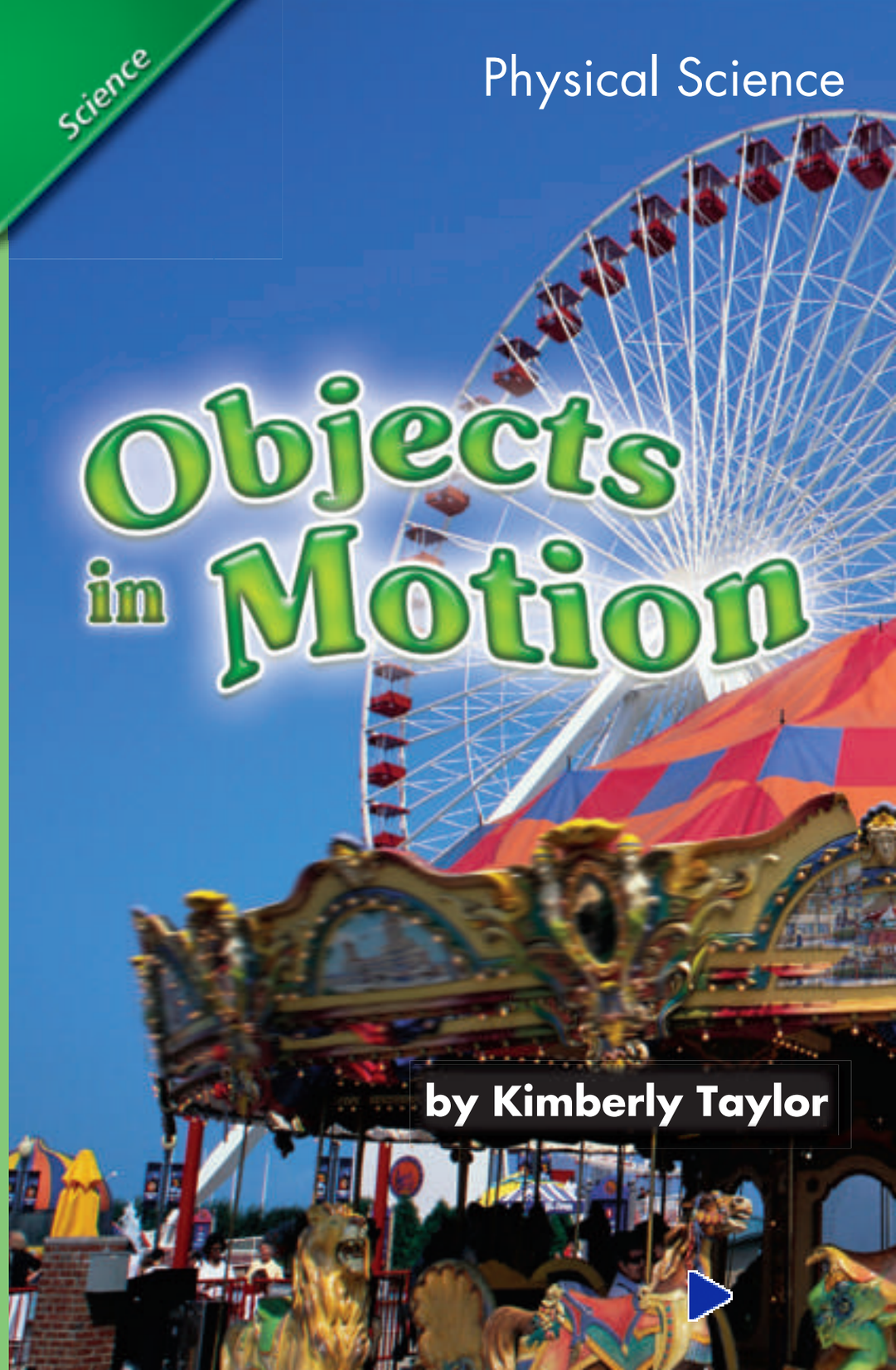
Science

Science

Physical Science

Objects in Motion



by Kimberly Taylor

Genre	Comprehension Skill	Text Features	Science Content
Nonfiction	Sequence	• Captions • Labels • Call Outs • Glossary	Motion

Scott Foresman Science 4.15

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scottforesman.com

ISBN 0-328-13901-7

9 780328 139019 90000

Vocabulary

force

frame of reference

friction

gravity

kinetic energy

potential energy

relative motion

speed

velocity

work

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ISBN: 0-328-13901-7

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What is motion?

Types of Motion

An object can move in a straight line. A train on a track often travels in a straight line. A baseball player usually runs from base to base in a straight line.

An object can also move in a curved path. A car moves in a curved path when it turns a corner. Curved motion takes place around a center point. A bicycle wheel moves in a curved path around its axle.

An object can also move back and forth. Plucking a guitar string makes it move back and forth. This motion is called a vibration.

The toy cars move in different paths around the track.

