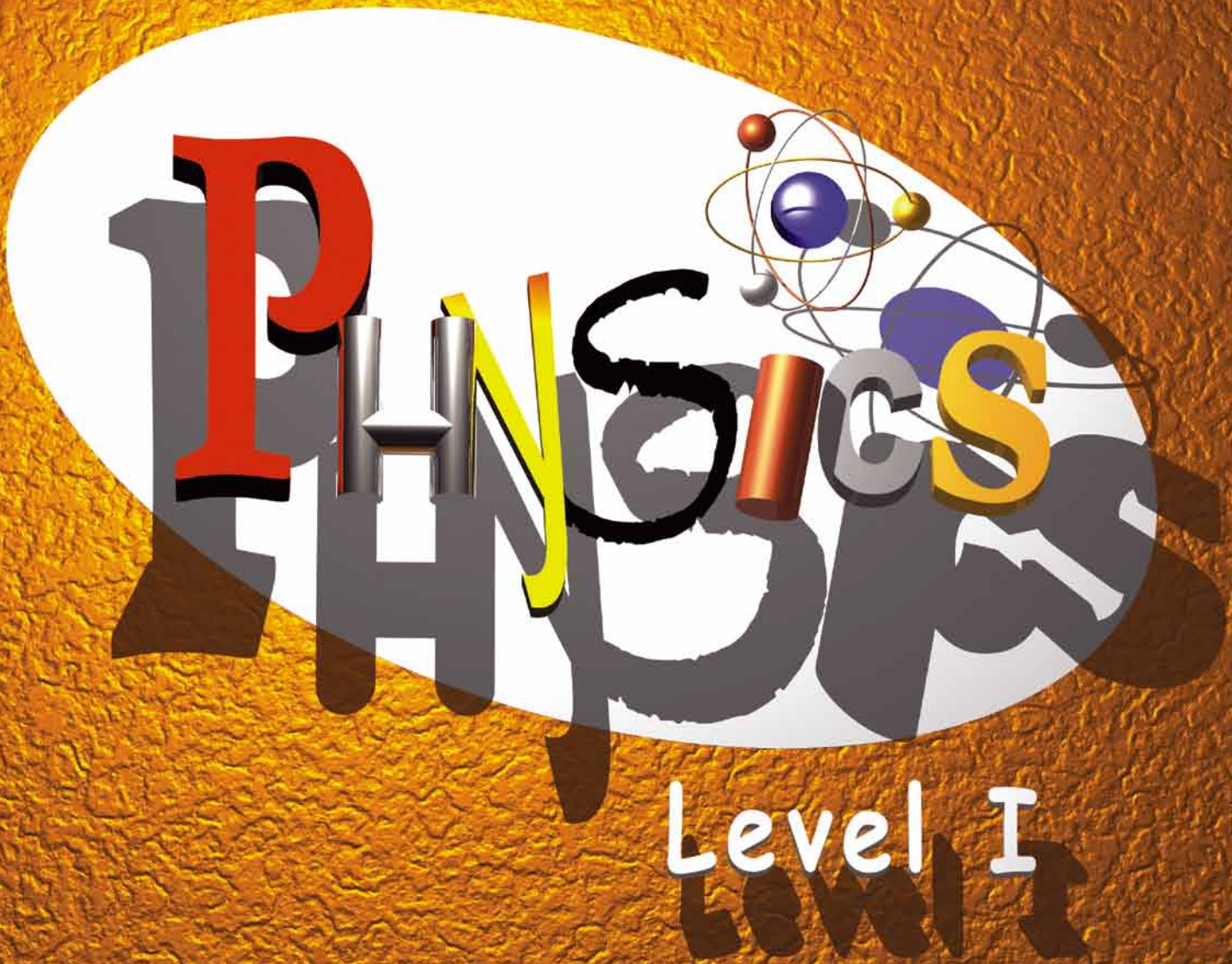
Real Science-4-Kids



Level I

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Energy and a Bouncing Ball—At the top of each bounce, the ball has only potential energy and no kinetic energy. As it falls, it loses potential energy and gains speed until, just before it hits, it has only kinetic energy and no potential energy. However, each time the ball hits the ground, it loses some energy as sound and heat, so each bounce becomes lower than the one before.

