



Physical Science

Unit 1 Chapters 1-2

Ch 1 - The Nature of Science

Ch 2 – Motion

Based on: Glencoe Physical Science 2008

** Supplements added for clarification & correction*

SECTION
1

Section Focus
Transparency

Splendid Science

Chapter
1

Scientists work in different areas and different ways. These photos illustrate the three main divisions of science—life science, Earth science, and physical science. Scientists often work in more than one area, requiring them to have a broad base of knowledge. A biologist, for example, needs to know a good deal of chemistry to understand cell functions.

- 1.** Volcanoes are a topic studied in Earth science. Why might you need to know some physical science when studying volcanoes?
- 2.** What is the general purpose of science?
- 3.** What do the three divisions of science have in common?

Chapter One 1 - Section 1

The Methods of Science

- **A. Science** studies natural patterns.
 - 1. Science is classified into three main categories: **life** science, **Earth** science, and physical science: sometimes a scientific study will overlap the categories.
 - 2. Science explains the natural world; explanations can **change** over time.
 - 3. Scientists **investigate** nature by observation, experimentation, or modeling.

- **B. Scientific method** - organized set of investigation procedures
 - 1. **State** a problem.
 - 2. **Gather** information.
 - 3. Form a **hypothesis** or educated guess based on knowledge and observation. * *The best definition for hypothesis is a “**Testable Prediction**”.*

- 4. An **experiment with variables** is a common way to **test** a hypothesis.
- a. A **dependent** (*responding*) **variable** changes value as other variables change.
 - b. An **independent** (*manipulated*) **variable** is changed to determine how it will affect the dependent variable.
 - c. A variable that does not change when other variables change is a **constant**.
 - d. A **control group** is the standard to which test results can be compared.

Scientific Method Steps 5-7

- 5. **Analyze** data from an experiment or investigation.
- 6. Form a **conclusion** based on the data.
- 7. Reduce **bias** by keeping accurate records, using measurable data, and repeating the experiment.

Ch 1 Sect 1 continued

- C. **Models** represent ideas, events, or objects and can be physical or computerized.
- D. A **theory** is an explanation based on many observations and investigations (** that has never yet be proven to be false – never yet “falsified”*)
- A **scientific law** is a statement about something that always seems to be true. (** but could one day be falsified simply by one negative test*)
- E. Science deals with the **natural** world; questions of value or emotion cannot be answered. (*See next slide*)
- F. **Technology** - applied science helping people

