

Assessment of your knowledge

(a) Answer the following questions to assess your command on terminology, facts, concepts, and theories learned in this chapter:

1. List the three typical steps of cellular signaling.
2. Describe two ways in which a ligand binding to an extracellular receptor can transmit a signal into the cytoplasm.
3. List the three main types of ligands.
4. Explain the biochemical properties of ligands that act extracellularly compared to those that act intracellularly.
5. What happens to the receptor of bone morphogenetic protein 2 (BMP2) when it binds the ligand?
6. What is the structure of a G-protein-coupled receptor?
7. What happens to a G-protein upon binding of a ligand to a G-protein-coupled receptor?
8. How does protein kinase A get activated?
9. Name three members of the receptor tyrosine kinase family.
10. Which Smads are activated by bone morphogenetic proteins (BMPs) and which are activated by transforming growth factors (TGFs)?
11. Name the three major signaling pathways that Wnts can activate.
12. What happens to β -catenin when Wnt binds its receptor?
13. How does a Rho family protein get activated?
14. Why is NF- κ B known as a latent regulatory protein?
15. Name three roles of interleukins.
16. Why is vitamin D considered a deviation from the cell signaling paradigm?
17. What are transcription factors?
18. What is a mechanism that cells use to ensure the correct set of genes is activated?
19. How has RNA sequencing affected the field of tissue engineering?
20. Why are three-dimensional models considered powerful for tissue engineering?

(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. Provide an example of why you might want to promote Wnt signaling. And knowing that CHIR99021 is a Wnt activator, describe how it works.
2. Describe a scenario in which one ligand can have two different effects on cells. Provide detailed molecular information.
3. Sometimes cellular signaling proceeds by inhibiting a part of a pathway instead of activating it. Give a detailed example.
4. Describe the steps of GPCR signaling involving the parathyroid hormone-like hormone.
5. VEGF signaling contributes to the formation of new blood vessels. Draw the steps of RTK signaling involving VEGF.
6. BMP signaling contributes to bone formation. Draw the steps of TGF- β signaling involving BMP.
7. Explain how negative regulation of BMP activity occurs.
8. Draw the steps of canonical Wnt signaling.
9. How is it that some signals have very fast actions while others are comparatively slow?
10. Show and explain how different extracellular environments could lead to different levels of signal transduction in the same cell.