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1.1 Introduction

Have you ever wondered what makes a feather float but a boulder fall, or why a bird can fly but a whale cannot? Have you ever noticed that when your mom quickly puts on the brakes, the car stops, but your ice cream ends up on the dashboard? Have you ever wondered why, when you slide your stocking feet on the carpet, you can "shock" your dad?

All of these observations, and others like them, begin the inquiry into the field of science called physics. The name physics comes from the Greek word *physika*, which means "physical or natural." Physics investigates the most basic laws that govern the physical or natural world.

1.2 The basic laws of physics

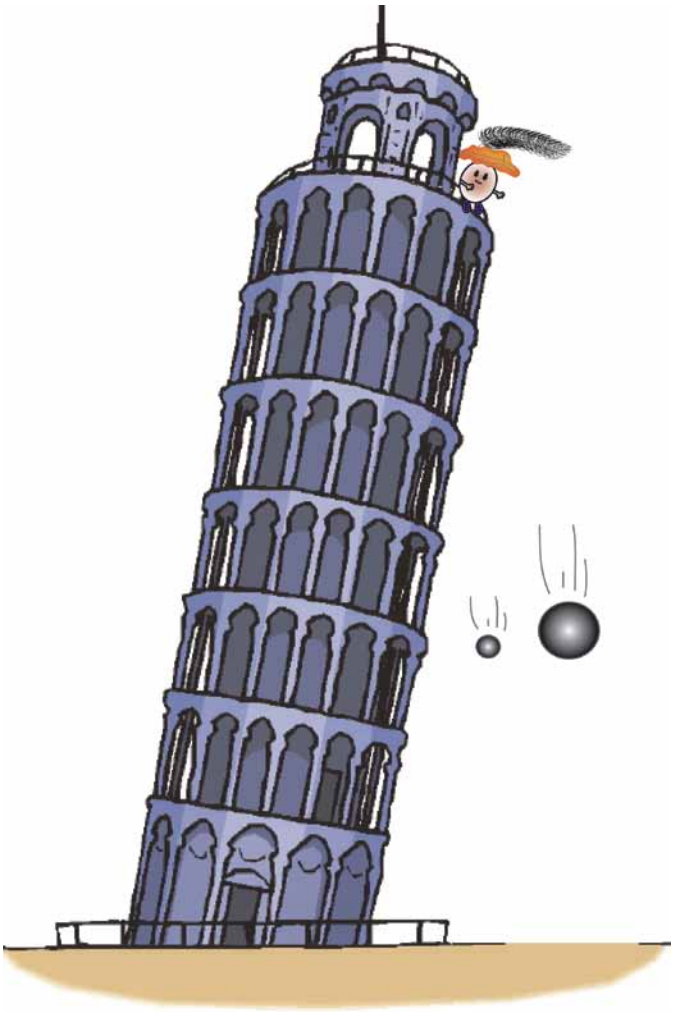
What is a basic law of physics? Are the laws of physics like the laws that tell us not to speed or not to steal? No. In fact, physical laws are statements that tell us about how the physical world around us works. Using these laws, we can understand why baseballs go up and then come down, why airplanes can fly, why rockets can land on the moon, and why we see rainbows after it rains. Physical laws are never broken, unlike laws that tell us not to speed or not to steal. For example, Newton's law of gravity tells us why we stay firmly on the surface of the earth and do not sometimes just fly off. People have always known that the world behaves in regular and reliable ways. For example, people have observed for centuries that the sun always rises and sets, that water always flows downhill, or that, if it is cold enough, water will turn into ice. The laws of physics are statements about these regular and reliable observations.

We know that objects such as baseballs, airplanes, and people *consistently* obey the laws of physics and don't suddenly break one or two. It would be kind of hard to play baseball if every once in a while the ball hit by the batter landed on the moon.