When you walk down the street, you pass objects that do not move. You know you are moving when you pass a fixed object. If you stand still, you know that a car is moving because its position changes. You can compare how objects seem to change their positions. The change in an object's position compared to another object's position is **relative motion.**

From your position on the sidewalk, you see the bus change position as it moves toward you.

How You Know You Are Moving

How do you know if someone on a water slide is moving? How do you know if the water moves? You can see how the positions of the water and the person change. You see their positions changing compared to the slide.

Your **frame of reference** is made up of the objects you use to notice movement. It is your point of view. How an object seems to move depends on your frame of reference.

Suppose you are riding on a float in a parade. The float moves past people watching the parade, and you wave at them. From your frame of reference, the people seem to be moving. But the people haven't moved! As the parade moves, people on the sidewalk see you pass by. From their frame of reference, you are moving.

Suppose you are sitting at your desk in school. You would say you are not moving. If you use the Sun as your frame of reference, however, you would say that you, your desk, and your school are all moving. This is because you travel with Earth as it moves around the Sun.

From your frame of reference on the bus, everything on the bus seems to be staying in the same place, and everything outside the bus seems to be moving.

Measuring Motion

Speed is the rate at which an object changes position. It tells how fast an object moves. Speed is measured in units of distance divided by units of time. One way to measure speed is in kilometers per hour. If one car is moving at a high speed and one is moving at a low speed, which one changes position faster? The car moving at a high speed does. You can find the average speed of an object. To do this, you divide the distance the object moves by the time it takes.

Velocity is both the speed and the direction an object is moving. Direction can be given by words such as *east, west, south,* and *north*. Other words that tell direction are *down, up, left,* and *right*.

An acceleration is any change in an object's speed or direction. Speeding up is an acceleration. Slowing down is also an acceleration. The speed of a roller coaster on a curved path does not have to change in order for it to accelerate. It accelerates because it changes direction as it travels on the curved path.

How does force affect moving objects?

Force

A **force** is a push or pull. Force can make a fixed object move. It can also make a moving object stop, change direction, slow down, or move faster.

Sometimes a force must touch an object to have an effect on it. This is a contact force. You must hit a marble with an object, such as your finger, in order to make it move on a level surface.

Some forces can act on an object without touching it. A magnet can pull a piece of iron toward it without touching the iron.

Pushing or pulling can change an object's position and motion. A strong magnet can pull a piece of iron toward it from farther away than a weak magnet can. The change that takes place depends on how strong the force is.

A moving marble hits one that is standing still. The contact force of the moving marble makes the other marble move.

Combining Forces

Forces have size and direction. These dogs are combining forces. But they are working against each other. They are pulling the toy in opposite directions, but they are pulling with the same size force. The forces are balanced. The toy does not move. If one dog pulls with more force, the forces will not be balanced. The toy will move toward the dog that is using more force.

Sometimes more than one force acts on objects. If you and your friend push on opposite sides of a door with the same size force, the forces are balanced. The door will not move. If you push one side of the door while your friend pulls the other side, the forces are acting in the same direction. The door will move toward your friend. The total force on an object is found by adding all of the forces.

Force and Motion

Two or more forces acting on an object in opposite directions can be balanced. The object does not move. A still object starts to move only when the forces acting on it change. Inertia is the resistance an object has to any change in motion.

A moving object also changes its motion only when a force acts on it. A moving object will keep moving at the same speed and in the same direction as long as balanced forces are acting on it. An object can change speed or direction if the force acting on it changes.

More force is needed to change the motion of an object with more mass. You can easily pull an empty wagon. When you put objects in the wagon, you add mass. You must pull with more force to move the wagon.

These horses are using force to move the plow.

Friction

Friction is a force that acts when two surfaces rub together. Friction can keep objects from moving. It can slow or stop moving objects. Friction depends on an object's surface and weight.

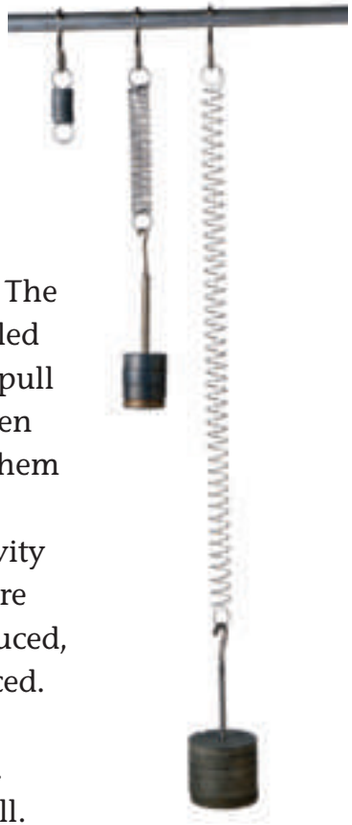
This Super Slide has a very smooth surface.

Rubbing together objects with rough surfaces causes a lot of friction. Rubbing together objects with smooth surfaces causes less friction.

A box of feathers is easy to push. The same box filled with books presses against the floor with more force. The box is harder to move.

