

**Basic
Science Concepts**

Unit 1
Plants and Their Needs p. 10

Unit 2
Parts of Plants p. 16

Unit 3
Plant Survival p. 22

Unit 4
Plant Growth p. 28

Unit 5
How We Use Plants p. 34

Unit 6
Protecting Plants p. 40

**STEM
Experiments**

Experiment 1:
Growing Up

p. 46



Experiment 2:
Sipping Water

p. 50



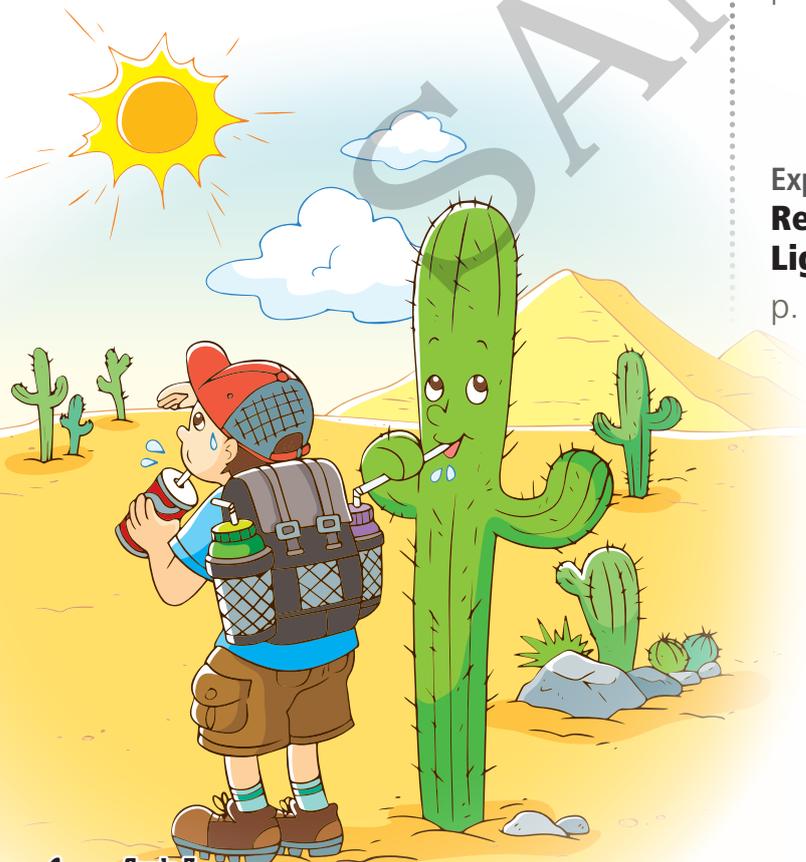
Experiment 3:
**A Plant's
Favorite Color**

