

**Chapter 1:  
Introduction**

- 1. What is “Biology”?**
- 2. Characteristics of Living Things**
- 3. The Scientific Method**

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**1. What is Biology?**

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**What is Biology?**

**Biology is the scientific study of Life:  
of living things and the environments  
they live in.**

**Biology is investigated on a variety of  
scales from the very small (atoms  
and molecules) to the very large  
(populations and ecosystems)...**

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## Levels of Biological Inquiry

subatomic particle < atom < molecule < organelle

Organelle	A structure within a cell that performs a specific function	 mitochondrion	 chloroplast	 nucleus	
Molecule	A combination of atoms	 water	 glucose	 DNA	
Atom	The smallest particle of an element that retains the properties of that element	 hydrogen	 carbon	 nitrogen	 oxygen
Subatomic Particle	Particles that make up an atom	 proton	 neutron	 electron	

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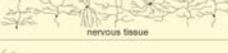
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## cell < tissue < organ < organ system < organism

Multicellular Organism	An individual living thing composed of many cells	 pronghorn antelope
Organ System	Two or more organs working together in the execution of a specific bodily function	 the nervous system
Organ	A structure usually composed of several tissue types that form a functional unit	 the brain
Tissue	A group of similar cells that perform a specific function	 nervous tissue
Cell	The smallest unit of life	 nerve cell

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## population < species < community < ecosystem < biome < biosphere

Biosphere	That part of Earth inhabited by living organisms; includes both the living and nonliving components	 Earth's surface
Ecosystem	A community together with its nonliving surroundings	 snake, antelope, hawk, bushes, grass, rocks, stream
Community	Two or more populations of different species living and interacting in the same area	 snake, antelope, hawk, bushes, grass
Species	Very similar, potentially interbreeding organisms	 herd of pronghorn antelope
Population	Members of one species inhabiting the same area	

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## 2. Characteristics of Living Things

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### Characteristics of Living Things

All things that we consider to be “alive” have the following characteristics:

- 1) the ability to reproduce
  - have genetic material (DNA, RNA)
- 2) acquire and use energy and matter
  - i.e., undergo metabolism
- 3) maintain a “constant” internal environment
  - i.e., homeostasis
- 4) respond, adapt to external environment

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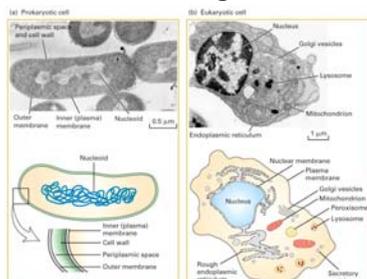
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### Cells are the Smallest Unit of Life

The most basic thing to exhibit all characteristics of being “alive” is the cell.



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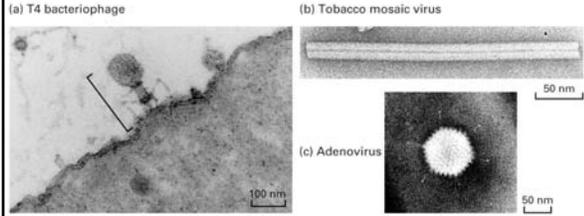
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## Is a Virus Alive?

No. By themselves, viruses don't reproduce, metabolize, respond to their environment or maintain homeostasis.



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## 3. The Scientific Method

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### The Scientific Method

Observation > Hypothesis > Experiment > Conclusion

- scientific investigation begins with an observation that leads to a question (ideally "Yes/No")

e.g., "Does vitamin D help prevent colds?"

**A good hypothesis is a statement that:**

- predicts an answer to the question of interest
- contains only objective, well-defined terms
- can be tested or challenged experimentally

"People who take vitamin D are less likely to get a cold."

\*A good hypothesis doesn't have to be correct, just testable!\*

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## Experimentation...

Hypotheses are tested experimentally, and experiments contain variables:

### Independent Variable (IV)

- the single factor that varies in an experiment
  - e.g., whether or not one takes a vitamin D supplement

### Standardized Variables (SV)

- all other factors that remain constant
  - e.g., age, gender, location, stress level, etc.

### Dependent Variables (DV)

- outcome being measured or recorded
  - e.g., occurrence of colds

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## ...more on Experimentation

Ideally experiments have 1 independent variable.

- any changes in the results (dependent variable) *must* be due to changes in the IV
  - >1 IV makes it unclear which IV affected the DV!

\*\*\*In an experiment, the IV is tested for its effect on the DV\*\*\*

Experimental results are then interpreted to either support or disprove the hypothesis:

- a hypothesis can never be proven, only supported
- an experimental result that is *inconsistent* with a hypothesis reveals it to be incorrect!

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## Control Experiments

Every experiment should ideally include a test in which the IV is set to zero or some default value, a test referred to as a control:

- leave out the IV (e.g., no Vitamin D)
- if IV can't be left out (e.g., temperature), set it to a default or background level (e.g., room temperature)

This sort of test is also called a negative control.

Positive controls (tests that give a known positive result) are also appropriate for some experiments.

\*\*\*Controls provide a reference for comparison in addition verifying that the experimental results are reliable\*\*\*

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## A Classic Biological Experiment

**Observation:**  
Flies swarm around meat left in the open;  
maggots appear on meat.

**Hypothesis:**  
Flies produce the maggots; keeping flies away  
from meat will prevent the appearance of maggots.

**Experiment**

control **1 independent variable** test

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### Key Terms for Chapter 1

- homeostasis
- hypothesis
- variables: independent, dependent, standardized
- control experiments

**Relevant Review Questions:**  
3, 6

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