You can reduce friction between objects. Wax or oil can make surfaces smoother. You need less force to move objects with less friction between them.

How are force, mass, and energy related?



The Force of Gravity

A ball falls to the ground when you drop it. The force that acts on the ball to make it fall is called gravity. **Gravity** is a force that makes objects pull toward each other. The amount of force between two objects depends on the distance between them and their masses.

If objects are close together, the force of gravity is strong. Gravity is weaker when the objects are farther apart. As the mass of the objects is reduced, the force of gravity between them is also reduced. If the mass of one object doubles, the force of gravity between it and another object doubles.

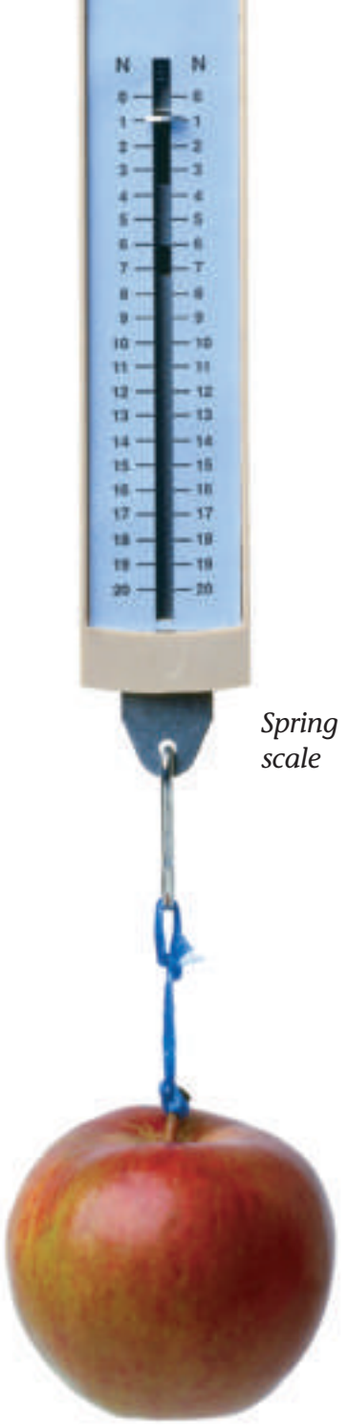
Earth's mass pulls on a ball, causing it to fall. The ball also pulls on Earth. But the ball does not have enough mass to move Earth.

The Moon has less mass than Earth. The force of gravity is not as strong on the Moon.

Measuring Force

You can measure force with a spring scale. A spring scale has a hook on the bottom. When you hang an object from the hook, the spring inside stretches. The object's weight determines how much the spring stretches. Weight is a measure of the force of gravity that acts on an object's mass. A heavy object has a strong force. A strong force will make the spring stretch more.

A marker on the scale moves along a number line as the spring stretches. The numbers on the scale show a unit of force called the newton. The newton was named after Sir Isaac Newton, who explained how motion and force are related. It takes about one newton of force to lift a small apple.



Spring scale

Energy and Motion

Energy is the ability to do work. **Work** is the ability to move something. Work causes a change. Any change in motion requires energy.

Kinetic energy is the energy of motion. All moving things have kinetic energy. The faster an object moves, the more kinetic energy it has. The amount of kinetic energy depends on an object's mass and speed.

Stored Energy

The swing in the picture stops briefly when it reaches the top of its path. The stopped swing has **potential energy,** or energy that is stored. Potential energy changes into kinetic energy once the swing begins to move again.

An object that has been stretched or squeezed has potential energy. A wind up toy has potential energy in its tightened spring.

A wrecking ball has a lot of kinetic energy before it crashes into a building.

Changing Kinds of Energy

Wind the spring of a toy bird. Each turn winds the spring inside the toy tighter. This adds more stored, or potential, energy. When you release the toy, the bird hops forward as the spring unwinds. The energy stored in the spring changes into kinetic energy.

You can change a rock's potential energy into kinetic energy by pushing it so that it starts to roll down a hill. The total amount of energy always stays the same. Energy cannot be made or destroyed.

Glossary

force	any push or pull
frame of reference	the point of view from which you detect motion
friction	the force that acts when two surfaces rub together
gravity	the force that makes objects pull toward each other
kinetic energy	the energy of motion
potential energy	stored kinetic energy
relative motion	the change in one object's position compared to another object's position
speed	the rate at which an object changes position
velocity	the speed and the direction in which an object is moving
work	the ability to move something or make a change

What did you learn?

1. How is motion measured?

2. What are some effects that force can have on moving objects?

3. List two types of energy. Give an example of how energy can change from one type to another.

4. **Writing** in Science The amount of friction between objects depends on each object's surface and weight. On your own paper, write a description of the effect that friction has on objects of different surfaces and weights. Include details from the book to support your answer.

5. **Sequence** Two dogs pull a toy with the same size force but in opposite directions. What will happen next if one dog pulls with more force?