humans, spectrum of different rates and styles of cell replacement and tissue renewal.A large dose of ioniz- ing radiation, by blocking cell division, halts renewal: within a few days, the lining of the intestine, for example, becomes deprived of cells, lead- ing to the devastating diarrhea and water loss characteristic of acute radiation sickness.In the skin, the outer layers of the epidermis e continually flaking off and being replaced from below, so that the involving renewal of the matrix as well as of cells: old bone are epidermis on. is renewed with a turnover time of about two months.Newborn absorptive and goblet cells generated from the stem cells are carried upward by a sliding movement in the plane of the epithelial sheet until they reach the exposed surfaces of the villi; at the tips of the villi the cells die and are shed into the lumen of the gut (Figure 21-36).Although they are not terminally differentiated, stem cells of adult tissues are nevertheless specialized: under normal conditions, they stably express sets of gene regulatory proteins that ensure that their differentiated progeny will be of the appropriate types.In the lining of the small intestine, for example, the absorptive and goblet cells together are arranged as a single-layered epithelium that covers the surfaces of the fingerlike villi that project into the lumen of the gut.The epidermis is a many-layered epithelium, with stem cells and precursor cells in the basal layer, adherent to the basal lamina; the differentiating cells travelWhen a stem cell divides, though, each daughter has a choice: either it can remain a stem cell, or it can embark on a course leading irreversibly to terminal differentiation, usually via a series of precursor cell divisions (Figure 21-35).New red blood cells in humans are con- tinually generated in the bone marrow (from yet another class of cells) macrophages, while new matrix is deposited by another set of cells, and released into the circulation, from which they are removed and destroyed after 120 days.Red blood cells, surface epidermal cells, Many of the differentiated cells that need continual replacement are and the absorptive and goblet cells of the gut lining are all of this type.The stem cells a stock of proliferating precursor cells, which themselves usually derive and proliferating precursor cells are retained in the corresponding tis- sues along with the differentiated cells.This epithelium is continuous with the epithelium that lines the crypts that descend into the underlying con- nective tissue, and the stem cells lie near the bottom of the crypts.Bone, for example, has a turnover time of about ten years in matrix is slowly eaten away by a set of cells called osteoclasts, akin to osteoblasts, akin to fibroblasts.Stem Cells Generate a Continuous Supply of Terminally Differentiated Cells themselves unable to divide.Such cells are referred to as terminally differentiated: they lie at the dead end of their developmental pathway.Replacements for terminally differentiated cells are generated from from small numbers of more slowly dividing stem cells.Stem cells are not terminally dif- ferentiated and can divide without limit (or at least for the lifetime of the animal).The job of the stem cell and pre- cursor cells, therefore, is not to carry out the specialized function of the differentiated cell, but rather to produce cells that will.The pattern of cell replacement varies from one stem-cell-based tissue to another.And so Our life depends on these renewal processes.Stem cells are usually present in small numbers and often have a nondescript appear- ance, .making them difficult to identify.A contrasting example is found in the epidermis

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