The external environment is different from the internal environment found within an organism and within its cells. **To survive, organisms transfer materials between the two environments.**

This takes place at exchange surfaces and always involves crossing cell plasma membranes.

The environment around cells of multicellular organisms is called <u>tissue fluid</u>. Because most cells are too far from exchange surfaces for diffusion alone to supply or remove various materials, on (e) absorbed these are rapidly distributed to the tissue fluid and waste products returned to the exchange surface from removal.

Organisms with a higher metabolic rate exchange more materials so need a larger surface area to volume ratio. Substances that need to be exchanged include: respiratory gases (oxygen/CO2) nutrients (glucose/fatty acids/amino acids/vitamins/ minerals) excretory products (urea/CO2).

Surface area to volume ratio:

For exchange to be effective, the exchange surface must be large compared to its volume.



Features of specialised exchange surfaces:

- Large surface area to volume ratio—increases rate of exchange
- Very thin so that the diffusion distance is short—rapid exchange
- Selectively permeable—allow secreted materials to cross
- Transport system to ensure the movement of the internal medium (such as blood) maintain diffusion gradient

• Fill in the table below:

Size of side (a)	Surface area of the box (a x a x 6)	Volume of the box (a x a x a)	Surface area to volume ratio
1	6	1	6:1
2	24	8	3:1
3	54	27	2:1
4	96	64	1.5 : 1
5	150	125	1.2 : 1
6	216	216	1:1

Surface Area:	Volume:
$\int 4\pi r^2$	$\frac{4\pi r^3}{3}$