Assessment of your knowledge

(a) Answer the following questions to assess your command on terminology, facts, concepts, and

theories learned in this chapter:

1. What is the name of the process during embryogenesis in which the three germ layers are

established?

2. Name the three germ layers and indicate for each of these germ layers organs that are

derived from these cells.

3. When do embryonic cells of the inner cell mass of the blastocyst loose pluripotency?

4. What is a morphogen?

5. Name a few examples of growth factors that can act as morphogens.

6. At which position in the embryo do neural crest cells arise?

7. Why is it difficult to isolate neural crest cells for tissue engineering purposes?

8. Which are the two most important cell sources contributing to cardiac development?

9. Explain why transplantation of an avascular heart valve in a child with a congenital heart

valve disorder is far from ideal?

10. What is the difference between vasculogenesis and angiogenesis?

11. Which process drives the specification of blood vessels in arteria and veins?

12. Which cell types are responsible for stabilization of the vessel walls in arteries and veins

and precapillaries?

13. Schwann cells are important for survival of peripheral nerves and can be divided in two

types of cells. Which types?

14. The survival of Schwann cells critically depends on signaling molecules derived from the

associated neuron. What is the name of this signaling molecule?

15. Keratinocytes and dermal fibroblasts are derived from two distinct germ layers. Which are

these germ layers?

16. During skin development in vitro, the role of the dermal fibroblasts can be replaced by a

growth factor. Which growth factor?

17. Which three cellular processes drive embryonic skin development?

18. Two distinct processes drive bone formation in the embryo. Name these two processes and

indicate which bones are formed through either of these processes?

19. Osteoblasts and chondrocytes at one hand and osteoclasts at the other hand are derived

from two distinct cell lineages. Which are these two cell lineages?

20. Provide two examples highlighting the critical role of environmental factors during organ

formation in the embryo.

(b) Answer the following questions to assess your ability to apply the concepts and theories learned

in this chapter in real life, clinical, and scientific situations:

1. Describe shortly how the sequence of events that lead to the formation of the three germ

layers during gastrulation can be mimicked in vitro starting from iPS cells.

2. Epithelial to Mesenchyme Transition (EMT) is a frequent recurring process during organ

formation and during tumor metastasis. Describe shortly the sequence of events that result

in an EMT and provide an example of an EMT during embryogenesis.

3. Describe the sequence of geometrical changes that lead to the formation of a functional

heart.

4. Argue why tissue engineering strategies relying on a modular approach are likely more

successful than a top-down approach in which one attempts to engineer a whole organ in

one step.

5. Argue why knowledge of organ formation during embryogenesis can help in optimizing

tissue engineering strategies.

6. Describe shortly the sequential steps in bone formation by endochondral ossification.

7. Argue why the healing of critical bone defects that do not heal spontaneously by using a

tissue engineering strategy that relies on endochondral ossification is likely more successful

than attempts of healing these bone defects using the intramembranous ossification

pathway.

8. Argue why it is not possible to differentiate an iPS cell directly into a cardiomyocyte.

9. Describe the interactions between Schwann cells and peripheral nerves and vice versa.

10. What would be your strategy to derive a differentiation protocol for the generation of

kidney epithelial cells starting from an established iPS cell line?