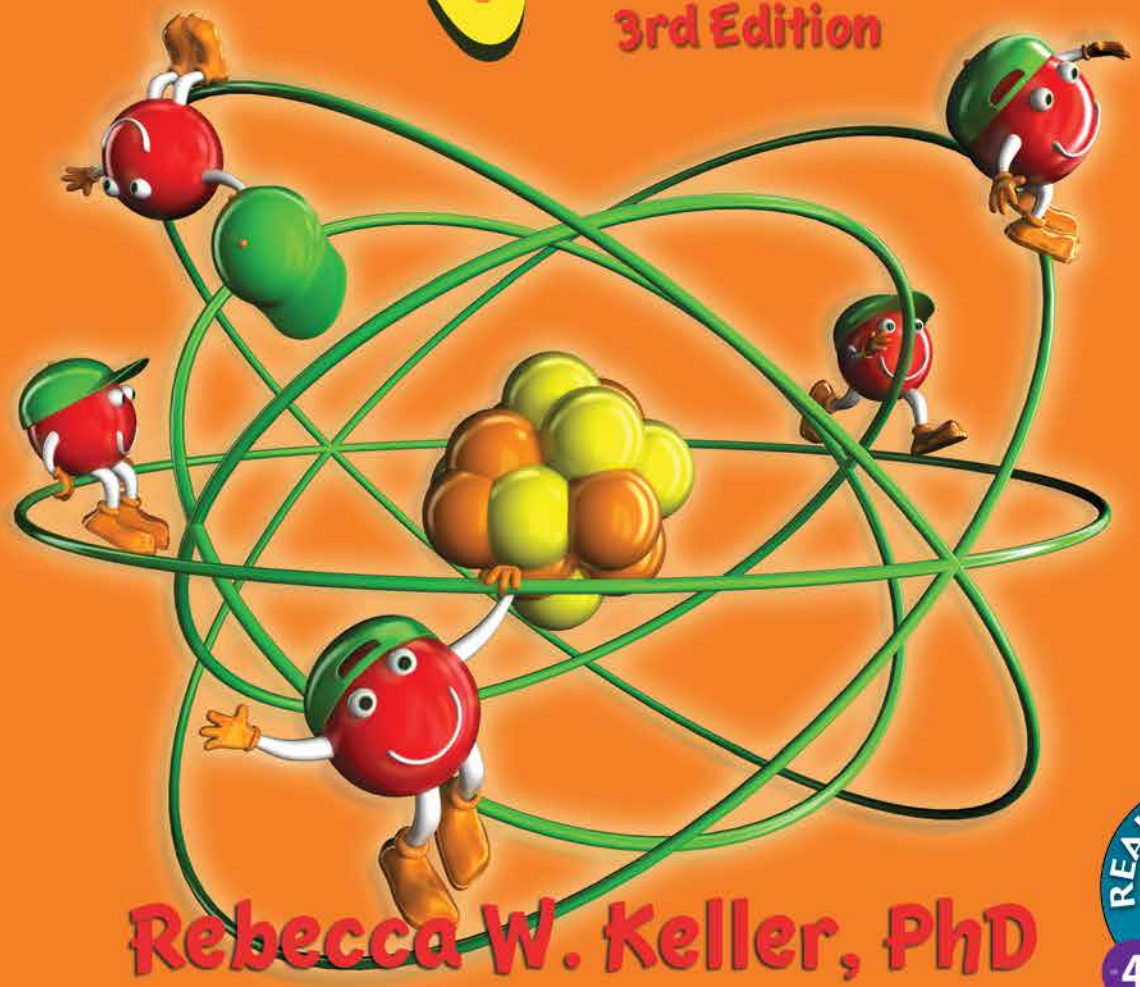
Featuring Chapters from:
Student Textbook
Laboratory Notebook
Teacher's Manual
Lesson Plan
Study Notebook
Quizzes
Graphics Package

Focus On Elementary Physics

3rd Edition



Rebecca W. Keller, PhD

Real Science 4 Kids

Introduction

Welcome to the ***Focus On Elementary Physics 3rd Edition Preview Booklet*** where you can take our one semester unit study program for a test run!

The materials sampled in this booklet are taken from a full semester course, with two chapters from each part of the curriculum:

- The ***Focus On Elementary Physics Student Textbook–3rd Edition*** provides foundational science concepts presented in a way that makes it easy for students to read and understand. The many colorful illustrations make each chapter fun to look at and reinforce concepts presented.

- With two science experiments for each chapter, the ***Laboratory Notebook*** helps young students learn how to make good observations, an important part of doing science. Open-ended questions help students think about what they are learning, and information is provided to assist students with understanding what they observed while performing their experiments.

