are relevant, option (c) is correct.

**Final Answer:** The correct option is (c)  
Both (a) and (b).

**EXPERT'S SOLUTION** : *Kunal Batra, Ph.D Stem Cell Biology, IISc Bangalore*

**Strategic angle.** Treat this as a stem-cell and organ-culture concept question. Use the exact NCERT property first, then add the explanation.

**Step 1.** Stem cells are studied for replacing damaged tissues and treating diseases with limited current therapy.

**Step 2.** Identify whether the question asks for a definition, comparison, list or MCQ choice.

**Step 3.** Anchor the answer in the NCERT term: self-renewal, potency, source, support or tissue architecture.

**Step 4.** The final answer is: The correct option is (c) Both (a) and (b).

**Step 5.** This route keeps the answer compact enough for exams and complete enough for revision.

**Final Answer:** The correct option is (c)  
Both (a) and (b).

**Q 9.17** The stem cells may be obtained from sources such as:

- (a) Bone marrow
- (b) Umbilical cord blood
- (c) Adipose tissue
- (d) All of these

★ **Quick Solution**

Concept: Stem Cell Culture and Organ Culture.

Chapter: Class 12 Biotechnology Chapter 9.

Route: Bone marrow, umbilical cord blood and adipose tissue can all provide stem cells.

**SOLUTION**

**Concept used.** Adult and postnatal stem cells are found in several tissues and clinically useful sources.

**Step 1.** Bone marrow is a classic source of haematopoietic stem cells.

**Step 2.** Umbilical cord blood is also a stem-cell source after birth.

**Step 3.** Adipose tissue can provide adult stem or stromal cell populations.

**Step 4.** Because all three are possible sources, option (d) is correct.

**Final Answer:** The correct option is (d)  
All of these.

**EXPERT'S SOLUTION** : *Sneha Kapoor, M.Sc  
Regenerative Biology, University of Mumbai*

**Strategic angle.** Treat this as a stem-cell and organ-culture concept question. Use the exact NCERT property first, then add the explanation.

**Step 1.** Adult and postnatal stem cells are found in several tissues and clinically useful sources.

**Step 2.** Identify whether the question asks for a definition, comparison, list or MCQ choice.

**Step 3.** Anchor the answer in the NCERT term: self-renewal, potency, source, support or tissue architecture.

**Step 4.** The final answer is: The correct option is (d) All of these.

**Step 5.** This route keeps the answer compact enough for exams and complete enough for revision.

**Final Answer:** The correct option is (d)  
All of these.

**Q 9.18** Assertion: Embryonic stem cells can give rise to different cell types.

Reason: Embryonic stem cells are pluripotent.

(a) Both assertion and reason are true and the reason is the correct explanation of the assertion.

(b) Both assertion and reason are true but the reason is not the correct explanation of the assertion.

(c) Assertion is true but reason is false.

(d) Both assertion and reason are false.

★ **Quick Solution**

Concept: Stem Cell Culture and Organ Culture.

Chapter: Class 12 Biotechnology Chapter

9. Route: Both statements are true, and

pluripotency explains the ability to form different cell types.

### SOLUTION

**Concept used.** Pluripotent cells can differentiate into almost all cell types of the embryo.

**Step 1.** Embryonic stem cells are present in the inner cell mass of the blastocyst.

**Step 2.** They can differentiate into many types of body cells.

**Step 3.** That is because embryonic stem cells are pluripotent.

**Step 4.** So the reason correctly explains the assertion.

**Final Answer:** The correct option is (a)  
Both assertion and reason are true and the reason is the correct explanation.

**EXPERT'S SOLUTION** : *Yash Desai, M.Sc Cell Biology, MSU Baroda*

**Strategic angle.** Treat this as a stem-cell and organ-culture concept question. Use the exact NCERT property first, then add the explanation.

- Step 1.** Pluripotent cells can differentiate into almost all cell types of the embryo.
- Step 2.** Identify whether the question asks for a definition, comparison, list or MCQ choice.
- Step 3.** Anchor the answer in the NCERT term: self-renewal, potency, source, support or tissue architecture.
- Step 4.** The final answer is: The correct option is (a) Both assertion and reason are true and the reason is the correct explanation.
- Step 5.** This route keeps the answer compact enough for exams and complete enough for revision.

**Final Answer:** The correct option is (a) Both assertion and reason are true and the reason is the correct explanation.

**Q 9.19**

**Assertion:** Stem cells are undifferentiated and found in multicellular organisms, and undergo numerous mitotic cycles.

**Reason:** Stem cells have self-renewal feature and do not exhibit cellular potency.

(a) Both assertion and reason are true and the reason is the correct explanation of the assertion.

(b) Both assertion and reason are true but the reason is not the correct explanation of the assertion.

(c) Assertion is true but reason is false.

(d) Both assertion and reason are false.

★ **Quick Solution**

Concept: Stem Cell Culture and Organ Culture.

Chapter: Class 12 Biotechnology Chapter 9.

Route: The assertion is true, but the reason is false because stem cells do exhibit potency.

**SOLUTION**

**Concept used.** Stem cells are defined by self-renewal and potency, not by absence of potency.

**Step 1.** Stem cells are undifferentiated cells

found in multicellular organisms.

**Step 2.** They can undergo mitotic cycles and maintain their population.

**Step 3.** Self-renewal is a correct stem-cell property.

**Step 4.** The reason becomes false when it says stem cells do not exhibit cellular potency.

**Step 5.** Stem cells do exhibit potency, which is their differentiation potential.

**Final Answer:** The correct option is (c)  
Assertion is true but reason is false.

**EXPERT'S SOLUTION** : *Ananya Rao, Ph.D*  
*Biotechnology, IIT Delhi*

**Strategic angle.** Treat this as a stem-cell and organ-culture concept question. Use the exact NCERT property first, then add the explanation.

**Step 1.** Stem cells are defined by self-renewal and potency, not by absence of potency.

**Step 2.** Identify whether the question asks for a definition, comparison, list or MCQ

choice.

**Step 3.** Anchor the answer in the NCERT term: self-renewal, potency, source, support or tissue architecture.

**Step 4.** The final answer is: The correct option is (c) Assertion is true but reason is false.

**Step 5.** This route keeps the answer compact enough for exams and complete enough for revision.

**Final Answer:** The correct option is (c) Assertion is true but reason is false.

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## Key Takeaways

- Stem cells are defined by self-renewal and potency.
- Totipotent, pluripotent and multipotent cells differ by differentiation range.
- Embryonic stem cells have wider potency, while adult stem cells usually have fewer ethical concerns.
- Organ culture preserves three-dimensional tissue organisation better than ordinary cell culture.
- Organ culture needs suitable support, nutrient diffusion and gas exchange.

End of Exercises