

Cell specialization

What is differentiation?

Cell specialization

How do gradients affect gene expression in an early embryo?

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What are the two properties of stem cells?

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Name two stem cell niches in adult humans.

Cell specialization

Totipotent, pluripotent, multipotent: what can each form?

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Name some of the largest and smallest human cells.

Cell specialization

What is the SA:V of a cube of side L?

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Why does SA:V constrain cell size?

The concentration of a signal molecule differs with position, so cells in different positions express different genes.

The development of unspecialized cells into specialized cells by expressing different genes.

Bone marrow and hair follicles.

They can divide endlessly and differentiate along different pathways.

Large: egg (about 110 μm), neurons with long axons, striated muscle fibres. Small: sperm, red blood cells (about 7-8 μm).

Totipotent: any cell type, including placenta. Pluripotent: any body cell. Multipotent: a limited range of related cells.

Exchange depends on surface area but the need for exchange depends on volume, which increases faster as a cell grows.

$6L^2 \div L^3 = 6 \div L$, so SA:V falls as L increases.

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Name three adaptations that increase the SA:V of cells.

Cell specialization **HL only**

How are type I pneumocytes adapted?

Cell specialization **HL only**

How are type II pneumocytes adapted?

Cell specialization **HL only**

Compare cardiac muscle cells and striated muscle fibres.

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Suggest why cardiac muscle cells are branched.

Cell specialization **HL only**

Why is a striated muscle fibre an atypical cell?

Cell specialization **HL only**

What are the acrosome and midpiece of a sperm for?

Cell specialization **HL only**

How do cortical granules prevent polyspermy?

They are extremely thin, giving a short diffusion distance for gases.

Flattening (erythrocytes), microvilli and invagination (proximal convoluted tubule cells).

Both have contractile myofibrils. Cardiac: branched, short, one nucleus. Striated: unbranched, long, many nuclei.

Many lamellar bodies (secretory vesicles) that discharge surfactant into the alveolar lumen.

It has one continuous plasma membrane but forms by fusion of cells and has many nuclei.

Branches joined at intercalated discs form a network, so impulses spread quickly and the heart contracts as a unit.

After one sperm enters, they release their contents by exocytosis, hardening the zona pellucida.

Acrosome: enzymes to digest a path through the zona pellucida. Midpiece: mitochondria making ATP for the flagellum.

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Name three adaptations of the human egg.

Large size with nutrients in the cytoplasm; a zona pellucida; cortical granules.