Discussion Question

- **What area of questioning is science restricted to?**

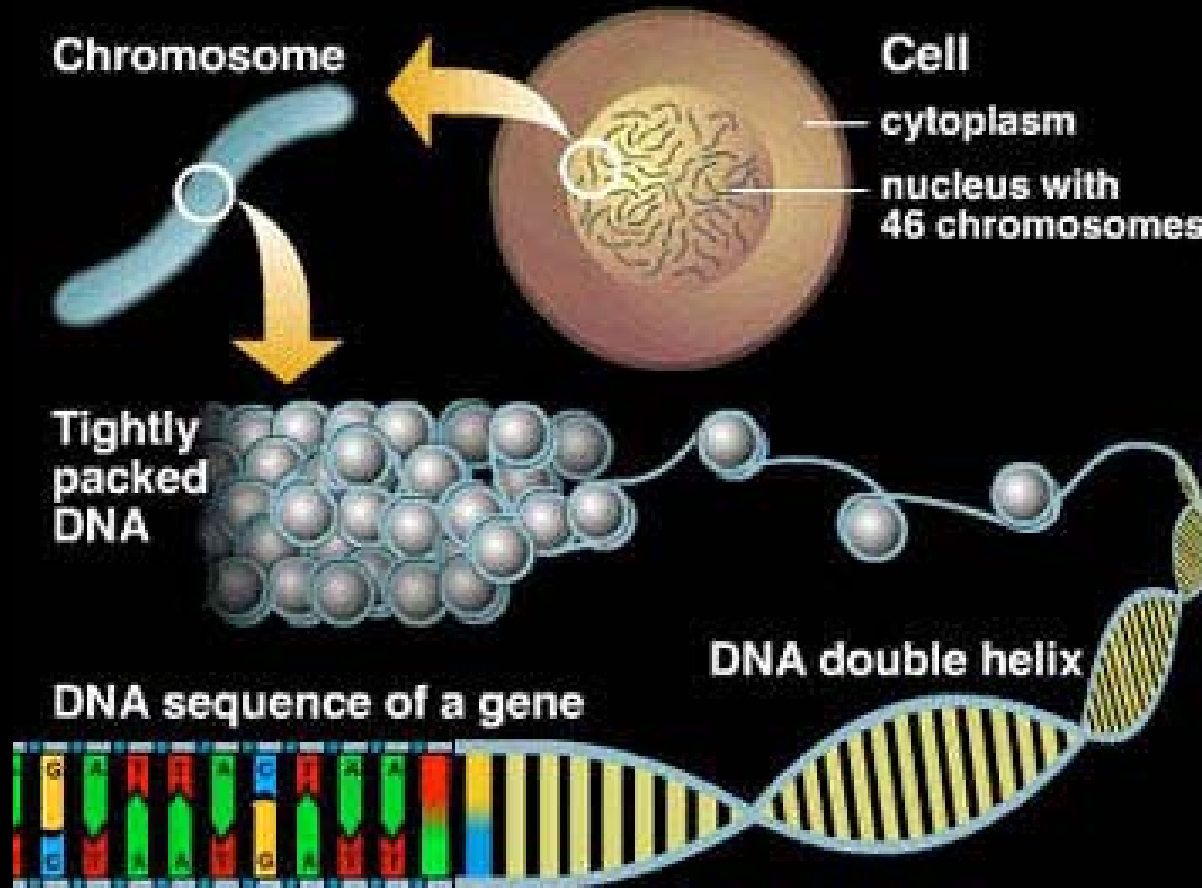
- **The natural world**

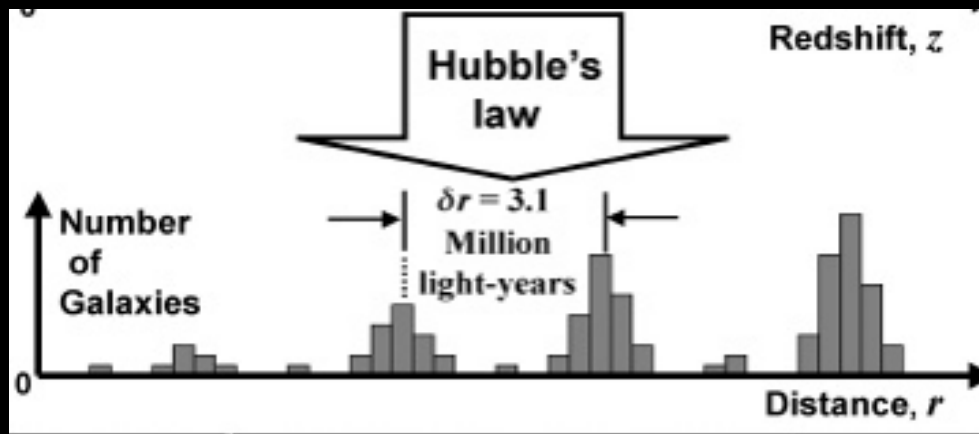
- * This is what the secular textbook states. Yet, scientific investigation of evidence in the natural world leads to the logical inference (conclusion) of an Intelligent Designer.*

- For examples –*

- DNA information must come from **intelligence***
- The galactocentric universe indicates **design***

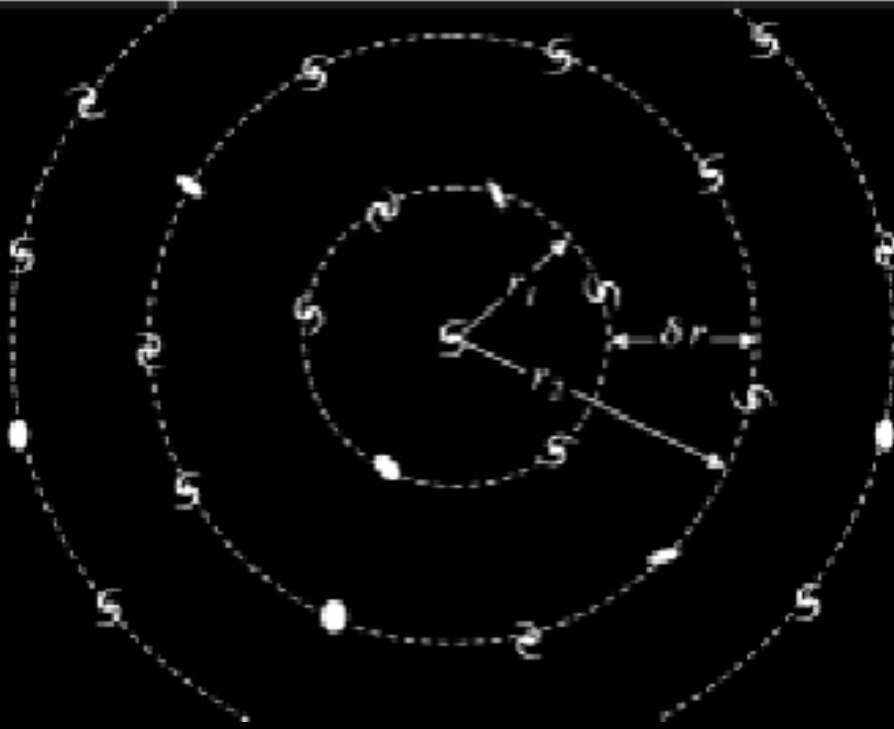
DNA – © Designed Not Accidental





**Galacto -
centric**

**Built in
Universal
Beauty**



- “**Assumptions** can be dangerous, especially in science. They usually start as the most plausible or comfortable interpretation of the available facts. But when their truth cannot be immediately tested and their flaws are not obvious, assumptions often *graduate to articles of faith*, and new observations are **forced** to fit them. Eventually, if the volume of **troublesome** information becomes unsustainable, the **orthodoxy must collapse**.” [*Emphasis added in bold italics*]

– John Mattick, PhD, professor of molecular biology at the University of Queensland and director of the Institute for Molecular Bioscience. “*The Hidden Genetic Program of Complex Organisms*”, *Scientific American*, October 2004, p. 61.)

Do NOT Believe

- Anything I say, or . . .
- Anything anyone else might say.
- Unless there is sufficient **EVIDENCE** to make it worthy of your trust (faith, belief).

The Scientific Method of Inquiry is Logical and Biblical

Proverbs 14:15

“The simple believes every word,
but the prudent considers well his steps.”

Isaiah 1:18

God said: “Come let us reason together.”

Hebrews 11:1-3

“Faith is the substance of things hoped for,
the evidence of things not seen.

1. What is the origin of the Universe? (space, time, matter, and energy)?

- **Atheistic Evolutionary Science says:**

Nobody + Nothing = Everything (bang), millions of years ago. However, this is a mathematical absurdity, since $(0 + 0 = 0)$. This violates Laws of Mathematics and Thermodynamics.

- **Theistic Evolutionary Science says:**

God initiated the big bang millions of years ago.

- **Scriptural Science says:**

God created (“bara”) all things out of nothing (“ex nihilo” – John 1:1-3).

2. What is the origin of life? (DNA coded information) & (“nephesh” soul)?

- **Atheistic Evolutionary Science says:**
Non-living chemicals produced life (spontaneous generation).
However, this violates two Laws of Science:
 - Law of Biogenesis (Life comes only from Life)
 - Law of Information (Information comes from Intelligence)
- **Theistic Evolutionary Science says:**
God made non-living chemicals live through evolution.
- **Scriptural Science says:**
God created specific “kinds” of creatures, each with a vast, yet limited, capacity for genetic variation.
(Example: The wolf “kind” became foxes, dogs, etc).
Plants do not have “nephesh” life, therefore plants cannot think, feel or suffer. They were designed as food.

