



Physics

Teacher's Guide



SGS-SFI/COC-US09/5501

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Unit 1: Forces

In this unit, students learn about forces and how they affect the motion of objects. They read about gravity and how it affects every object in the universe. Students also study the language of motion and how to calculate an object's velocity, acceleration, and the forces acting upon it. Lesson 1 introduces students to the terms and equations used to describe motion. Lesson 2 helps students understand Newton's laws of motion and the way these laws explain why things move the way they do. In Lesson 3, students will become familiar with the effects of gravity, both on Earth and in the universe.

Lesson 1—Kinematics

Goal: To understand the terms and equations used to describe motion

WORDS TO KNOW

acceleration	dynamics	scalars
angular acceleration	kinematics	speed
angular displacement	magnitude	translational motion
angular velocity	mechanics	vectors
axis of rotation	revolutions per minute	velocity
displacement	rotational motion	

Lesson 2—Dynamics

Goal: To understand Newton's laws of motion; to use those laws to explain why things move the way they do

WORDS TO KNOW

centripetal force	newton	reaction
friction	perpendicular	rotational inertia
net force	principle of inertia	torque

Lesson 3—Gravity

Goal: To understand the effects of gravity, both on Earth and in the universe

WORDS TO KNOW

black hole	event horizon	inverse square ratio
ellipse	free fall	law of falling objects
escape velocity	geosynchronous	law of universal gravitation

Notes on Application Activities in Student Text

Activity	Skills Applied	Product
Rotational Motion	measuring, applying concepts, explaining observations	demonstration of rotational motion
Reaction Time	observing, making simple calculations, using indirect measurement	measurement of reaction time
Discovering the Planets	gathering information, preparing written information	written description of a planet

Additional Activity Suggestions

- Isaac Newton is often considered to be the father of modern science and technology. Discuss how his findings have affected the world we live in today. Ask your students if they think science has had a positive effect or a negative effect on the world and why.
- Ask students to think of as many everyday examples of Newton's three laws as they can. Discuss how almost any motion can be attributed to one of these laws.
- Invite students to find out more about Galileo (or other early scientists) by looking at web sites such as the following: <http://galileo.rice.edu/>.



Differentiation

- Try to emphasize the similarity between translational motion and rotational motion. Although the concepts have different names, the underlying ideas are the same.

Unit 2: Energy and Heat

In this unit, students learn about the laws that govern energy and heat. They also learn about different types of energy and how to calculate energy and work. They study changes of phase that vary with heat and how heat engines work. Lesson 4 helps students understand work and mechanical energy. Students will apply the principle of the conservation of energy. In Lesson 5, students learn about the physical meaning of temperature and heat. They explore the effect of temperature and heat on objects. Lesson 6 covers the functioning of a heat engine. This lesson helps students grasp how the laws of thermodynamics and entropy limit a heat engine's performance.

Lesson 4—Mechanical Energy

Goal: To understand work and mechanical energy; to apply the principle of the conservation of energy

WORDS TO KNOW

conservation of energy	energy	kinetic energy
conservation of matter	gravitational potential energy	potential energy
elastic potential energy	joules	work

Lesson 5—Temperature and Heat

Goal: To understand the physical meaning of temperature and heat; to understand the effect of temperature and heat on objects

WORDS TO KNOW

absolute zero	heat	plasma
calorie	insulator	radiation
Celsius	Kelvin	specific heat
conduction	latent heat of fusion	temperature
conductor	latent heat of vaporization	thermal equilibrium
convection	phase change	thermal expansion
Fahrenheit	phases	

Lesson 6—Heat Engines and Thermodynamics

Goal: To understand the functioning of a heat engine; to understand how the laws of thermodynamics and entropy limit a heat engine's performance

WORDS TO KNOW

adiabatic compression	entropy	intake stroke
adiabatic expansion	exhaust stage	steam turbine
Carnot efficiency	heat engine	thermodynamics
efficiency	ignition stroke	

Notes on Application Activities in Student Text

Activity	Skills Applied	Product
Boiling Water in a Paper Cup	demonstrating concepts, explaining observations, doing hands-on activity	demonstration of phase transition
Heat from Food	demonstrating concepts, measuring, making simple calculations	measurement of food energy
Greenhouse Effect	gathering information, preparing written information	essay on the greenhouse effect

Additional Activity Suggestions

- Discuss the different forms of energy and how the transformation of energy is involved in everyday processes. Emphasize how energy is useful as a concept in all areas of science.
- Ask students to list as many examples of entropy as they can. They should be able to think of many examples of things that tend to go from order into disorder. Ask them how energy can be used to reduce the entropy in each of these cases.
- Students may be interested in studying their own calorie intake. Ask them to calculate the number of calories they consume each day and the number of calories they expend.
- Ask students to do further research into a specific type of renewable energy. A good resource is the United States Department of Energy's web site at <http://www.eere.energy.gov/>. This web site contains a list of different renewable energy technologies, describing their current applications, and links to different sites that are implementing the technologies.



Teaching Tip

- Many experiments in heat and energy require the use of flames or heaters. Always make sure students know safety precautions involved in using such devices.