Welcome to Bio 1030
Biology Today

Second Part of Semester
Feb 27-April 21, 2008

Instructor for Second Part:
Moti Nissani
Previous Lecture 1: Nature of Scientific Inquiry

Assigned Readings: Bio 1030 & Hempel: Scientific Inquiry
Both posted at: www.is.wayne.edu/mnissani/bio1030/

Instructor’s E-mail: aa1674@wayne.edu
Lectures will not typically reiterate material from assigned readings. I shall assume that you can master those on your own. Instead, lectures will explain, add to, and amplify key concepts.
Many discoveries and breakthroughs in science:
Extending our senses
Telescope: Moon
Dolphin Conversation.

With instruments, we can really eavesdrop:
Sonogram: Baby of 20 weeks:

http://youtube.com/watch?v=3bzEXM8c0P4
Microscopy is yet another way of expanding our sensory world:
There are several types of scopes:
3 Views of Paramecium with 3 Types of Scopes: Light (500X), Scanning Electron (2,000X), and Transmission Electron (2,800X)
A Typical Light Microscope

- Head
- Eyepiece
- Eyepiece Tube
- Nosepiece
- Objective turret
- Objectives
- Frame
- Iris Diaphragm
- Condenser
- Coarse Focus
- Fine Focus
- Illumination System
- Base
- Illumination Intensity Knob
Microscopy: 3 Key Features:

- Magnification: with scope
- Resolution: w scope
- Contrast: w scope
The Microscope, in turn, led to the CELL THEORY

Cells: The building blocks of all living organisms
Robert Hook’s Drawing, Plants, 1665
A Few Years Later, Antonie van Leeuwenhoek Saw Living bacteria, sperm, protozoa
Cell Theory. Cells are a fundamental feature of ALL LIFE (viruses excepted). There are 2 useful classification schemes here:

• unicellular vs. multicellular
• eukaryotes vs. prokaryotes
unicellular vs. multicellular

AMEOBA, that’s it, that is the entire organism
A Paramecium: about 100 μm (0.1ml, 0.00001m)
Here is how a live paramecium looks under the microscope.
Some cells, like bacterial cells, are very small, less than 1/10 of each of your trillions of cells: *E. coli*
And here is an example of an organism that is made of MANY CELLS
Here is another: If you scrape your cheek, stain, and place under the scope:
Cellular Organization of Higher Plants
A Second classification scheme: Eukaryotes vs. Prokaryotes

<table>
<thead>
<tr>
<th>Prokaryotes</th>
<th>Eukaryotes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smaller</td>
<td>Larger</td>
</tr>
<tr>
<td>Simpler</td>
<td>More complex</td>
</tr>
<tr>
<td>Most do not have membrane-enclosed organelles</td>
<td>Membrane-enclosed organelles</td>
</tr>
<tr>
<td>Bacteria and archaea</td>
<td>Protists, plants, fungi, animals</td>
</tr>
</tbody>
</table>

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The cells of a whale are about the same size as the cells of a mouse.
Every second, your body produces about 2 million red blood cells.
Scientific Notation: Powers:

\[ 2^3 = 2 \times 2 \times 2 = 8 \]

\[ 2^4 = 2 \times 2 \times 2 \times 2 = 16 \]

\[ 10^1 = 10 \]

\[ 10^3 \text{ m} = 10 \times 10 \times 10 = 1,000 \text{ m} = 1 \text{ kilometer} \]

\[ 10^6 = 10 \times 10 \times 10 \times 10 \times 10 \times 10 = 1,000,000 \text{ (1 million)} \]

Try to solve: What is \( 10^9 \)?
Scientific Notation: Negative Powers

$10^{-1} \text{ m} = \frac{1}{10} = 0.1 \text{ m}$

$10^{-3} \text{ m} = \frac{1}{1000} = 0.001 \text{ m} = 1 \text{ ml}$

$10^{-6} \text{ m} = \frac{1}{1,000,000} = 0.000001 \text{ m} = 1 \mu\text{m}$

=1 micrometer

Try to solve: What is $10^{-2}$?
So, if I had microscopic vision and could see air, I would see zillions of dancing atoms. Likewise, if I could magnify any living thing, I would see:

- **Single cells or clumps, simple, small:** prokaryotes (e.g., *E. coli*)
- **Single cells, large, complex:** Single-Celled Eukaryotes (e.g., paramecium, amoeba)
- **Complex, many cells:** Eukaryotes (maple trees, dogs, fleas)
Another way of visualizing this, from small to big:

Viruses: 0.00000001 meter: Life forms?

Bacteria: 0.000001 m, prokaryotes

Euglena, amoeba (single-cell organisms),
human heart cells (building blocks of a larger organism): 0.000001 m

A human child: 1 m

Distance to alpha-centauri: 4.3 light years,
or 40,000,000,000,000,000,000,000 m
Orders of Magnitude

<table>
<thead>
<tr>
<th>Measurement Equivalents</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 meter (m) = 100 cm = 1,000 mm = about 39.4 inches</td>
</tr>
<tr>
<td>1 centimeter (cm) = 10^{-2} \left(\frac{1}{100}\right) m = about 0.4 inch</td>
</tr>
<tr>
<td>1 millimeter (mm) = 10^{-3} \left(\frac{1}{1,000}\right) m = \frac{1}{10} cm</td>
</tr>
<tr>
<td>1 micrometer (µm) = 10^{-6} m = 10^{-3} mm</td>
</tr>
<tr>
<td>1 nanometer (nm) = 10^{-9} m = 10^{-3} µm</td>
</tr>
</tbody>
</table>
OK, Let’s see if I have been just talking to myself. Try to Answer:

$3^5=$
1. Cell theory states that . . .

2. Organisms can be classified, based on their number of cells into: _____ and _______ organisms
1. Based on complexity, size, and structures of their cells, organisms can be divided into which two major groups? ______________ __________________

2. Instruments that expand our sensory world are:
1. Explain: Magnification, resolution, contrast. What does $1 \times 10^{-3}$ mean?

2. What does $1 \times 10^3$ mean?

3. What does $1 \times 10^{-3}$ mean?
1. What’s our class website?
2. Instructor’s e-mail?
We mentioned that the cell of a mouse is about the same size as the cell a whale.

- So, cell-wise, what’s the difference between these 2 mammals?
- What about the cells of whales and bacteria? Whales and euglena?