3. What is the origin of NEW DNA (new coded information)?

- **Atheistic Evolutionary Science says:**
New DNA came from chance, time, mutations, and violently competitive selection.
- **Theistic Evolutionary Science says:**
God designed this process of violent competition and death.
- **Scriptural Science says:**
God created a peaceful Garden of Eden without disorder, suffering, or death.

4. What is the origin of disorder? (Dysfunction, disease, and death in the universe)

- **Atheistic Evolutionary Science says:**
This horrible process is just the result of cruel chance.
- **Theistic Evolutionary Science says:**
God deliberately desired and designed survival of the fittest.
- **Scriptural Science says**
It is the result of sinful rebellion by angels and man.

Origin of disorder

- **Scriptural Science says**

It is the result of sinful rebellion by angels and man.

- **This rebellion was a willful act of stepping out from under God's hand of provision and protection.**
- **Satan, Adam, and Eve chose to be their own authority, self-deification.**
- **The consequence is a partial separation from the full provision and protection of God.**
- **The consequence of sin is death, that is, separation from God who is the source of order and life.**
(Escalating Entropy, the increase of disorder apart from God)

Testing (*Verifying*) is Biblical

- “Taste and see that the Lord is Good” (Ps 34:8)
 - *Means we should examine the evidence of history and our own times of obedience to see if God really is good and faithful.*
- “Test the spirits” (1 John 4)
 - *Means we should examine the evidence to see if spiritual teachers are teaching the same as what the Bible teaches.*
- Christianity today is being infected with a mystical, subjective, feeling-based faith that is NOT biblical faith based on objective, logical evidence.

Dangers of Feeling-Based Faith

- What if you were married with six kids and had a “FEELING” that God was telling you to sell your home and business, and give all your money to the poor?
 - Is this enough evidence to do it?
 - What other evidence could you examine?
- The Bible (God’s Word) has enough principles about life (financial responsibility, marriage, parenting) to guide you in making wise decisions.

A Hypothesis About the Bible

- If the Bible is written by God who transcends TIME (*a God who exist is not limited by time*) , then the Bible should contain accurate statements about the future (prophecy).
- The Bible does contain hundreds of prophecies that have been proven true
- Not one of the Bible's statements has ever been proven false (*falsified*), not even its statements about the future, the ancient past, science, or any other subject.

Not All Sciences are Equal

- **INDIRECT Science:**

- **Psychology & Sociology**

- **Historical Science**

- The study of origins (creation vs. evolution)
- Many assumptions about the **past**.

- **DIRECT Science:**

- **Experimental Science**

- Repeatable, observable, & in the **present**
- Falsifiable

- **Operational Science**

- Application of experimental results
- New Technologies, etc.

SECTION
2

Section Focus
Transparency

Pick a Scale and Go with It

Chapter
1

What does it mean if someone says that the temperature is thirty-two degrees? It depends entirely on the scale that they're using. Referring to a temperature of 32 might mean that it's a hot summer's day or that it's so cold that even oxygen is frozen solid.

- 1.** Label the three pictures "32°F," "32°C," and "32 K."
- 2.** Why must a measurement include the units in order to be meaningful?
- 3.** What kind of units do you use to measure length? Mass?

Ch 1 Section 2

Standards of Measurement

- **A. Standard** - exact quantity that people agree to use for comparison
- **B. Measurements must have a number and a unit.**
 - **1. SI** - an improved version of the metric system used and understood by scientists worldwide
 - **2. SI system is based on multiples of 10** and uses prefixes to indicate a specific multiple.
- **C. Length** is measured using a unit appropriate for the distance between two points.

- **D. Volume** – the amount of space an object occupies
- **E. Mass** - measure of matter in an object
 - 1. **Density** - mass per unit volume of a material
 - 2. A unit obtained by combining different SI units is called a **derived unit**.
- **F. Time** is the interval between two events; temperature is measured using a thermometer.

SI Units

- **SYSTEME INTERNATIONAL d'UNITES
(INTERNATIONAL SYSTEM OF MEASUREMENTS)**
- The SI is a Universal, Standardized form of measurement that is use by all Scientist around the world. It allows us to understand each others work and duplicate each others experiments to check the results.

SI BASE UNITS:

- There are **SEVEN** Fundamental Base Units

Length - meter m

Mass - kilogram kg

Time - second s

Electric Current - ampere A

Temperature - kelvin K

Substance Amount - mole mol

Luminosity - candela cd

TABLE 1-1 *SI Base Units*

Base quantity	Name	Abbreviation
Length	meter	m
Mass	kilogram	kg
Time	second	s
Electric current	ampere	A
Thermodynamic temperature	kelvin	K
Amount of substance	mole	mol
Luminous intensity	candela	cd

SI Base Units

TABLE 1.4 SI Base Units

Physical Quantity	Name of Unit	Abbreviation
Mass	Kilogram	kg
Length	Meter	m
Time	Second	s ^a
Temperature	Kelvin	K
Amount of substance	Mole	mol
Electric current	Ampere	A
Luminous intensity	Candela	cd

The abbreviation sec is frequently used.