- The ***Teacher's Manual*** includes instructions for helping students conduct the experiments, as well as questions for guiding open inquiry. The commonly available, inexpensive materials used for all the experiments can be seen in the complete materials lists included in this booklet.

- Using the ***Lesson Plan*** makes it easy to keep track of daily teaching tasks. A page for each chapter in the ***Student Textbook*** has the objectives of the lesson and questions for further study that connect science with other areas of knowledge, such as history; philosophy; art, music, and math; technology; and language. Forms are included for students to use to do a review of material they've learned and to make up their own test for the chapter. Also included are icons that can be copied onto sticker sheets and used to help plan each day of the week.

- Different types of fun activities are presented in the ***Study Notebook.*** These help reinforce the concepts students are learning and include making observations, some simple experiments, matching, fill in the blank, cut and paste, writing, following directions, and more.

- The one final and two midterm ***Quizzes*** are self-explanatory. For those who are not fans of quizzes, students can use the self-test at the end of the ***Lesson Plan*** instead.

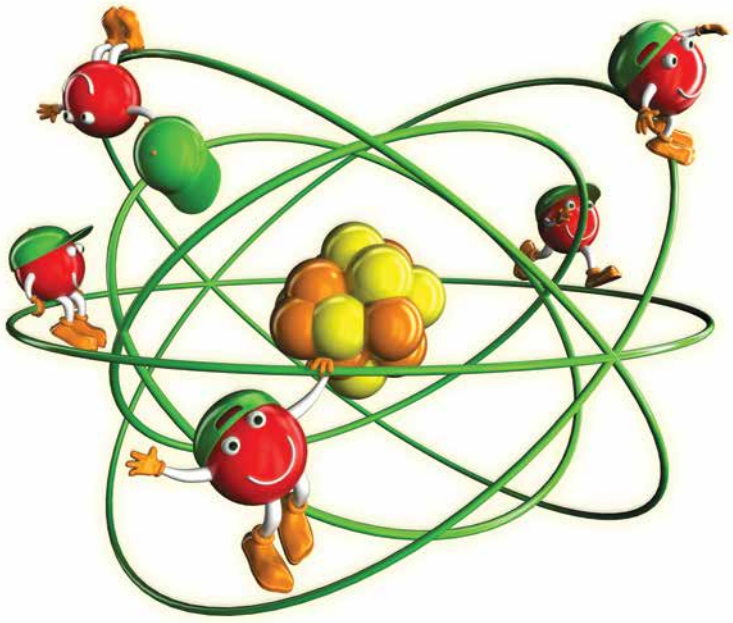
- Another type of teaching aid is provided in the ***Graphics Package,*** which has two full-color images from each chapter of the ***Student Textbook.*** These graphics can be used to create additional teaching aids such as flash cards, wall posters, PowerPoint lectures, or overhead projections.

