

Hewitt/Lyons/Suchocki/Yeh  
**Conceptual Integrated  
 Science**

Chapter 1  
 ABOUT SCIENCE

### A Brief History of Advances in Science

The beginnings of science go back thousands of years to a cause-and-effect way of looking at the world.



Figure 1.1

### A Brief History of Advances in Science

Forward steps in the history of science, as highlighted in the text, occurred in many regions, beginning in ancient Greece and Polynesia.

During the Dark Ages in Europe, previous scientific knowledge was lost as religion became established.

During the 10th through 12th centuries, Islamic people brought books into Spain that had been banned by the church, and universities emerged as centers of knowledge.

### A Brief History of Advances in Science

During the 15th century,

- invention of Gutenberg's printing press
- arrival of Renaissance period that provided a foothold to the advance of science and rational thinking

During the 16-17th century,

- Galileo and Isaac Newton show the way for both experimental and theoretical science.

### Mathematics and Conceptual Integrated Science

#### Mathematics

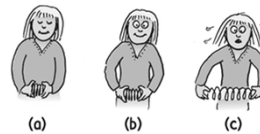
- Is an important tool in science
- equations are shorthand notation for the relationships between scientific concepts
- abbreviates a relationship that can be stated in words
- makes common sense
- equations can guide your thinking

### Mathematics and Conceptual Integrated Science

Example:

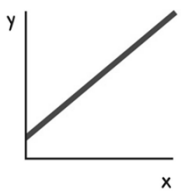
Concept—When you stretch a spring, your pull is proportional to the stretch.

Proportion—expressed as  $F \sim x$ ,  
 where  $F$  is your pulling force, and  
 $x$  is the distance the spring stretches



### Mathematics and Conceptual Integrated Science

Proportions and equations tell you:  
If one thing changes a certain way, another will change correspondingly.

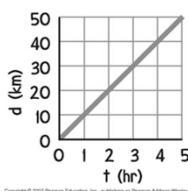


(a) The direct proportion.

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### Mathematics and Conceptual Integrated Science

Proportions and equations tell you:  
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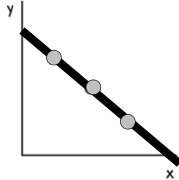
(b) A car travels at a constant speed. The more time it travels, the farther it goes. Distance is directly proportional to time.

This is a direct proportion.

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### Mathematics and Conceptual Integrated Science

Proportions and equations tell you:  
If one thing changes a certain way, another will change correspondingly.



What type of proportion is this?

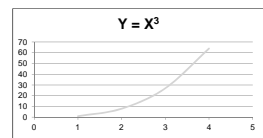
If Y gets smaller as X increases, then this is an inverse proportion, or

$Y \sim 1/X$

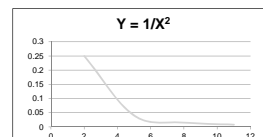
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### Mathematics and Conceptual Integrated Science

**Power Law**  
•  $Y \sim X^n$



**Inverse Square Law**  
•  $Y \sim 1/X^2$



### The Scientific Method—A Classic Tool

As outlined in section 1.3: Observation, Question, Hypothesis, Prediction, Testing/Experimenting, Conclusions  
one of the ways good science is performed

More important than a particular method is

- attitude of inquiry
- experimentation
- willingness to accept findings, even those not desired

### The Scientific Hypothesis

Principle of Falsifiability:  
For a hypothesis to be considered scientific, it must be testable—it must, in principle, be capable of being proved wrong.

## The Scientific Experiment

Rather than philosophize about nature, Galileo went an important step further—he *experimented!*

“The test of all knowledge is experiment. Experiment is the sole judge of scientific truth.”

Richard Feynman

“No number of experiments can prove me right; a single experiment can prove me wrong.”

Albert Einstein

## Facts, Theories, and Laws

**Fact:** a phenomenon about which competent observers can agree

**Theory:** a synthesis of a large body of information that encompasses well-tested hypotheses about certain aspects of the natural world

**Law:** a general hypothesis or statement about the relationship of natural quantities that has been tested over and over again and has not been contradicted - also known as a *principle*

## Science Has Limitations

Domain of science

- is in natural phenomena
- does not deal with the “supernatural”
- Is not related to “false science”, pseudoscience (Example: Astrology)

Claims to supernatural phenomenon, true or otherwise, lie outside the domain of science.

## Science And Society

In a recent poll, it was discovered that:

- 75% do not know that antibiotics kill bacteria but not viruses
- 57% do not know that electrons are smaller than atoms
- 53% of adults can't roughly approximate the percent of the Earth's surface that is covered with water
- 47% of adults don't know how long it takes for the Earth to revolve around the Sun
- 41% of Americans are unaware that dinosaurs and humans did not coexist

## Science, Art, and Religion

Science asks how

Religion asks why

Art bridges the two

When science and religion address their respective domains, conflict between the two is minimized or absent.

## Technology—The Practical Use of Science

Technology is

- an important tool of science
- sometimes the fruit of science, as in medicine that cures disease
- a human endeavor
- can be used to elevate or to diminish the human condition

The Natural Sciences: Physics, Chemistry,  
Biology, Earth Science, and Astronomy

Natural philosophy was at one time the study of unanswered questions about nature.

- It became science as answers were found
- As knowledge about the natural world increased, science became specialized into the different branches we know about today.
- Your textbook attempts to integrate the various branches into an overall scientific knowledge.

The Natural Sciences: Physics, Chemistry,  
Biology, Earth Science, and Astronomy

- **Physics** is the study of basic concepts such as motion, force, energy, matter, heat, sound, light, electricity, and magnetism.
- **Chemistry** builds on physics and studies how matter is put together to produce the growing list of materials and medicines we use in our everyday lives.

## Integrated Science

Why Integrated Science?

Because the fields of science

- overlap
- merge into one another, such as biophysics, biochemistry, geophysics, astrophysics, bioastrophysics
- acknowledged to present a cohesive study of the natural world