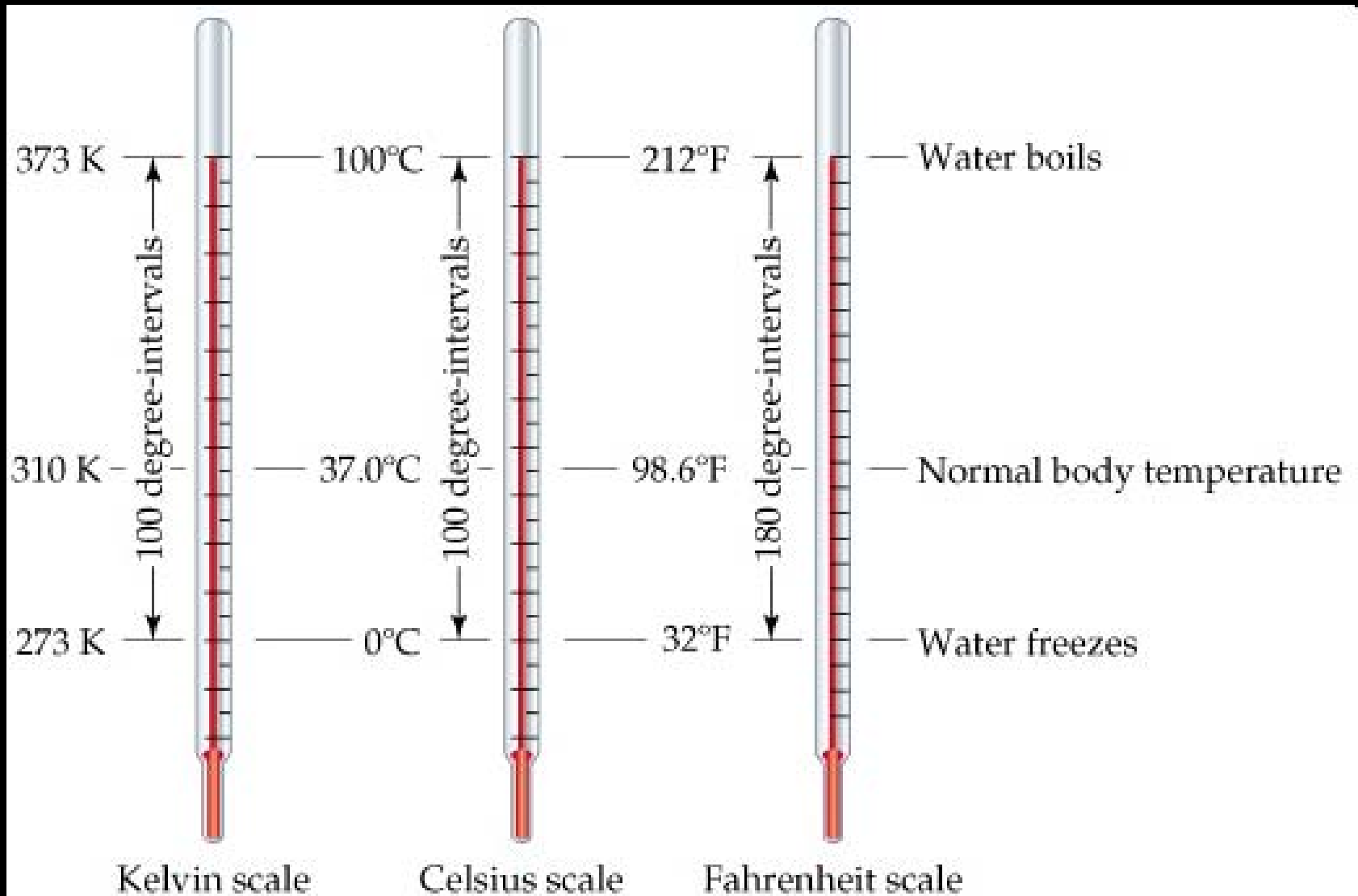
SI DERIVED UNITS:

- To measure Surface Area or Velocity, among other things, Derived Units are used.
- Derived Units are produced by mathematical relationship:
 - between TWO Base Units
 - or between TWO Derived Units.

TABLE 1-3 *SI Derived Units Often Used in Biology*

Derived quantity	Name	Abbreviation
Area	square meter	m ²
Volume	cubic meter	m ³
Mass density	kilogram per cubic meter	kg/m ³
Specific volume	cubic meter per kilogram	m ³ /kg
Celsius temperature	degree Celsius	°C

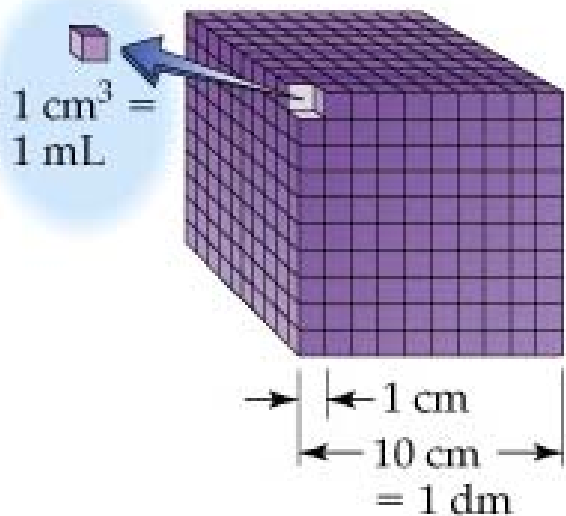
Temperature



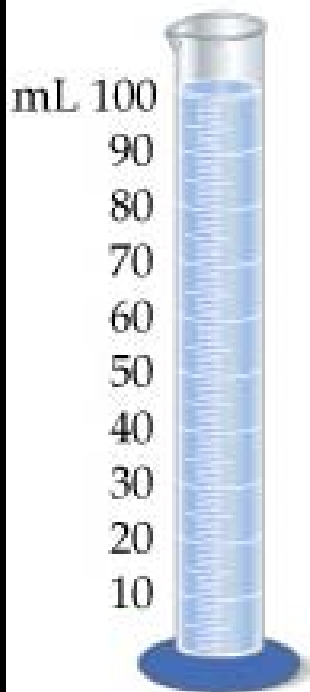
$$K = ^\circ C + 273.15$$

- “The **Kelvin scale** is the SI temperature scale, and the SI unit of temperature is the kelvin (K). Historically, the Kelvin scale was based on the properties of gases
- “Zero on this scale is the lowest attainable temperature, a temperature referred to as *absolute zero*. Both the Celsius and Kelvin scales have equal-sized units—that is, a kelvin is the same size as a degree Celsius.
- “Thus, the Kelvin and Celsius scales are related as follows:
- Kelvin = C + 273.15