p. 54



Experiment 4:
**Reaching for
Light**

p. 58



Section 2: Structures and Mechanisms

Basic Science Concepts

STEM Experiments

Unit 1
Structures p. 64

Unit 2
Forces Acting on Structures p. 70

Unit 3
Strength and Stability p. 76

Unit 4
Structures and Materials p. 82

Unit 5
Bridges p. 88

Unit 6
Structures and Us p. 94

Experiment 1:
Columns in Compression
p. 100



Experiment 2:
Uncrushable Eggs
p. 104



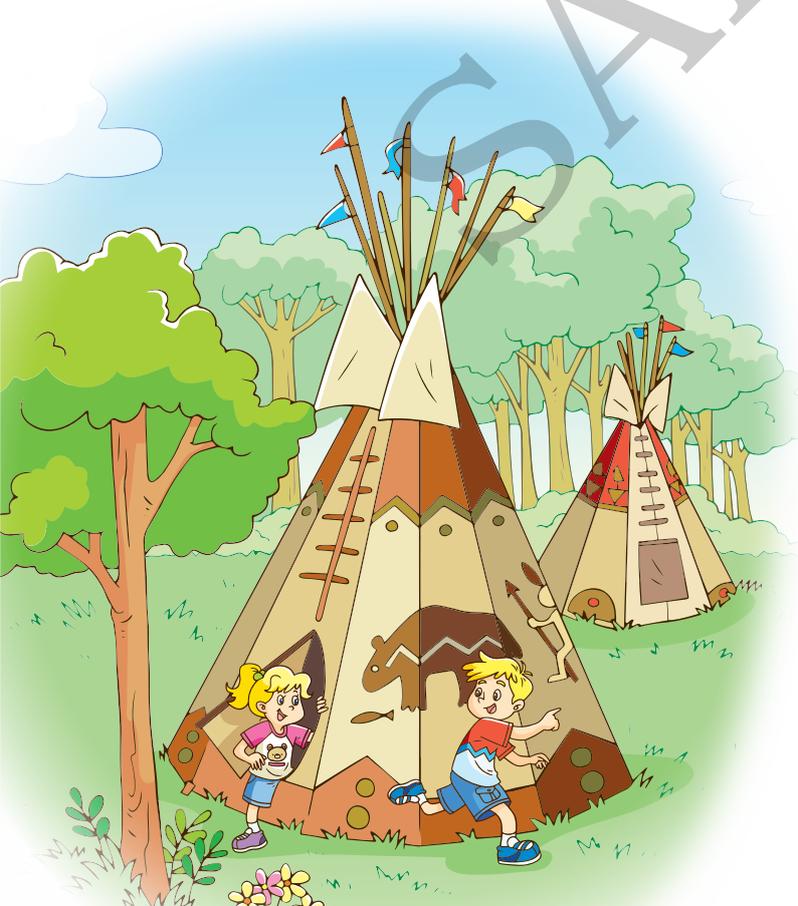
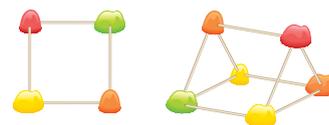
Experiment 3:
Standing Tall
p. 108



Experiment 4:
The Mightiest Shape
p. 112



Experiment 5:
Building Bridges
p. 116



Section 3: Matter and Energy

Basic Science Concepts

Unit 1 Force: Push or Pull	p. 122
Unit 2 Contact and Noncontact Forces	p. 126
Unit 3 Forces and Movement	p. 130
Unit 4 Friction	p. 134
Unit 5 Forces in Nature	p. 138
Unit 6 Forces in Our Lives	p. 142

STEM Experiments

Experiment 1:
The Power of Friction
p. 146



Experiment 2:
Going Down
p. 150



Experiment 3:
Electric Balloons
p. 154



Experiment 4:
The Three-layer Float
p. 158



Experiment 5:
Amazing Parachutes
p. 162



Experiment 6:
An Egg in a Bottle
p. 166



Section 4: Earth and Space Systems

Basic Science Concepts

Unit 1 Soil	p. 172
Unit 2 Types of Soil	p. 176
Unit 3 Uses of Soil	p. 180
Unit 4 Compost	p. 184
Unit 5 Living and Nonliving Things in Soil	p. 188
Unit 6 Soil and Society	p. 192
Answers	p. 218

STEM Experiments

Experiment 1: **Separating Soil**

p. 196



Experiment 2: **Thirsty Soil**

p. 200



Experiment 3: **Soil Discovery**

p. 204



Experiment 4: **Water Filters**

p. 208



Experiment 5: **Water and Rocks**

p. 212



UNCRUSHABLE EGGS

understanding what makes
a structure strong

The strength of a structure is its ability to support an object's weight and the compression forces the object creates. Believe it or not, an egg is actually an example of a strong structure. If you ever try squishing an egg from its top and bottom, you will find it surprisingly strong. In fact, you can stand on eggs in a carton without breaking them.

But what makes an egg so strong?



What you need:



a raw egg



a jar



cooking vinegar

It is easy to crack an egg but why is it difficult to be crushed in the palm of our hands?



Difficulty:



Time needed:

1 day

In this experiment, you will learn what makes a structure strong.

What to do:

- 1 Put the egg in the jar.
- 2 Add enough vinegar to cover the egg.
- 3 Wait for a few minutes and watch what happens to the egg.
- 4 Leave the egg in the vinegar for one day.
- 5 Remove the egg from the jar.
- 6 Touch the egg. How did it feel?

