



Diameter (cm)	0.5	1.0	1.5
Surface Area (cm <sup>2</sup> )	0.79	3.14	7.07
Volume (cm <sup>3</sup> )	0.6	0.52	1.77
Surface to Volume Ratio	13.2:1	6:1	4:1

**Figure 4.31.1****Surface to Volume Ratio as it Relates to Cell Size**

As can be seen from the graphic, as the size of a spherical cell becomes larger, its volume increases more so than the surface area. Since the cell relies on its surface area to absorb nutrients and eliminate wastes, there comes a certain volume of the cell which the surface area cannot support. That means the cell needs more nutrients than the limited surface area of the cell can absorb, and needs to eliminate more wastes than can be passed across the cell membrane outside the cell.

All nutrients need to come into the cell from the outside, and all biosynthesized products and wastes need to be eliminated from inside of the cell. As stated above, all movement processes occur across the cell membrane. That means that cells are dependent upon the membrane surface area to provide for the movement of substances into and out of the cell. However, the metabolic needs of the cell are more determined by the volume of the cell. Therefore, there will be a theoretical size at which the surface area of the cell cannot facilitate the proper passage of substances to and from the cell and the cell dies.

**4.32 PEOPLE OF SCIENCE**

**Robert Hooke** (1635-1703) was an English scientist and architect who first termed the word "cell" after looking at some cork using a microscope he devised on his own. He was the inventor of the compound microscope, in which a series of lenses are used to magnify an image; it is still the most common microscope in use today. He also invented several practical items, such as the universal joint (still used in cars and trucks today). He was the first to describe some properties of elasticity and work out a formula that is referred to, 300 years later, as Hooke's Law.

**4.33 KEY CHAPTER POINTS**

- Cell theory states that cells are the basic functional unit of all life.
- Organisms which contain only one cell are unicellular organisms. **Organisms** which contain more than one cell are multicellular organisms.
- All cells:
  - have DNA
  - have diverse shapes and functions
  - have a cell membrane to protect it and organelles inside
  - reproduce themselves
  - can absorb nutrients from their environments
  - can digest and process nutrients
  - can synthesize organic molecules
  - can move substances into, out of, and throughout the cell
  - can respond to the environment
  - can maintain homeostasis
- There are two basic cell types—prokaryote and eukaryote.
- The cell membrane protects the cell from the environment.
- The cell interior contains the organelles and DNA.
- The cell membrane is a two layer structure composed of phospholipids and proteins.
- The cell membrane transports substances into and out of the cell in a variety of ways.