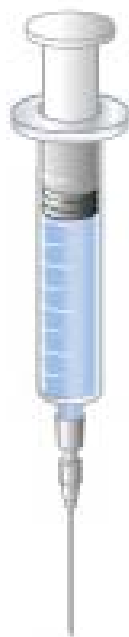
$$1\text{L} = 1\text{ dm}^3 = 1000\text{ cm}^3$$



Volume Visualized



Graduated cylinder



Syringe



Buret



Pipet



Volumetric flask

Metric Conversion

Linear Measure

1 centimeter	0.3937 inch
1 inch	2.54 centimeters
1 decimeter	3.937 in., 0.328 foot
1 foot	3.048 decimeters
1 meter	39.37 inches, 1.0936 yds.
1 yard	0.9144 meter
1 dekameter	1.9884 rods
1 rod	0.5029 dekameter
1 kilometer	0.62137 mile
1 mile	1.6094 kilometers

Square Measure

1 sq. centimeter	0.1550 sq. inches
1 sq. inch	6.452 sq. centimeters
1 sq. decimeter	0.1076 sq. foot
1 sq. foot	9.2903 sq. decimeters
1 sq. meter	1.196 yards
1 sq. yard	0.8361 sq. meter
1 hectare	2.471 acres
1 acre	0.4047 hectare
1 sq. kilometer	0.386 sq. mile

Measure of Volume

1 cu. centimeter	0.06 1 cu. inch
1 cu. Inch	16.39 cu. centimeters
1 cu. decimeter	0.0353 cu. foot
1 cu. foot	28.3 17 cu. decimeters
1 cu. yard	0.7646 cu. meters
1 cu. meter	0.2759 cord
1 cord	3.625 steres
1 liter	0.908 qt. dry 1.0567 qts. liq.
1 quart dry	1.101 liters
1 quart liquid	0.9463 liter
1 dekaliter	2.6417 gals, 1.135 pks.
1 gallon	0.3785 dekaliter
1 peck	0.881 dekaliter
1 hectoliter	2.8378 bushels
1 bushel	0.3524 hectoliter

Weights

1 gram	0.03527 ounce
1 ounce	28.35 grams
1 kilogram	2.2046 pounds
1 pound	0.4536 kilogram

Quick Conversions

Multiply	By	To obtain
Meters	3.28	Feet
	39.37	Inches
Centimeters	0.3937	Inches
Milimeters	0.0394	Inches
Feet	0.3048	Meters
	30.48	Centimeters
	300.48	Milimeters
Inches	2.54	Centimeters
	25.4	Milimeters
Pounds	0.45392	Kilograms
	453.592	Grams
Kilograms	2.20462	Pounds
kg/cm ²	14.22	Lbs/In ²
kg/m	0.6721	Lbs/Ft

SI Unit Prefixes

TABLE 1.5 Selected Prefixes Used in the Metric System

Prefix	Abbreviation	Meaning	Example
Giga	G	10^9	1 gigameter (Gm) = 1×10^9 m
Mega	M	10^6	1 megameter (Mm) = 1×10^6 m
Kilo	k	10^3	1 kilometer (km) = 1×10^3 m
Deci	d	10^{-1}	1 decimeter (dm) = 0.1 m
Centi	c	10^{-2}	1 centimeter (cm) = 0.01 m
Milli	m	10^{-3}	1 millimeter (mm) = 0.001 m
Micro	μ^a	10^{-6}	1 micrometer (μm) = 1×10^{-6} m
Nano	n	10^{-9}	1 nanometer (nm) = 1×10^{-9} m
Pico	p	10^{-12}	1 picometer (pm) = 1×10^{-12} m
Femto	f	10^{-15}	1 femtometer (fm) = 1×10^{-15} m

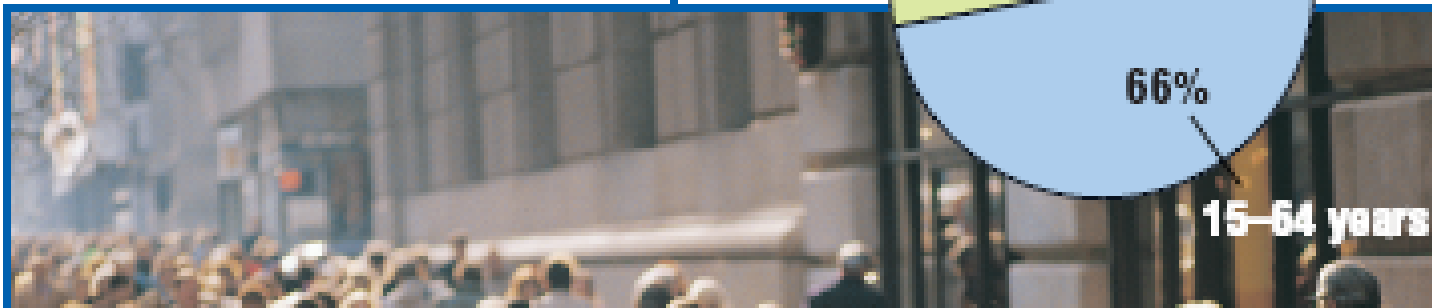
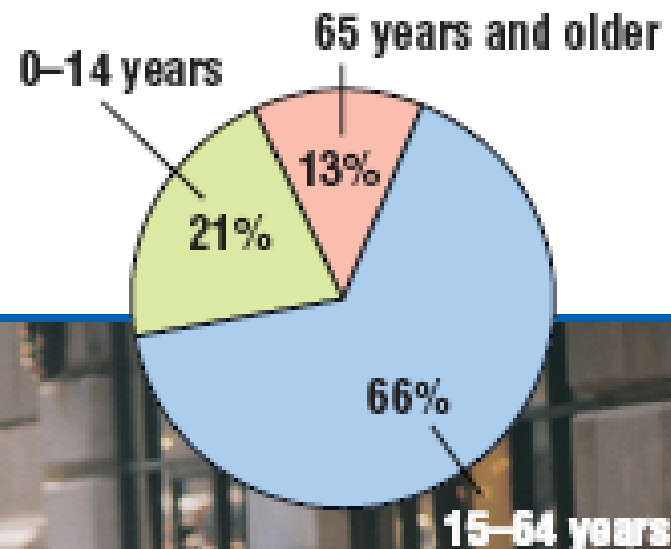
This is the Greek letter mu (pronounced "mew").