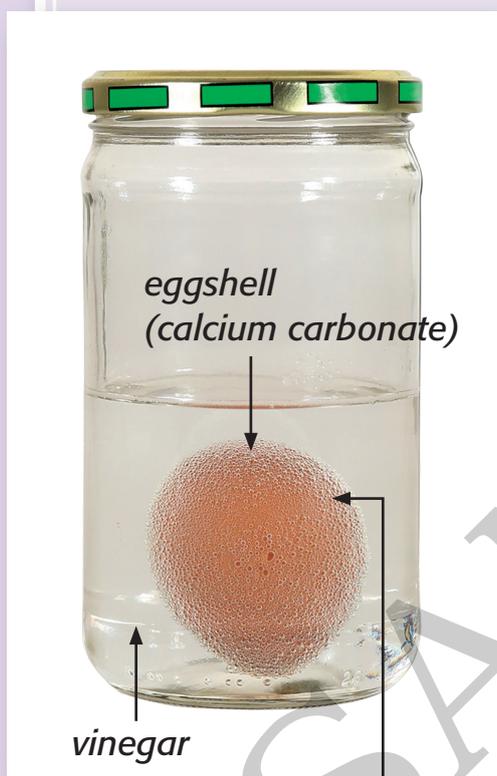
STEM Note

Vinegar is made through a process called fermentation. It can be made from apples, grapes, or grains. Vinegar has antibacterial properties, which make it a natural disinfectant and useful for cleaning surfaces.



WHAT *just* happened?

Though an eggshell is fragile, the calcium carbonate, which is the substance in the eggshell that makes it hard, in combination with its dome shape, makes an egg strong and able to support a lot of weight.



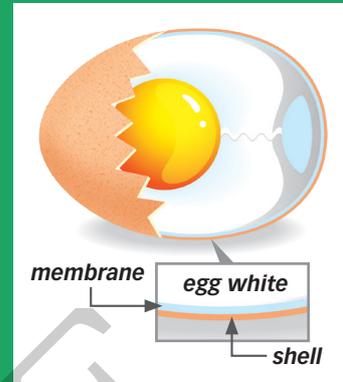
bubbles (carbon dioxide)

In Step 3 of the experiment, did you notice some bubbles forming on the eggshell and rising to the surface of the vinegar? The bubbles were carbon dioxide, which was the result of the chemical reaction between the calcium carbonate in the eggshell and the acetic acid in the vinegar. Acetic acid can dissolve calcium carbonate. When the egg lost its solid structure, the egg inside remained intact and was held together by the egg's membrane. The

membrane helped keep the dome shape of the egg, but the egg itself became flimsy and rubbery to touch.



- Did the vinegar affect only the eggshell? How about the membrane (the lining between the shell and egg white) and egg white?
- Why do eggs need to be strong?
- How does the egg's dome shape contribute to its strength?
- Name some animals that lay eggs.
- What are some different shapes and sizes of eggs?



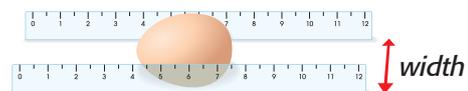
- Calcium carbonate is an essential substance for many animals. Do some research online and find out in what animals we can find calcium carbonate.



- What are some other examples of dome-shaped structures in nature?
- Use pipe cleaners or drinking straws to build a dome-shaped structure.



- Weigh the egg before you put it in the vinegar and after you take it out. Was there any difference in the weight?
- Measure the height and the width of an egg before you put it into the vinegar and after you take out. Were there any differences in the height and width?



The two rulers help keep the egg in place and their distance is the width of the egg.

3 Forces and Movement

Forces cause movement. In this unit, you will see how forces cause objects to move in different ways, or not move at all if the two opposing forces are balanced.



The man and his dog have been here for a while and haven't moved at all. They show balanced forces.

After completing this unit, you will

- understand how different forces can cause a moving object to keep the same speed, speed up, slow down, change direction, or stop.
- know that movement is caused by unbalanced forces.

