# Meet The Microbes!
## Activity 1: How Big Are Microbes?

## NGSS Alignment

### CORE IDEAS

**Core Idea LS1: From Molecules to Organisms: Structures and Processes**

LS1.A: Structure and Function

**Core Idea LS2: Ecosystems: Interactions, Energy, and Dynamics**

LS2.B: Cycles of Matter and Energy Transfer in Ecosystems

### CROSS CUTTING CONCEPTS

- ☐ Patterns
- ☑ **Cause and effect: Mechanism and explanation**
- ☐ Scale, proportion, and quantity
- ☐ Systems and system models
- ☑ **Energy and matter: Flows, cycles, and conservation**
- ☐ Structure and function
- ☐ Stability and change

### PRACTICES

- ☑ **Asking questions (for science) and defining problems (for engineering)**
- ☐ Developing and using models
- ☐ Planning and carrying out investigations
- ☐ Analyzing and interpreting data
- ☐ Using mathematics, information and computer technology, and computational thinking
- ☑ **Constructing explanations (for science) and designing solutions (for engineering)**
- ☑ **Engaging in argument from evidence**
- ☐ Obtaining, evaluating, and communicating information

# Activity 1: How Big Are Microbes?

Microbes are too small to see with an unaided eye and therefore it is difficult to gain perspective of their size. In this activity you will make a scale model showing the relative sizes of viruses and bacteria in comparison to a human blood cell and a human hair.

*(Adapted from: http://www.microbeworld.org/microbeworld-experiments/lets-get-small)*

**Time:** 50 minutes

**Materials:**

- Metric ruler or meter stick
- Access to large, open area (field, gymnasium, empty parking lot)
- Magnifying glass
- **Activity 1: Relative Size Chart**
- Pictures of human hair, human red blood cell, bacterium, virus (use those provided in **Activity 1: Images** or find/draw your own)

## Procedure

1. Examine an actual human hair **with** and **without** magnification.
2. Using the information in the **Relative Size Chart**, mark off a distance equal to the **width of a human hair**. Place an image of a human hair at this distance.
3. Repeat this process, measuring and marking the scale distances representing the diameter of a **human red blood cell**, the size of a **bacteria** and the size of a **virus**.

