1. State the *functions of life*, as demonstrated by all living organisms.
2. Define the following terms, with examples:

*Unicellular*

*Multicellular*

*Acellular*

1. State some examples of *modern technology* that have confirmed cell theory.
2. Outline the three fundamental statements of *cell theory*

|  |
| --- |
| *i. Cells are the smallest units of life* |
|  |
| *ii.*  |
|  |
| *iii.*  |
|  |

1. Outline the significance of the work of these scientists in forming cell theory.

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| *i. Antonie van Leuwenhoek* |
|  |
| *ii. Robert Hooke* |
|  |
| *iii. Louis Pasteur and Robert Remak* |
|  |

1. Describe how the following examples might be exceptions to cell theory.

 a. Muscle cells and fungal hyphae

 b. Viruses

 c. Amoebae

1. Complete this table of SI units of length:

|  |  |  |
| --- | --- | --- |
| **Unit** | **Abbreviation** | **Metric Equivalent****Whole scientific notation** |
| kilometer | km | 1 000 m | 103 m |
|  | m | 1 m | 1m  |
| centimeter | cm |  | 10-2 m |
|  | mm | 0.001 m | 10-3 m |
| micrometer | μm | 0.000 001 m |  |
| nanometer | nm |  |  10-9m |

1. The diagram below shows the characteristic rod-shaped structure of *E. coli* bacteria.



 a. Calculate the *magnification* of the image.

b. State the method (shown here) by which bacteria reproduce.

1. Calculate the *actual size* of the structures delineated in yellow.



1. *Calculate the magnification* of these scale bars:



1. What is the magnification of these images?

1. Scale bar 10µm measures 40mm on the image.

 b. Scale bar 5µm measures 25mm on the image.

1. A micrograph has a scale bar of 2µm, which measures 40mm on the image. Measuring the maximum length of the cell in the image, the ruler reads 180mm. How long is the cell?
2. A student views an image of a cell magnified 350 times. The image is 250mm long. What is the actual length of the sample in the image?
3. Compare the sizes of these structures. Use SI units. 

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Plant cell | Animal cell | nucleus | bacteria | Mito-chondria | virus | ribosome | Membrane thickness | molecules |
|  |  |  |  |  |  |  |  |  |

1. Use some of these electron microscope resources to view molecules, cells and structures and to practice calculating magnifications and actual sizes.

Virtual Electron Microscope: **http://virtual.itg.uiuc.edu/**

 Microscopy UK: **http://www.microscopy-uk.org.uk/**

1. As the volume of a cell increases, what happens to…? (increase/ decrease)
2. Production of waste products.
3. Usage of nutrients and oxygen.
4. The surface area: volume ratio.
5. State the advantages of maximizing the *surface area: volume ratio* in a cell.
6. List some adaptations used by cells to maximize SA:Vol ratio.
7. List some adaptations used by multicellualr organisms to maximize SA:Vol ratio
8. Describe how a large SA:Vol ration can be harmful or costly to small animals.
9. Describe how the invasive *Caulerpa* algae genus break the rules of SA:Vol.
10. Unicellular organisms carry out all the functions of life, multi-cellular organisms differentiate and show emergent properties. Describe what is meant by the term *emergent properties*.