A new tissue engineering company has acquired the licensing rights to the following technologies, listed in increasing order of the expense of production and the expense of the license:

(a) An absorbable polymer which can be fabricated into non-porous and porous structures of various sizes and shapes. Small molecules and proteins can be incorporated into the polymer.

(b) Selected growth factors.

(c) Neonatal and adult cells of selected tissue types.

In your answers to the following questions you should propose the least expensive solution for the problem. Briefly explain the rationale underlying your solution and how the implant would function.

1. Cardiovascular Applications.
   As a result of her own coronary bypass, the CEO has been motivated to develop a construct that could be adapted to a variety of cardiovascular applications. Her idea is to seed a single sheet of a scaffold with cells and then to: (1) roll up the sheet to form a tube for use as a coronary artery; (2) cut out pieces of the sheet to apply to a heart valve frame; and (3) cut pieces of the sheet to use as patches for the treatment of myocardial infarcts.
   a. Which cell type(s) would you propose if the initial application is the coronary artery?
   b. Would there be any benefit to implanting the tube, which is to be used for engineering a coronary artery, first in another tissue site?
   c. Would it be likely that this construct would be effective for use for the heart valve and as a patch for the myocardial infarct?
   d. If you could produce a construct (single sheet) specifically to be used to treat the myocardial infarct, how would you proceed? Include mention of any methods that you would use to treat/condition the cell-seeded construct in vitro, before its implantation.
   e. In considering the use of cells alone for treatment of myocardial infarcts, it has been proposed that marrow-derived mesenchymal stem cells be used because they can be shown to differentiate to cardiac cells in vitro. If there is a benefit to their use in vivo, would you expect that it is due only to their differentiation into cardiomyocytes in the patient?

2. Marrow-Derived Mesenchymal Stem Cells (MSCs) for treating Defects in Meniscus and Articular Cartilage.
   a. A recent press release from a company which processes MSCs indicates that injection of the cells into a joint in which there is a torn meniscus may be of benefit. What traits of MSCs would explain their benefit in this application.
b. Many patients who present with a defect in articular cartilage of the knee joint also have a defect in the underlying bone. Which technologies would you use together to produce an implant for the treatment of such defects?