Vocabulary

balanced forces: equal amounts of forces on opposite sides

unbalanced forces: unequal amounts of forces on opposite sides



Extension

A force starts, speeds up, slows down, stops, or changes the direction of movement.

Forces happen in pairs. Do you know that there are two forces acting upon a person standing on the floor?

The floor pushes upward on the boy.

Gravity pulls downward on the boy.



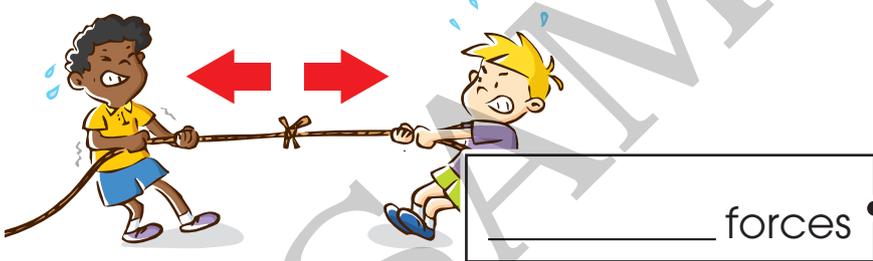
The forces on me are balanced.

What happens if the forces are unbalanced?



A. Look at each pair of arrows. Decide whether the forces are “balanced” or “unbalanced.” Then draw lines to match.

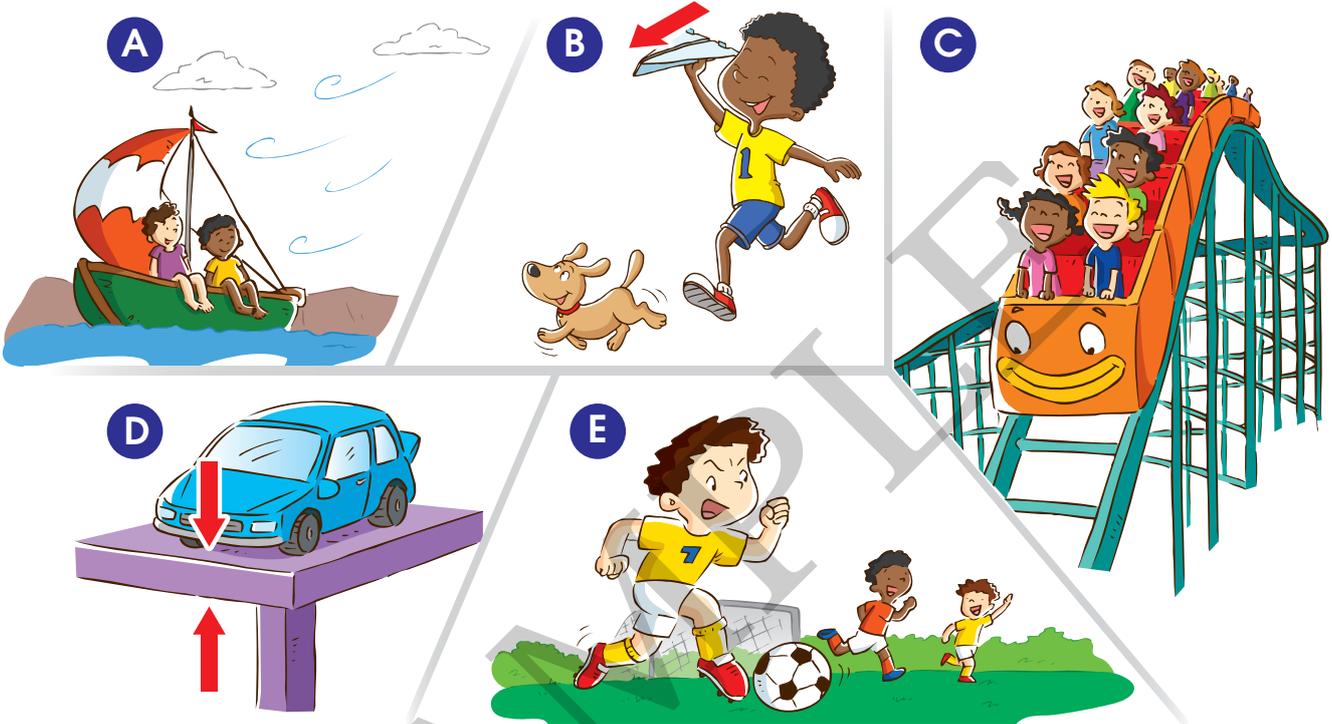
The bigger the arrows are, the greater the forces.



