

3-D Performance Assessment

Performance Expectation: **HS-LS1-4**

Grade Level: **High School**

Adapted from [SNAP](#)¹

Title	Stem Cell Kidney Replacement		
Designed by	Jennifer Lumia, Tim Shrout, Omer Bitar	Course(s)	Living Environment
 This work is licensed under a Creative Commons Attribution-NonCommercial 4.0 International License.			

Performance Expectation	HS-LS1-4: Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms. Clarification Statement: none Assessment Boundary: Assessment does not include specific gene control mechanisms or rote memorization of the steps of mitosis.
-------------------------	---

Science and Engineering Practice	Developing and Using Models • Use a model based on evidence to illustrate the relationships between systems or between components of a system.
Disciplinary Core Ideas	LS1.B: Growth and Development of Organisms • In multicellular organisms individual cells grow and then divide via a process called mitosis, thereby allowing the organism to grow. The organism begins as a single cell (fertilized egg) that divides successively to produce many cells, with each parent cell passing identical genetic material (two variants of each chromosome pair) to both daughter cells. Cellular division and differentiation produce and maintain a complex organism, composed of systems of tissues and organs that work together to meet the needs of the whole organism.
Crosscutting Concept	Systems and System Models • Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions — including energy, matter, and information flows — within and between systems at different scales.

Student Performance	1. Components of the model 2. Relationships 3. Connections
---------------------	--

¹ The Short Performance Assessment (SPA) and the Assessment Rubric adapted from the Stanford NGSS Assessment Project <http://snappgse.stanford.edu/>



Performance Assessment

Phenomenon

A student was injured in an accident which caused both kidneys to fail. A matching organ donor was unavailable, and as their doctor you must replace the damaged organs. Fortunately, his parents harvested stem cells when he was born.

