Chapter 1
Exploring Life and Science

Points to ponder

• What is biology?
• What characterizes life?
• How do we classify life?
• Where do humans fit into the big picture?
• How do we study science?
• Where is scientific information published and what should you be aware of?

1.1 The characteristics of life

What characteristics are shared by living organisms?

• Organized from the atom to the biosphere
• Maintain a relatively constant internal environment (homeostasis)
• Respond to internal and external stimuli
• Use materials and energy from the environment
• Reproduce offspring
• Growth and development
• Organisms adjust or adapt to their environment
How are living things organized?

How are living organisms classified?

How do we classify humans?

<table>
<thead>
<tr>
<th>Domain</th>
<th>Human</th>
<th>House cat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kingdom</td>
<td>Eukarya</td>
<td>Eukarya</td>
</tr>
<tr>
<td>Phylum</td>
<td>Chordata</td>
<td>Chordata</td>
</tr>
<tr>
<td>Class</td>
<td>Mammalia</td>
<td>Mammalia</td>
</tr>
<tr>
<td>Order</td>
<td>Primates</td>
<td>Carnivora</td>
</tr>
<tr>
<td>Family</td>
<td>Hominidae</td>
<td>Felidae</td>
</tr>
<tr>
<td>Genus</td>
<td>Homo</td>
<td>Felis</td>
</tr>
<tr>
<td>Species</td>
<td>sapiens</td>
<td>domesticus</td>
</tr>
</tbody>
</table>
1.2 Humans are related to other animals

What distinguishes humans?

• Cultural heritage or patterns of our behavior passed from one generation to the next
• Well-developed brains
• Upright stance
• Language skills
• Varied tool use
• Modification of our environment for our own purpose which may threaten the biosphere

1.3 Science is a process

What do we know about science?

• Science is a way of knowing about the natural world
• Science and scientists should be objective
• Scientific conclusions may change or be modified as our understanding and technology increase
• Science is studied using the scientific method

1.3 Science is a process

The steps of the scientific method

1. Observation
2. Hypothesis
3. Experimental/Verification
4. Conclusion
5. Scientific Theory

New observations are made and analyzed data are studied.

Input from various sources is used to formulate a tentative statement.
The hypothesis is tested by experiment or further observations.
The results are analyzed, and the hypothesis is supported or rejected.
Many experiments and observations support a theory.
The scientific method in action

- Observations: many patients had a particular bacterium near their ulcers
- Hypothesis: *Helicobacter pylori* is the cause of gastritis and ulcers.
- Experiment/observations:
  1st – *H. pylori* was isolated and grown from ulcer patients
  2nd – humans swallowing a *H. pylori* solution resulted in inflammation in their stomachs
- Conclusion: *H. pylori* was the cause of most ulcers and can be cured by antibiotics

A controlled study

- Variables:
  - Experimental variable is the variable that is purposely changed or manipulated
  - All other variables need to remain constant
- Groups:
  - Test group is a group of subjects that are exposed to the experimental variable
  - Control group is a group for comparison that is not exposed to the experimental variable
Reading about scientific information

- Scientific journals are considered the best source of information but can be difficult for the lay person to understand.
- Often the lay person reads secondary sources and must be wary of information taken out of context.
- Be careful of information on the Internet by using reliable sources such as URLs with .edu, .gov and .org.

What should you look for when you read about science?

- Beware of anecdotal data.
- Understand methodology and results.
- Does the data justify the conclusions inferred by the scientists?
- Be able to read a graph.
- Have some understanding of statistics.

Does science have social responsibilities?

- Science is a way of acquiring knowledge about the natural world through a systematic process separating it from ethics, religion and aesthetics.
- Technology is the application of scientific knowledge to human interests.
  - Biotechnology (genetically modified crops).
  - Gene technology (cloning of humans or gene therapy to modify inheritance).
  - Use of stem cells from embryos.
- The Western world believes that science and technology improves our lives.
- You will learn more about all of these as you venture through this text. Consider your opinions.