- moves to the left
- moves to the right
- stays at rest

B. Fill in the blanks to complete the sentences about the effects of forces on the objects.

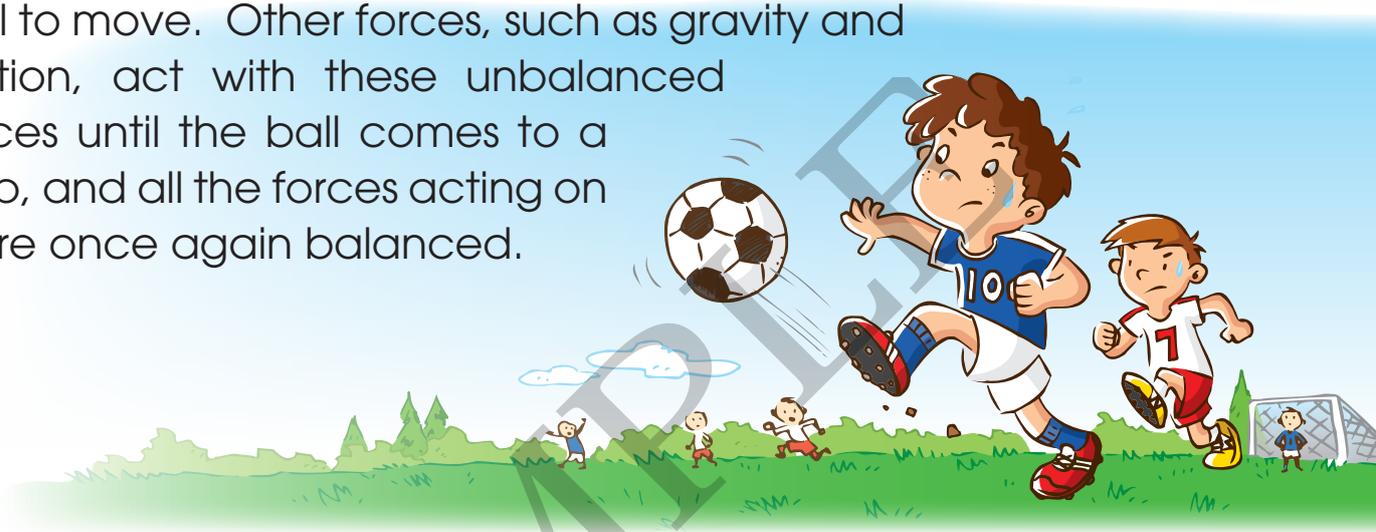
speed up stop start change direction remain at rest



- A** The sailing yacht will _____ due to the force of wind if wind blows from another direction.
- B** The paper plane will _____ due to muscular force.
- C** The roller coaster will _____ due to the force of gravity.
- D** The toy car will _____ due to balanced opposing forces.
- E** The soccer ball will eventually _____ due to the force of friction.

C. Read the paragraph. Write T for true and F for false. Then draw an arrow to show balanced forces.

Balanced forces are at work on a soccer ball when it is at rest: gravity pulls the ball to the ground and the ground pushes it back. However, when a soccer player kicks the ball, the motion creates unbalanced forces, which cause the ball to move. Other forces, such as gravity and friction, act with these unbalanced forces until the ball comes to a stop, and all the forces acting on it are once again balanced.



1. When a ball is at rest, it has balanced forces.

2. Unbalanced forces can cause a ball at rest to move.

3. Unbalanced forces are at work on a ball when it is in the air.

4. Draw an arrow to show the force from the ground that acts on the ball.