Stimulus

Figure 1) Differentiation of Cells

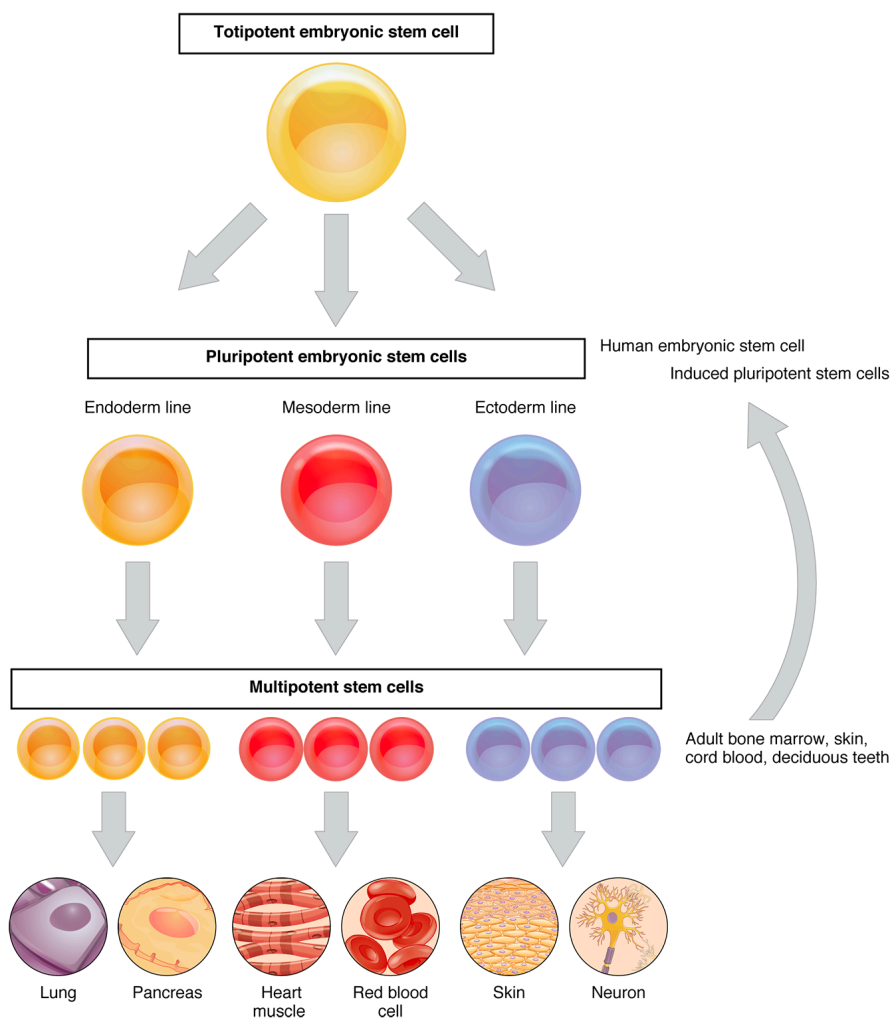
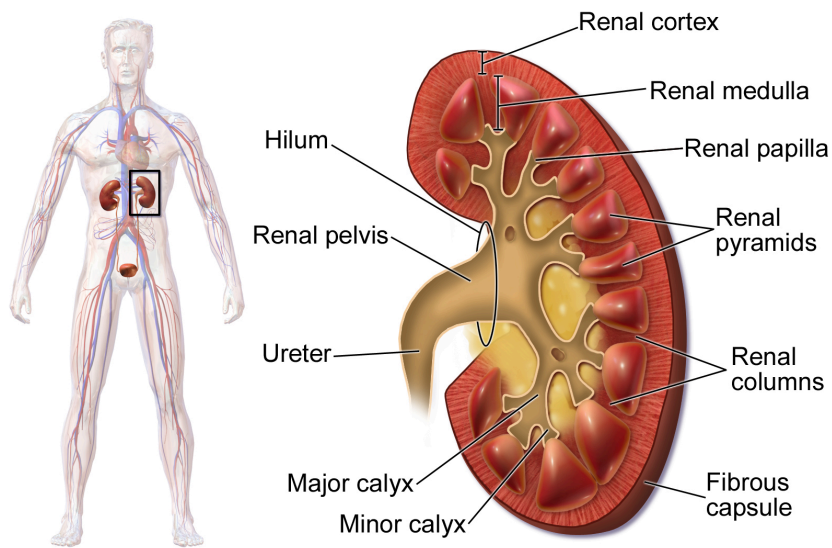
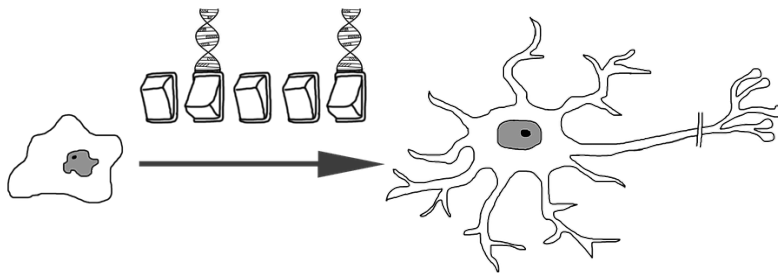


Figure 2) Kidney Structure



The Structure of a Kidney

Figure 3) Genetic switches



Prompt

Use figures 1, 2, and 3 to answer the following questions.

- 1) Compare the **genes of an individual's stem cells** with their kidney cells?
- 2) **Using the models**, what genetic changes need to be made in **stem cells** to develop into kidney cells?
- 3) **Once a small number of kidney cells are formed**, what cellular process needs to occur to form an entire kidney?
- 4) **Based on the image in figure 3**, would the creation of one type of kidney cell be sufficient in forming a functioning kidney?

Name_____

Cell Division and Differentiation Assessment

The Scenario:

A student was injured in an accident which caused both kidneys to fail. A matching organ donor was unavailable, and as their doctor you must replace the damaged organs. Fortunately, his parents harvested stem cells when he was born.

