Chapter 1 – The Study of Life

**Biology** is the study of life

How do we study life?

**Scientific method** – A methodology that considers only what is observable by the senses or by instruments that extend the ability of the senses

It starts off with a **hypothesis** – a tentative explanation of a scientific question based on observations & past knowledge – “an educated guess”!

Once a hypothesis is stated, it must be tested

Once tested, the data is analyzed to see if it supports the hypothesis or rejects it!

**The interesting thing about science is that a test can never prove a hypothesis true, because somewhere down the line a more sophisticated test may prove it wrong**

Hence, some think of science as what is left after alternative hypotheses have been rejected

**Theories** are related hypotheses that have stood the test of time & have not yet proven wrong.

It doesn’t mean they’ll last forever, but they have a good shot!
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Characteristics of Life

Living things …

1. are organized
2. acquire materials & energy
3. are homeostatic
4. respond to stimuli
5. reproduce
6. grow & develop
7. are adapted to their environment
8. belong to a population
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Living things are organized - Levels of organization

1. Molecular/chemical Atoms/Elements combine to form basic **biomolecules**

![Periodic Table of the Elements](image-url)
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Living things are organized - Levels of organization

1. Molecular/chemical  
   Atoms/Elements combine to form basic biomolecules

Covalent reactions (3)

Oxygen + Hydrogen → Water (H\textsubscript{2}O)

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Living things are organized - Levels of organization

1. Molecular/chemical  
   Atoms/Elements combine to form basic biomolecules

Condensation synthesis and hydrolysis of a dipeptide
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Living things are organized - Levels of organization

2. **Organelles**

   Biomolecules combine to form the organs of the cell
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Living things are organized - Levels of organization

2. Organelles
   Biomolecules combine to form the organs of the cell

3. Cells
   Basic unit of life capable of independent existence

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Animal cell
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Living things are organized - Levels of organization

4. Tissue

**Cells of similar structure & function**

A. **Muscle** - for contraction & force generation
   - skeletal, cardiac, & smooth

B. **Nervous** - for control via the initiation & transmission of electrical impulses

C. **Epithelial** - for protection, secretion, & absorption -
   - **exocrine** (ducted) glands & **endocrine** (ductless) glands

D. **Connective** - for support & binding of organs & structures
   - Blood, cartilage, bone, tendon, ligaments
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Living things are organized - Levels of organization

5. **Organs**  
   Composed of 2 or more **tissue** types - designed to perform a specific task

6. **Organ system**  
   Groups of organs working together to fulfill a common activity necessary for survival
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11 Major Body Systems

1. Circulatory
2. Digestive
3. Respiratory
4. Urinary
5. Skeletal
6. Muscular
7. Integumentary
8. Immune
9. Nervous
10. Endocrine
11. Reproductive
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Living things are organized - Levels of organization

7. Organism
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Living things acquire materials & energy

Living organisms must acquire materials & energy from the environment & convert them to molecules that their bodies need to survive

**Metabolism** – the sum of all chemical reactions in a cell or organism

Subdivided into:

1. **Catabolism** – Chemical reactions involving breaking larger molecules into smaller ones

2. **Anabolism** – Chemical reactions involving making larger molecules from smaller ones

Whenever any of these chemical reactions are occurring, you can think of it as energy **changing from one form to another**, with some processes requiring energy & others releasing energy
Living things are homeostatic

**Homeostasis** – State of balance or equilibrium

**Can you name some parameter in your body that must be maintained at a constant level or state?**

**How do we maintain homeostasis?**

**Negative** feedback occurs when a change in a controlled variable triggers a response that opposes the change, driving the variable in the opposite direction of the initial change

1. **Sensor** Monitors the magnitude of the controlled variable
2. **Set Point** Desired (homeostatic) magnitude of the controlled variable
3. **Integrator** Compares the sensor’s reading with the set point value
4. **Effector** Brings about the response to bring the controlled variable back to its set point value
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Living things respond to stimuli

Why is it necessary for you to respond to stimuli?

Living things reproduce

Why are you similar to any of your relatives with regards to both physical & psychological characteristics?

All information about you is encoded for in your genes. Genes are formed from molecules called DNA (deoxyribonucleic acid), & these genes are passed from parent to offspring via reproduction

Living things grow & develop

From the point of fertilization to death organisms go through obvious changes

Can you believe that you started out as a single round cell?
Living things are adapted

**Adaptations** are modifications that make an organism suited to its way of life

**How do these adaptations come about?**

**EVOLUTION!**

Evolution = change

**How are you adapted to your current environment?**

**Can you evolve to changes in your environment?**

Living things belong to a population

**Population** – All the members of a species that live within a community

**Species** – Group of similarly constructed organisms capable of interbreeding & producing fertile offspring; organisms that share a common gene pool

**Community** – Group of many different populations that interact with one another

**Ecosystem** – The interactions between a community & its physical environment

**Biosphere** – All the ecosystems interacting with one another = EARTH
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The classification of living things

**Taxonomy** – A system dedicated to naming, describing, & classifying organisms

### Classification of organisms

<table>
<thead>
<tr>
<th>Kingdoms of Life</th>
<th>Representative Organisms</th>
<th>Organization</th>
<th>Type of Nutrition</th>
<th>Representative Organisms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monera</td>
<td>spirochete, bacilli, Anabaena, Gloeocapsa</td>
<td>Microscopic single cell (sometimes chains or mats)</td>
<td>Absorb food (some photosynthesize)</td>
<td>Bacteria including cyanobacteria</td>
</tr>
<tr>
<td>Protista</td>
<td>paramecium, euglenoid, slime mold, dinoflagellate</td>
<td>Complex single cell, some multicellular</td>
<td>Absorb, photosynthesize, or ingest food</td>
<td>Protozoans, algae, water molds, and slime mold</td>
</tr>
<tr>
<td>Fungi</td>
<td>black bread mold, yeast, mushroom, bracket fungus</td>
<td>Some unicellular, most multicellular filamentous forms with specialized complex cells</td>
<td>Absorb food</td>
<td>Molds, yeast, and mushrooms</td>
</tr>
<tr>
<td>Plantae</td>
<td>moss, fern, pine tree, nonwoody flowering plant</td>
<td>Multicellular form with specialized complex cells</td>
<td>Photosynthesize food</td>
<td>Mosses, ferns, non-woody and woody flowering plants</td>
</tr>
<tr>
<td>Animalia</td>
<td>coral, earthworm, blue jay, squirrel</td>
<td>Multicellular form with specialized complex cells</td>
<td>Ingest food</td>
<td>Invertebrates, fishes, reptiles, amphibians, birds, and mammals</td>
</tr>
</tbody>
</table>
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PRACTICE QUESTIONS

1. What are the characteristics of life?

2. What is the proper progression of the levels of organization in the body (small to big)?

3. The four primary types of tissue are…

4. Define homeostasis.

5. Define metabolism, catabolism, anabolism.