1.3 How we get laws

How do we know what these laws are, and how did we discover them? Did the Earth come with a big instruction book that spelled out all of the laws? Not exactly. People had to figure them out on their own. Scientists use scientific investigation to discover how the world works. We will learn more about scientific investigation, including the scientific method, in the next section. One early scientist who used scientific investigation and helped develop the scientific method was Galileo Galilei (ga-lə-lā'-ō gal-ə-lā') Galileo was an Italian astronomer born in Pisa, Italy in 1564. He showed how two lead balls fall at the same rate even if one is larger than the other. He performed a famous experiment where he is said to have dropped two cannon balls off the Leaning Tower of Pisa. He found that, even though the two cannon balls were different weights, they landed on the ground at exactly the same time!

People still had trouble believing him, and it wasn't until Isaac Newton showed mathematically why this was true that it was finally accepted.



Isaac Newton is considered to be one of the greatest scientists of all time. He is also considered the founder of physics as we know it today. He was born in 1643 in England. He was a brilliant man who figured out many laws about how objects move. He was a great mathematician and wrote mathematical equations to describe these laws. One law that Newton discovered is the law of gravity. Newton confirmed Galileo's experiments and showed with mathematics just why two objects will reach the ground at the same time, even if one is heavier than the other. Physical laws are often described using mathematics. The precision of mathematics is one reason physics is so powerful.

1.4 The scientific method

Newton and Galileo used the scientific method to discover the laws of motion. The scientific method is a way of gathering information and drawing conclusions based on that information. Scientists have used this method to make many discoveries.

There are essentially five steps in the scientific method. The first step is observation. A scientist, like Newton, observes how things behave and may look for patterns or things that are similar from day to day.

For example, you may notice that each time it snows, people in big trucks spread salt on the roads. You may also notice that cars have less trouble on these salted roads than on roads without salt.

These are observations. From these observations, you might think of a general statement that tells something about what you have observed. This is the second step in the scientific method and is called forming a hypothesis (hī-pä′-thə-səs). A hypothesis is really just a guess. It is something that you think might be true about your observations but that hasn't been proven. For example, you might make the following statements about why salt is put on roads:

"The salt melts the ice on the road."
"The salt makes rubber tires sticky."
"The salt makes the snow stop falling."

All of these statements are hypotheses (hī-pä′-thə-sēz). That is, they are hypothetical (hī-pə-the′-ti-kəl), meaning they haven't been proven.

The third step is to *test* your hypothesis by using experimentation. By designing an experiment to test your hypothesis, you can find

out if your hypothesis is correct. For example, you may decide to test your hypothesis that "salt makes rubber tires sticky" with an experiment. You might take two pieces of rubber and add salt to one and not to the other. The one you don't add salt to would be a control. A control tells you what you would expect without salt so that you can tell if the salt makes any difference. Next, you would compare the two pieces of rubber to see if the one with salt is stickier than the one without salt.

This brings you to the fourth step in the scientific method, collecting results. As a scientist, you should always *record* the results of your experiment exactly as you see them. If the salty rubber is "stickier" than the regular rubber, then you should record that. If the rubber is not stickier with salt, then that is what must be recorded. At this point, you should not let what you *think* might happen affect how you record your results. This is very important. Also, *everything* you observe should be written down. Even your mistakes should be recorded.

Finally, the last step of the scientific method is to draw conclusions based on what your results show. Here again, your conclusions should be based only on your results and should not be influenced by what you think *should* have happened. For example, if the salt did not make the rubber stickier, then a conclusion might be:

Conclusion:

"Based on my data, the salt did not make the rubber more sticky."

Based on this one experiment, you cannot say why the salt helps the cars drive more easily. You would have to conduct more experiments. But you have been able to eliminate at least one hypothesis using the scientific method. Showing which hypotheses are NOT true is often just as important as showing which one is true.

1.5 Summary

Here are the main points to remember from this chapter:

- Physics is the study of how things move and behave in nature.
- The laws of physics are precise statements about how things behave.
- The laws of physics were determined using the scientific method.
- The five steps of the scientific method are as follows:

1. Observation
2. Forming a hypothesis
3. Experimentation
4. Collecting results
5. Drawing conclusions