FOCUS ON

Grades K-4

ELEMENTARY PHYSICS

3rd Edition



Rebecca W. Keller, PhD

REAL SCIENCE 4 Kids

Real Science-4-Kids

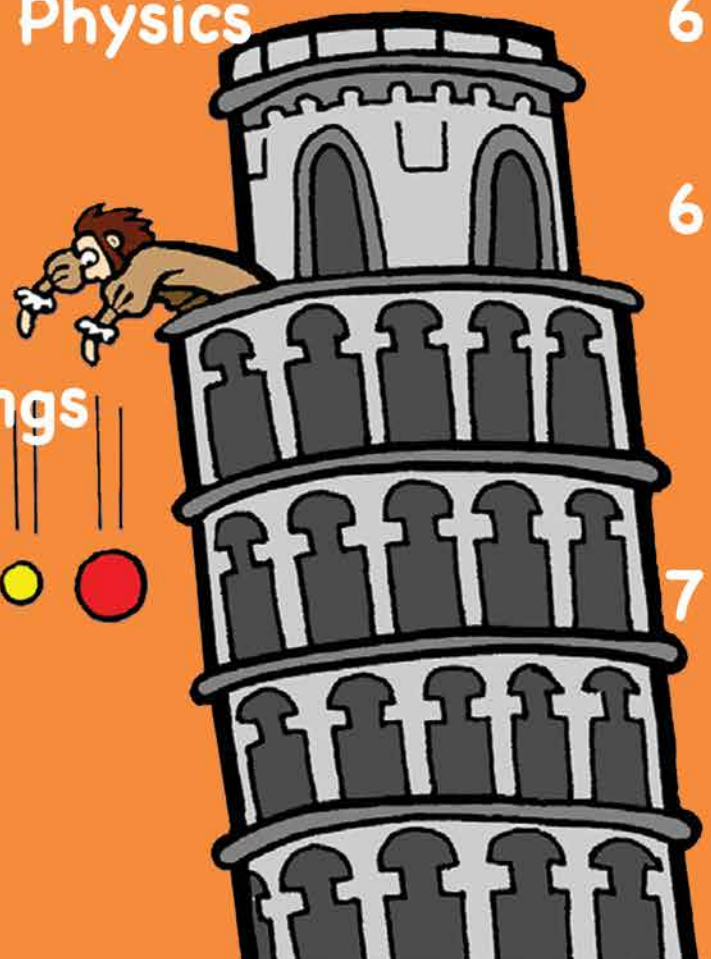
Illustrations: Janet Moneymaker

Focus On Elementary Physics Student Textbook–3rd Edition (softcover)
ISBN 978-1-941181-42-3

Published by Gravitas Publications Inc.
www.gravitaspublications.com
www.realscience4kids.com

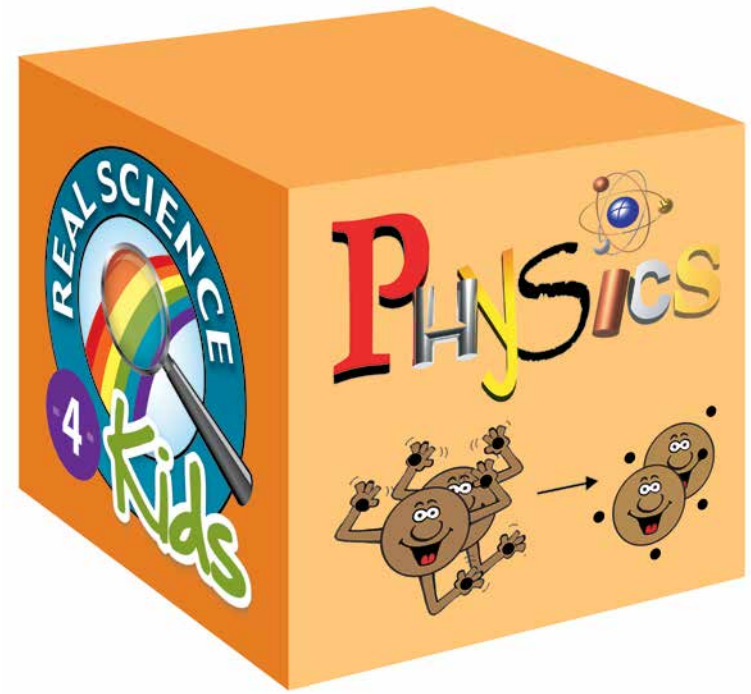
Contents

Chapter 1 What Is Physics?



1.1 Introduction

In this book we will take a look at the building block of science called physics.



Have you ever thrown a ball up in the air? Did you notice the ball when it left your hand? What did it do? Did it go up? Did it come back down? Unless it gets stuck in a tree or picked up by a big bird, a ball that is thrown up into the air will always come back down.

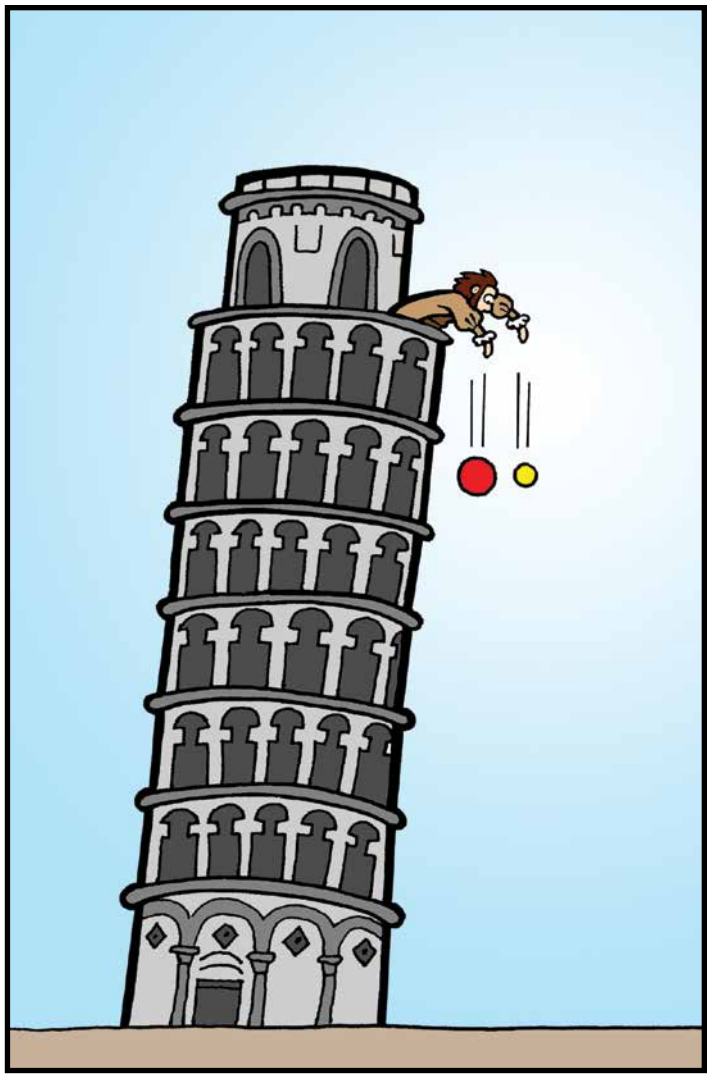
Have you ever tried to throw a ball really far or really high? Have you ever watched how far or how high the ball goes? Have you ever noticed that it's harder to throw a heavy ball than it is to throw a light ball? Have you ever noticed that it's almost impossible to throw a feather?