Discussion Question

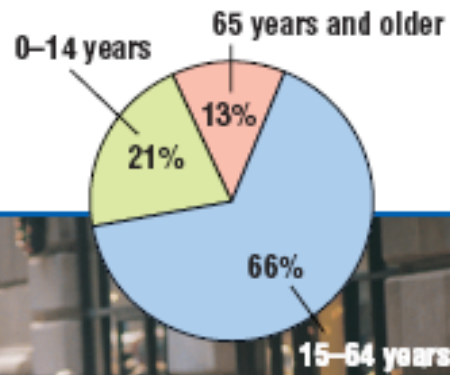
- **What is the SI measurement system?**
 - An improved version of the metric system used by scientists worldwide

Sometimes the best way to communicate information is with a graph. Circle graphs are a good way to show the parts of a whole—in this case, the U.S. population by age.

United States Population by Age



United States Population by Age



1. What information does the circle graph provide? Could you have obtained that information by looking at the photograph?
2. How else could you display these data?
3. Would it be useful to list all the people in the U.S. along with their ages? Why or why not?

Chapter 1 Section 3

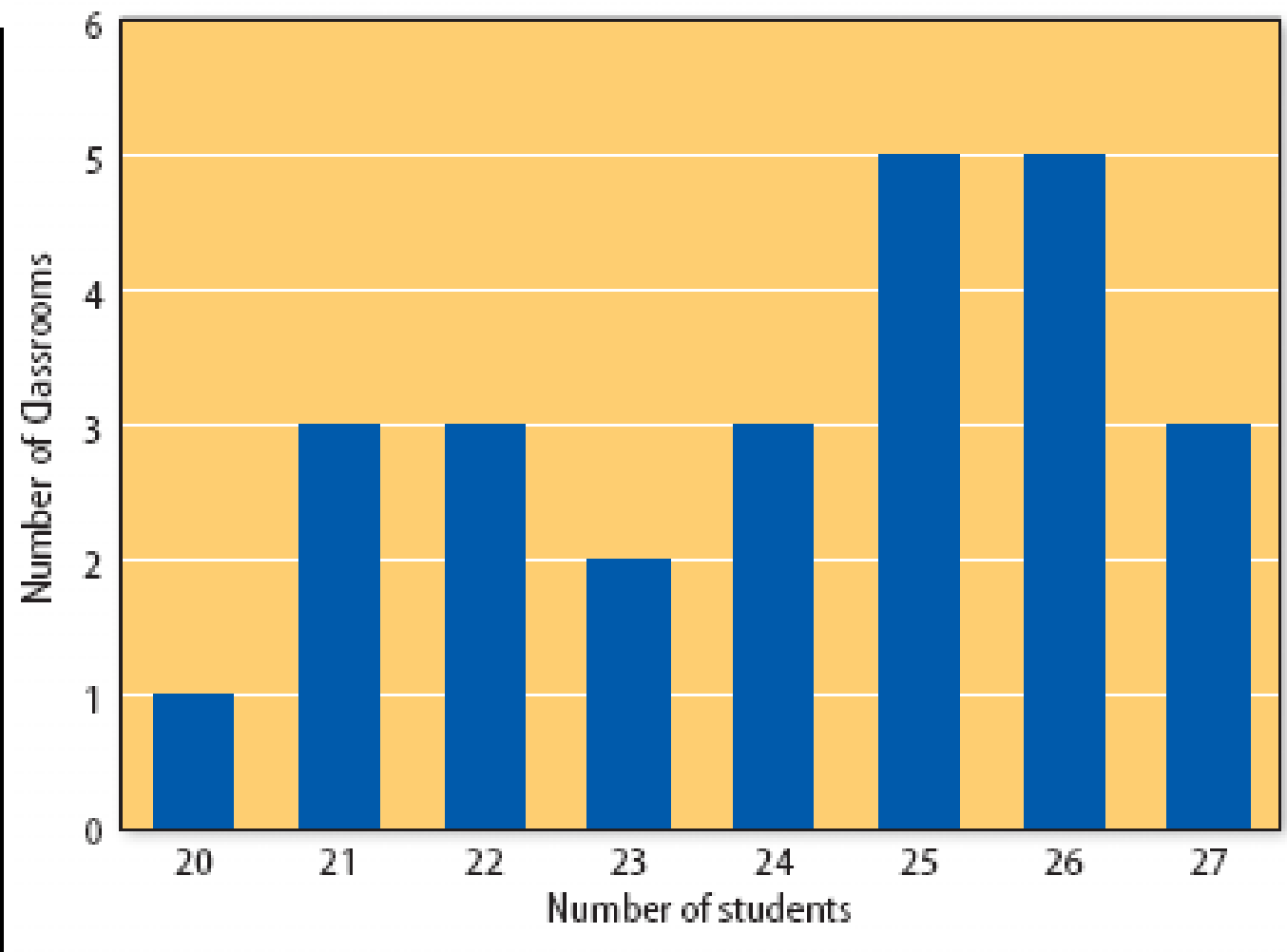
Communicating with Graphs

- A. **Graph** - visual display of information or data that is used to detect patterns
- B. A **line** graph shows a relationship where the dependent variable changes due to a change in the independent variable.
 - 1. The **scale** should make the graph readable.
 - 2. The x -axis should **always** be used for the independent variable.
 - 3. Units of measurement must be **consistent**.
- C. **Bar** graphs compare information collected by counting.
- D. **Circle** graphs show how a whole is broken into parts.

Discussion Question

- **What axis should always be used for the independent variable?**
 - The x-axis

Classroom Size (January 20, 2004)



Directions: Carefully review the tables and answer the following questions.

Time (s)	Approximate Speed (m/s)
0	0
1	10
2	20
3	30
4	40
5	50

Time (s)	Approximate Speed (m/s)
6	60
7	70
8	80
9	90
10	100
11	?

