CHAPTER 7

1) Cell-cell: adherens junctions, desmosomes and tight junctions. Cell-matrix: focal adhesive complexes. In terms of their transmembrane proteins, adherens junctions and desmosomes use cadherins, tight junctions use claudins and focal adhesive complexes use integrins. An adherens junction is based on cadherins, calcium dependent homophilic cell adhesion molecules which attach to the actin cytoskeleton through two linchpin proteins: ß-catenin, which interacts with the intracellular domain of cadherins and α–catenin, which interacts with ß-catenin and actin.
2) The result of the experiment is that the cells will sort according to type. This outcome needs to be interpreted in terms of a combination of cell adhesion and surface tension. In such situations, cells with the highest adhesivity and the highest surface tension will tend to be surrounded by cells with less. In this experiment, the epidermal cells will be outside and the neural cells inside, which is what happens in the embryo.
3) A radial cleavage leads, through sequential cell division, to an organism with a number of well-organized and, for the most part, equal size, blastomeres. In the sea urchin, the spindle of the first two divisions is perpendicular to the animal vegetal axis whereas the third division is parallel.
4) Compaction is the process whereby the cells in the morula acquire polarity and lead to the formation of an outer and an inner group of cells. The outer cells have a distinct apico-basal polarity, with tight and adherens junctions and begin to pump fluid into the inside; as a result, one gets a blastocoel. The cells in the inside do not have an apico-basal polarity and form the inner cell mass.
5) A typical epithelial tissue forms a cellular monolayer in which all cells have an apicobasal polarity and are linked through adherens junctions. During an epithelial to mesenchymal transition, the cells lose their polarity, largely triggered by the dissolution of the adherens junctions and the loss of cadherin. This process can be triggered by Snail, a transcription factor that represses the expression of E-Cadherin.
6) Look at figures 7.17 (sea urchin) and 7.28 (*Xenopus*) and describe.
7) Epiboly describes radial intercalation and results in a spreading of the surface occupied by cells, whereas convergence extension is a process of polarized cell rearrangements whereby a surface of cells becomes ‘thinner’ and longer at the same time. During gastrulation, the easiest description of the use of these two processes is that convergence extension is associated with the invagination of the endoderm and the mesoderm, while epiboly is the process by which the epidermis spreads over the space left by the internalizing endoderm and mesoderm.
8) In the three instances the process is the trigger for gastrulation and promotes the invagination of the cells, providing force to spread the movements to adjacent cells.
9) See section 7.16. The localised cell shape changes are represented in Figure 7.28. These changes drive the buckling of the epithelium which is maintained by strong cell adhesion.
10) The migration is described in Figure 7.45. Ephrins provide the cues for directionality and tracks of their migration.
11) Blood vessel formation – distinguish between vasculogenesis and angiogenesis. Include mechanism of branching morphogenesis involving proliferation and VEGF as a chemoattractant.
12) Do this using, as a basis, the images in figures 3.6, 7.28 and 7.29 for *Xenopus* and 3.12 and 7.33 for fish.