Force and Motion

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About **Force and Motion**

DeltaScienceModules, THIRD EDITION

Students explore *Force and Motion* with twelve hands-on activities and the Delta Science Reader. Students use a Delta Education tool—a push-pull meter—to measure force. They compare the relative work of moving identical objects different distances and different objects identical distances. Then students discover how simple machines make work easier by reducing the amount of force needed. They lift with levers, roll with wheels and axles, and raise with fixed and movable pulleys. They drag loads up inclined planes, separate objects with wedges, and secure wood blocks with screws. In a teacher demonstration, they see how a spring scale works. Young scientists crank gears, decrease friction, and investigate household gadgets to identify what makes them labor-saving devices.

In the Delta Science Reader *Force and Motion,* students read about the relationship between force, motion, and work. They discover how the six simple machines—lever, wheel and axle, pulley, inclined plane, wedge, and screw—help people do work by moving objects easier, faster, or farther. They also read about people in science—bicycle inventors—and how they created ways to make the bicycle an increasingly more complex (and safe) machine. Finally, students find out how the waterwheel works and how friction affects motion.

Overview Chart for Hands-on Activities

Hands-on Activity	Student Objectives
1 **Measuring Force** *page 13*	• observe the effect of pushing and pulling on objects • make a "push-pull meter," a device used to measure force • use the push-pull meter to measure the amount of force it takes to move various objects
2 **Work in Motion** *page 23*	• discuss what it means to do work • identify the elements necessary for work to be accomplished • compare the amount of work accomplished in moving objects a distance • discuss ways in which machines help make work easier
3 **Levers for Lifting** *page 31*	• name the parts of a lever • use a lever to lift a load • discover how the position of the fulcrum affects the amount of force needed to lift a load • discuss the tradeoff between force and distance when using a lever to do work
4 **Friction Stops Motion** *page 41*	• observe the effects of friction on a moving object • discover how lubrication reduces friction between an object and the surface over which it moves • suggest additional ways to reduce friction between objects
5 **Wheels Overcome Friction** *page 49*	• measure the amount of force it takes to drag a load • measure the amount of force it takes to roll a load on dowels • conclude that even the most primitive wheels reduce friction between an object and the surface over which it moves
6 **The Wheel and Axle** *page 57*	• identify the parts of a wheel and axle • observe how force gets transferred between the wheel and the axle • use a wheel and axle to lift a load • investigate the tradeoff of force for distance when using a wheel and axle machine
7 **Gears: Wheels with Teeth** *page 65*	• observe how gears transfer force • observe how gears can change the direction of rotation • observe how gears can change the speed of rotation
8 **Pulleys: Groovy Wheels** *page 73*	• make a single, fixed pulley and use it to lift a load • observe that a fixed pulley reverses the direction of applied force • make a single, movable pulley and use it to lift a load • observe that a movable pulley reduces the amount of force required to lift a load
9 **Inclined Planes** *page 83*	• measure the amount of force it takes to lift a load • measure the amount of force it takes to drag the same load up an inclined plane • discuss the tradeoff of force for distance when using an inclined plane
10 **Wedges** *page 91*	• observe how a wedge changes the direction of applied force • use a wedge to lift a load • discuss the tradeoff of force for distance when using a wedge
11 **Screws** *page 101*	• discover that a screw is an inclined plane wrapped around a cylinder • observe how screws change the direction of force • compare the amount of force it takes to drive a nail and a screw into a piece of wood • discuss the tradeoff of force for distance when using a screw
12 **Handy Dandy Simple Machines** *page 111*	• review the six types of simple machines • examine a variety of common objects and discuss the features that make them simple machines • describe how each item makes work easier
Assessment *page 119*	• See page 119.

Process Skills	Vocabulary	Delta Science Reader
observe, make and use models, measure	**force**	page 2
communicate	**machine, work**	pages 3, 4, 5
communicate, measure	**arm, effort, fulcrum, lever, load, pivot, simple machine, tradeoff**	page 6
observe, communicate, measure, compare	**friction, lubricant**	pages 2, 15
measure, predict, infer	**roller, wheel**	page 2
observe, make and use models, predict	**axle, wheel and axle**	pages 7, 14
observe	**gear, teeth**	
make and use models, observe	**groove, pulley**	page 8
measure, communicate	**inclined plane**	page 9
observe, make and use models, communicate	**wedge**	page 10
interpret data, observe, communicate	**cylinder, screw, threads**	page 11
communicate	**gadget, infomercial**	page 5

See the following page for the Delta Science Reader Overview Chart.