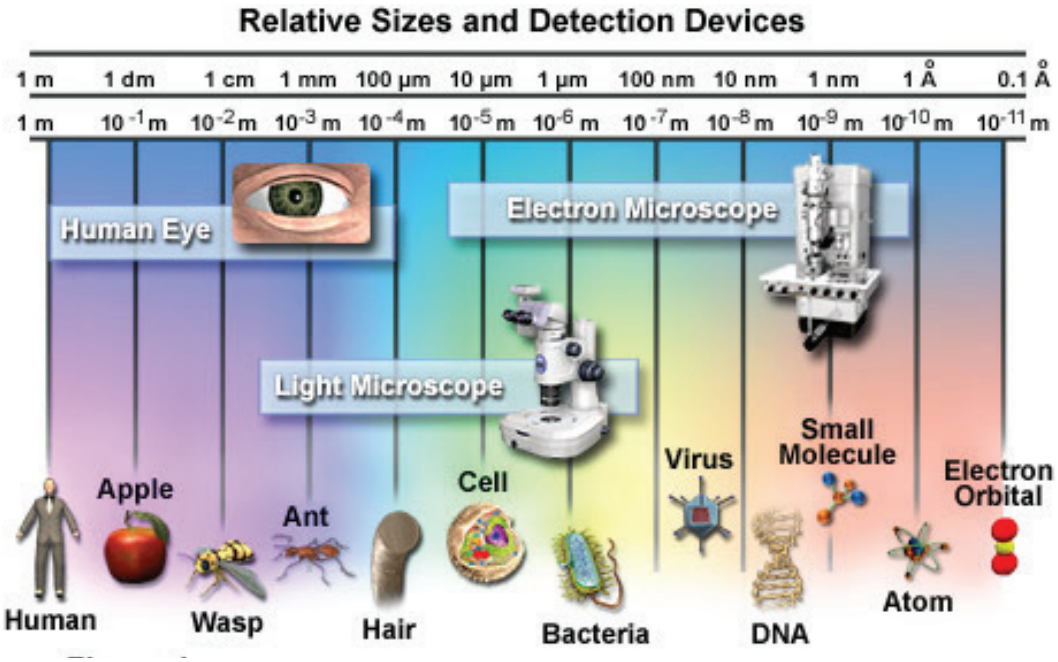
## Questions

1. **List in order of increasing size:** bacteria, virus, human red blood cell, human hair.
2. **How much bigger is a bacterium than a virus?**
   (Approximately how many times bigger is a bacterium than a virus?)
3. **How much bigger is a human red blood cell than a bacterium?**
   (Approximately how many times bigger is a human red blood cell than a bacterium?)
4. **Why do we need to make a model to show the relative sizes of these objects instead of simply looking in a microscope?**
   (Explain the benefits of using a model.)

# Activity 1: Relative Size Chart

| | Actual Size | Scale Size |
|---|---|---|
| **Human hair (width)** | 0.1 mm wide | 10 m |
| **Human red blood cell (diameter)** | 10.0 µm (0.01 mm) | 1 m |
| **Bacteria** | 0.5-2.0 µm (0.005-0.002 mm) | 5-20 cm |
| **Virus** | 20-100 nm (0.00002-0.0001 mm) | 2 – 20 mm |

**Key:**
cm = centimeters (hundredth of a meter)
mm= millimeters (thousandths of a meter)
µm = micrometers (millionths of a meter)
nm = nanometers (billionths of a meter)

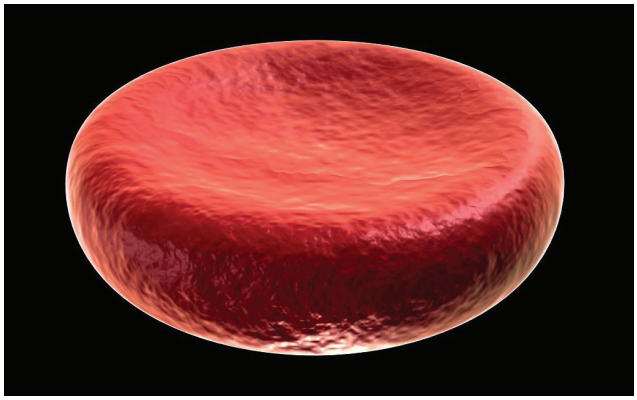



*http://micro.magnet.fsu.edu/cells/images/cellsfigure1.jpg*

# Activity 1: Images

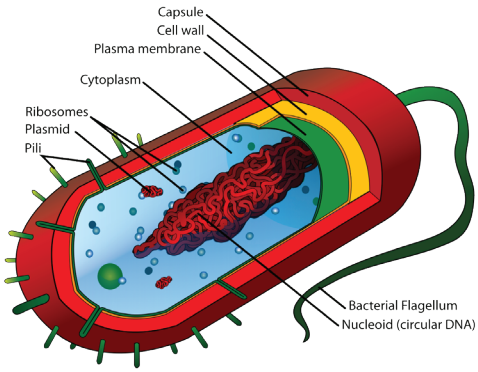
## Human Hair

*By Titus Tscharntke [Public domain], via Wikimedia Commons*



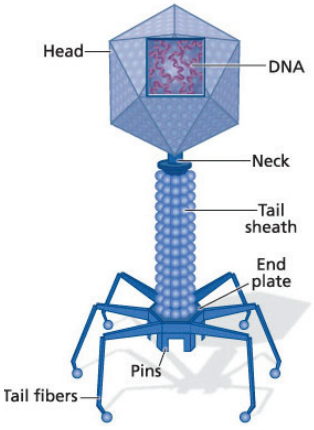
## Human Red Blood Cell

*By Rogeriopfm (Own work) [CC BY-SA 3.0 (http://creativecommons.org/licenses/by-sa/3.0) or GFDL (http://www.gnu.org/copyleft/fdl.html)], via Wikimedia Commons*




## Bacterium

*http://upload.wikimedia.org/wikipedia/commons/thumb/5/5a/Average_prokaryote_cell-_en.svg/1258px-Average_prokaryote_cell-_en.svg.png*




## Virus

*http://www.sholtoainslie.com/wp-content/uploads/2013/03/VirusStructure1.jpg*