1. The above data were collected during an experiment to find out the speed of an object dropped from a tall building. Which type of graph would be the best way to display this information?

A bar graph

C circle graph

B pie graph

D line graph

Time (s)	Approximate Speed (m/s)
0	0
1	10
2	20
3	30
4	40
5	50

Time (s)	Approximate Speed (m/s)
6	60
7	70
8	80
9	90
10	100
11	?

2. According to these data, about how fast would the object be dropping after 11 seconds?

F 90 m/s

H 110 m/s

G 100 m/s

J 120 m/s

Time (s)	Approximate Speed (m/s)
0	0
1	10
2	20
3	30
4	40
5	50

Time (s)	Approximate Speed (m/s)
6	60
7	70
8	80
9	90
10	100
11	?

3. An independent variable is the factor that affects the measure of the other variable. What independent variable could have been added to this experiment?

A time

B speed

C height

D graph

SECTION
1

Section Focus
Transparency

How about a rematch?

Chapter
2



1. Which animal ran faster?
2. How does the motion of a car racing on an oval track change?

Chapter Two - Section 1

Describing Motion

- **A. Motion** - when an object changes its position relative to a reference point
 - **1. Distance** - how far an object has moved
 - **2. Displacement** - distance and direction of an object's change of position from a starting point

- **B. Speed** - distance an object travels per unit of time
 - 1. **Rate** - any change over time
 - 2. Calculation for speed: $speed = distance / \underline{time}$
 - 3. Speed that doesn't change over time - **constant** speed
 - 4. Speed is usually not constant; usually an object has **changing** speed.
 - 5. **Average speed** - speed of motion when speed is changing: $speed = total \underline{distance} / total \text{ travel time}$
 - 6. **Instantaneous speed** - speed at any given point in time

- C. A distance-time **graph** displays motion of an object over time.
 - 1. Plot distance on a(n) **vertical** axis.
 - 2. Plot time on a(n) **horizontal** axis.
- D. **Velocity** - speed and direction of an object's motion
- E. Motion of Earth's crust - so **slow** we don't notice

Discussion Question

- **How do constant speed and changing speed differ?**
 - At constant speed, an object's instantaneous speed remains the same; at changing speed, an object's instantaneous speed varies.

Ch Two - Section 2 Acceleration

- **A. Acceleration** - change in velocity's rate
 - 1. **Positive** acceleration - speed is increasing.
 - 2. **Negative** acceleration - speed is decreasing.
 - 3. When an object changes speed or **direction**, it is accelerating.

- **B. Calculating acceleration**
- 1. Acceleration = change in velocity / time
- 2. Change in velocity = final velocity – initial velocity
- 3. Unit for acceleration - meters per second squared
- 4. Positive acceleration - positive number with a positive slope on a velocity-time graph
- 5. Negative acceleration - negative number with a negative slope on a velocity-time graph

- C. Amusement park acceleration—Roller coasters
 - 1. Changes in speed cause acceleration.
 - 2. Changes in direction cause acceleration.

Discussion Question

- **Is a wooden roller coaster's swaying acceleration? Why or why not?**
 - Yes, swaying is a change in direction.

Chapter Two - Section 3

Motion and Forces

- **A. Force** - a push or pull that one body applies to another
 - 1. A force can cause an object's motion to change.
 - 2. When two or more forces combine at the same time, they create a net force.
- **3. Balanced forces** are equal in size and opposite in direction.
- **4. Unbalanced forces** are unequal in size and / or are not in the same direction.

- **B. Inertia and Mass**
- **1. Inertia** - an object's resistance to any change in motion
- **2. Objects with greater mass have greater inertia.**
- **3. Newton's first law of motion** - an object moving at a constant velocity keeps moving at that velocity unless a net force acts on it; an object at rest will stay at rest unless a net force acts on it.

- C. Auto crashes—the law of **inertia** at work
 - 1. A passenger not wearing a seat belt keeps moving **forward** at the car's speed even after the car stops.
 - 2. A passenger wearing a seat belt slows down as the car **slows down** and stops.

Discussion Question

- **Why does it take more force to pick up a glass full of water than it does a same-sized empty glass?**
 - A full glass has greater mass.

Data and Observations

Table 1

English to SI Conversions		
Ingredient	English measure	SI measure
Water	1/2 cup	
Corn meal	2 cups	
Salad oil	4 tablespoons	
Dried rice	1/2 cup	
Potato flakes	3 cups	
Vinegar	1 teaspoon	
Dried beans	3 cups	

An organized set of procedures, or

scientific
method

begins by stating a(n)

1.

and
forming
a(n)

2.

which is tested
by performing

3.

that measure
information using

standards
of measurement

which include SI Base Units for

length, such as

4.

mass,
such
as

5.

time,
such
as

6.

temperature, such

7.

