1. You have been investigating the use of stem cells for various applications, and have been interested in obtaining human cells for your studies. One of your clinical colleagues has been able to obtain for you a suspension of human cells, which she says contains mature differentiated cells as well as stem cells.
   a) Is there some environmental culture condition that you could alter to try to favor the growth of the stem cells over the mature differentiated cells?
      Stem cells have a low oxygen demand compared to mature cells, so one can try to use low oxygen environment in the incubator.
   b) Would this approach likely work for all types of differentiated cells?
      Not necessarily, because some types of adult, mature cells such as chondrocytes also may be maintained in a low oxygen environment.

2. A colleague of yours, who is beginning to investigate the behavior of stem cells from various tissue sources, has told you that she expects stem cells from various sources to display different types of growth behavior in culture. Can you give her an example of a similar growth behavior displayed by stem cells isolated from different tissues?
   Stem cell from various sources (e.g., nerve and skeletal muscle) form spheres in culture (e.g., neurospheres). Cells will grow out from these spheres when the spheres are subcultured to other plastic dishes. Stromal cells (i.e., mesenchymal stem cells, MSCs) from marrow adhere to tissue culture plastic and grow as monolayers.

3. What method(s) can currently be used to identify a cell population as being mesenchymal stem cells (MSCs)?
   Two methods for identifying MSCs are: 1) adherence to plastic; and 2) differentiation potential in in vitro assays.
   There are currently no specific surface antigens that uniquely identify MSCs.

4. If MSCs were to be injected into the blood circulation of an animal, to what tissues would you expect them to engraft (disregarding clearance mechanisms)?
   MSCs will engraft to injured tissues and solid tumors.

5. Is the demonstration that MSCs can differentiate into a specific cell/tissue type in vitro indicative that the MSCs will differentiate into that cell type when implanted into that tissue in vivo?
   No, MSCs may differentiate to select tissue types in vitro but not differentiate to this tissue type in vivo. It may be that the growth factors employed in the in vitro assays are not present in the same doses, distributions, and forms in vivo.
6. It has been proposed that MSCs injected into defects in the infarcted heart wall may be beneficial even if the stem cells do not differentiate into cardiac muscle cells. Explain.

MSCs may release signals to stimulate host cell behavior: e.g., migration, mitosis, differentiation, biosynthesis, and apoptosis.