Figure 1) Differentiation of Cells

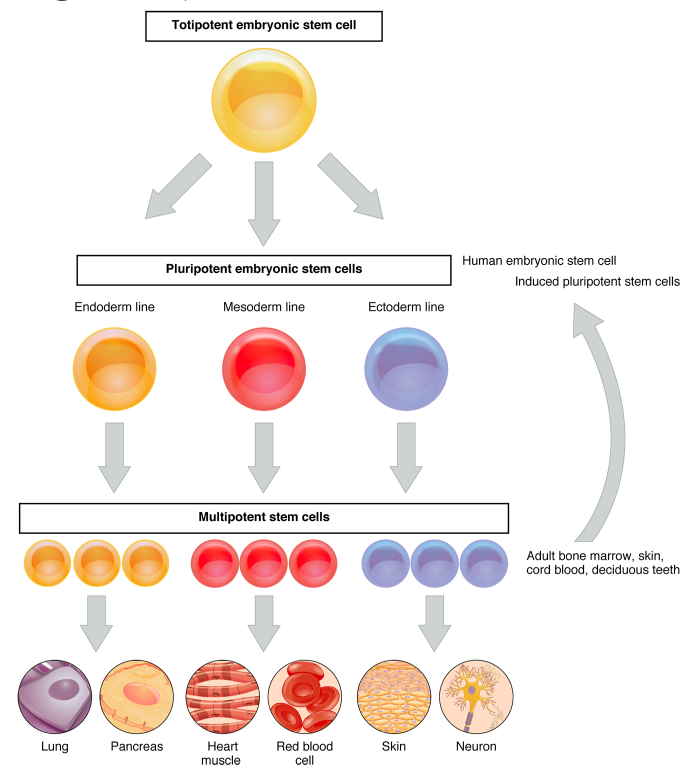


Figure 2) Kidney Structure

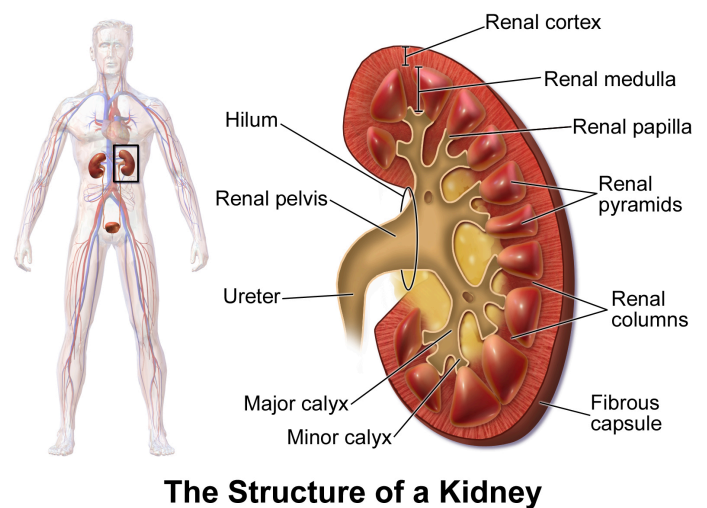
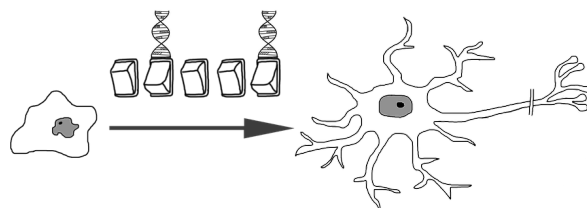


Figure 3) Genetic switches



Questions:

Use figures 1, 2, and 3 to answer the following questions.

- 1) Compare the genes of an individual's stem cells with their kidney cells?
- 2) Using the models (figures 1-3), what genetic changes need to be made in stem cells to develop into kidney cells?
- 3) Once a small number of kidney cells are formed, what cellular process needs to occur to form an entire kidney?
- 4) Based on the image in figure 2, would the creation of one type of kidney cell be sufficient in forming a functioning kidney?



Assessment Rubric* - Question 1

	Emerging	Developing	Approaching Proficiency	Excelling
Description of performance			Stem cells and kidney cells from the same person contain the same DNA.	
Sample student responses				

Assessment Rubric* - Question 2

	Emerging	Developing	Approaching Proficiency	Excelling
Description of performance				
Sample student responses				



Assessment Rubric* - Question 3				
	Emerging	Developing	Approaching Proficiency	Excelling
Description of performance				
Sample student responses				

Assessment Rubric* - Question 4				
	Emerging	Developing	Approaching Proficiency	Excelling
Description of performance				
Sample student responses				