Overview Chart for Delta Science Reader
Force and Motion

Selections	Vocabulary	Related Activity
Think About...		
What Is a Force? *page 2*	force, friction, gravity, newton, spring scale, weight	1, 4
What Is Motion? *page 3*	direction, distance, motion, position, speed	2
Energy and Work *page 4*	energy, work	1, 2
What Are Simple Machines? • Lever • Wheel and Axle • Pulley • Inclined Plane • Wedge • Screw *pages 5–11*	effort, fulcrum, inclined plane, lever, load, machine, pivot, pulley, screw, simple machine, wedge, wheel and axle	3–11
People in Science		
Bicycle Inventors *page 12*		5, 12
Did You Know?		
How Waterwheels Work *page 14*	waterwheel	6
About Friction *page 15*	lubricant	4, 5

See pages 127–134 for teaching suggestions for the Delta Science Reader.

MATERIALS LIST

Force and Motion

Quantity	Description
1	block, balsa wood*
8	boards, long†
8	boards, short†
8	bricks, half†
16	containers, plastic
1	detergent, liquid*
48	dowels
1	fasteners, brass, p/100*
16	fulcrums
8	gear bases
8	gear handles
16	gear pointers
8	gear wheels, large
24	gear wheels, medium
8	gear wheels, small
1	goggles, safety
32	nails
1	plastic rings, p/32
8	pulleys
16	push-pull meter frames
1	rubber bands, large, p/16
128	rubber bands, small*
32	screws
8	S-hooks
1	spoon, measuring, Tbsp.
1	spring scale
16	stirrers, paint
2	string*
1	talc, powdered*
1	tape, masking*
1	toys, assorted, p/8
1	transparency, Egyptian Pyramid
6	washers, p/35
8	wedges, wooden
32	wheels, wooden
1	Teacher's Guide
8	Delta Science Readers

Quantity	Description
TEACHER-PROVIDED ITEMS	
–	audiovisual equipment
16	books, hardcover
32	books, paperback, medium-size
4	cans, soda, empty*
4	cans, soda, full*
32	crayons
1	doorstop, rubber
1	hammer
1	marker
1	mixing bowl
1	overhead projector
2	paper towels, roll
32	paper, 8 ½ × 11"*
32	pencils
–	pictures of pyramids (optional)
32	rulers, dual-scale
32	scissors (blunt-tip)
1	screwdriver
16	shoes
1	tape, transparent*
–	water, tap
1	world map or globe (optional)

* = consumable item

† = in separate box

To order consumable items or refill kits, please call 1-800-442-5444.

ACTIVITY SUMMARY

In this Delta Science Module, students learn how force is necessary to set an object in motion and how simple machines can help us use less force to move objects.

ACTIVITY 1 Students are introduced to the concepts of force and motion by observing the effect of pushing and pulling on some toys. They make a "push-pull meter," a device for measuring the strength of a push or a pull. Then they use the push-pull meter to measure the amount of force it takes to move a variety of objects.

ACTIVITY 2 Students learn that work is accomplished when force is applied to an object and the object moves. Students compare the amount of work accomplished in moving objects a distance and discuss ways machines make work easier.

ACTIVITY 3 Students are introduced to the lever—the first of six simple machines. Students use a lever to lift a load and discover that they can make their work harder or easier simply by moving the fulcrum of the lever.

ACTIVITY 4 Students are introduced to friction, a force that resists motion. Students observe the effects of friction on a moving object. Then they discover how lubrication reduces friction between an object and the surface over which it moves, thereby reducing the amount of force needed to move the object.

ACTIVITY 5 Students compare the amount of force it takes to drag a load and to roll that same load on dowels. They discover what the ancient Egyptians knew: that even the most primitive wheels reduce friction.

ACTIVITY 6 Students are introduced to the second of six simple machines: the wheel and axle. Students observe how force gets transferred between the wheel and the axle. Then students use the wheel and axle machine to lift a load.

ACTIVITY 7 Students are introduced to a variation of the wheel and axle machine: the gear. By manipulating gear wheels of different sizes, students observe how gears can be used to change the direction of force.

ACTIVITY 8 Students are introduced to a third type of simple machine: the pulley. First, students build a single, fixed pulley system and use it to lift a load. They discover that the fixed pulley reverses the direction of applied force. Then students build a single, movable pulley system and discover that a movable pulley reduces the amount of force required to lift a load.

ACTIVITY 9 Students are introduced to a fourth type of simple machine: the inclined plane. Students revisit the ancient Egyptian pyramid builders. They compare the amount of force it takes to lift a load and to drag that load to the same height up an inclined plane. Then students discuss the tradeoff of force for distance.

ACTIVITY 10 Students are introduced to a fifth type of simple machine and a relative of the inclined plane: the wedge. In using a wedge to separate objects, students discover that a wedge changes the direction of applied force. Then students compare the amount of force it takes to lift a load and to raise a load with a wedge.

ACTIVITY 11 Students are introduced to the sixth and final type of simple machine: the screw, an inclined plane wrapped around a cylinder. Students compare the amount of force it takes to drive a nail and a screw into wood. By wrapping string around a screw, students visualize the great distance over which force is applied to a screw.

ACTIVITY 12 Students have an opportunity to show what they know about simple machines. They examine a variety of common household gadgets and discuss the features that make them simple machines.