Hypothesis

Meters

Problem

Experiments

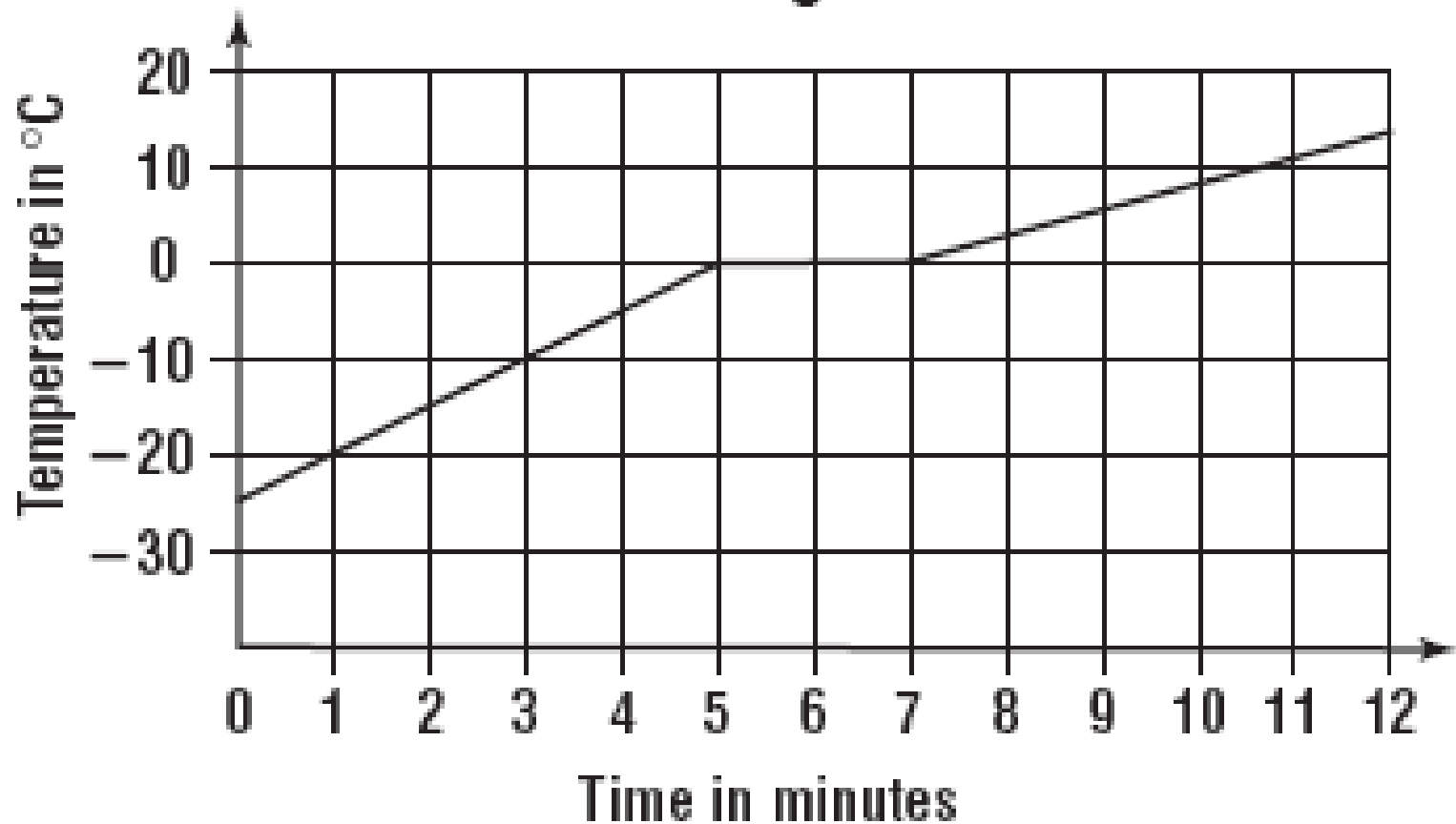
Grams

Kelvins

Seconds

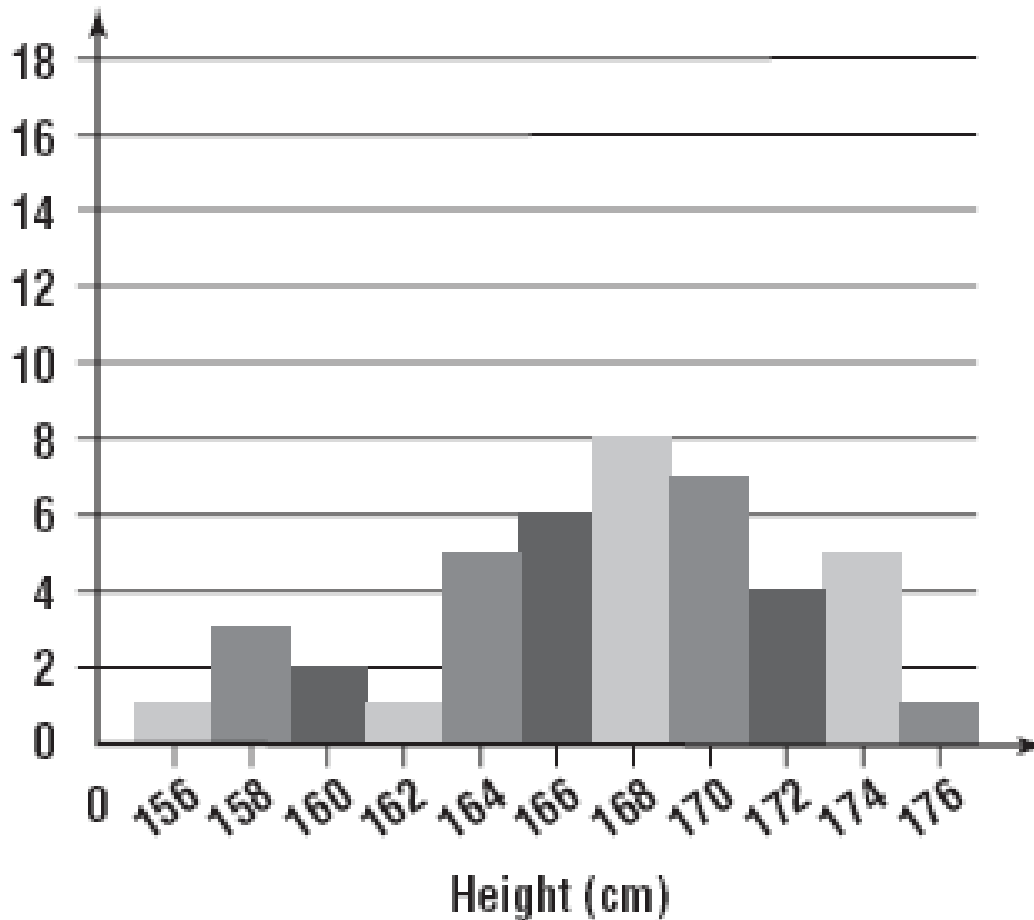
Graph A

Graph of Temperature versus Time for the Heating of Water



Graph C

Height of Students in Sarah's Class



Graph B

Elements Making Up Living Things