Physics is the branch of science that explores how far or how high a ball might go or how heavy it needs to be so that it can be thrown. Scientists who study physics are called physicists.

1.2 History of Physics

Physics is about studying the way things behave and then figuring out the rules those things follow to make them behave that way. Physicists don't make the rules, but they discover the rules by watching how the world works.

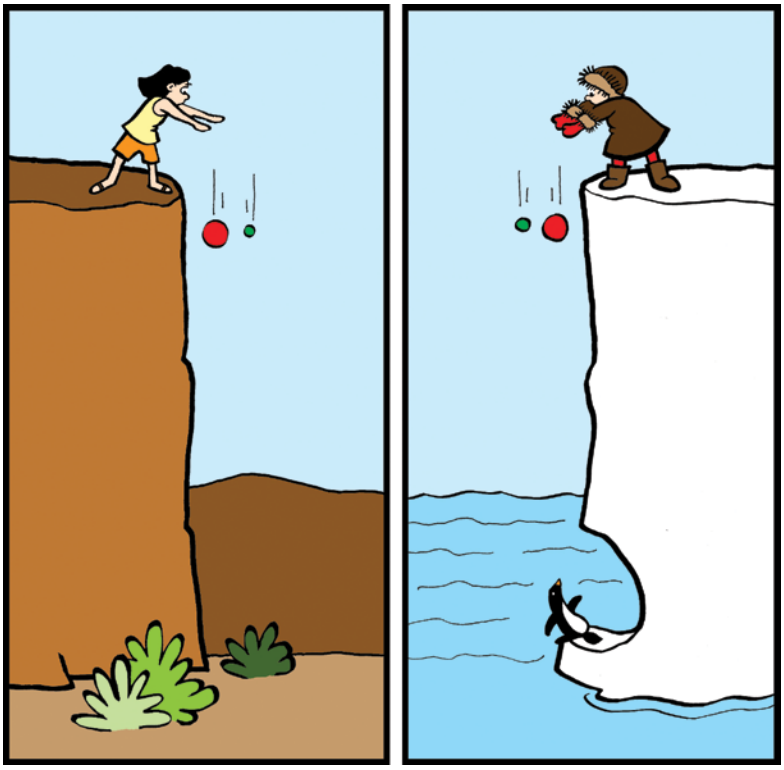
Aristotle studied motion, but it was Galileo Galilei, an Italian astronomer, who used physics to understand how things move.



Galileo is known for a famous experiment where he dropped two balls off a building to see what would happen. He used a heavy ball and a light ball. To everyone's surprise, he found out that they both hit the ground at the same time!

Physicists also use math to figure out the rules. Isaac Newton was a great scientist and mathematician who figured out many important rules of physics. By using math, Newton figured out exactly why the balls Galileo dropped hit the ground at the same time. Math is an essential part of physics and helps us understand the rules of physics.

1.3 Modern Physics



Did you know that balls will follow the same rules no matter where you are on the Earth? You can be in the frozen Arctic, and if you drop two balls, they will fall in exactly the same way. You can be in a desert, at the beach, or on a boat, and if you drop two balls, they will fall in exactly the same way. No matter where you are on Earth, a ball will always follow the rules of physics!

How balls behave when dropped is explained by the rule "what goes up - comes down" which is a rule about gravity. Gravity is what makes the balls come back down.

Gravity is also what keeps you from flying off the surface of the Earth. Balls, toys, cars, houses, and even birds obey the rules of gravity.

1.4 Everyday Physics

Every day, physics is happening all around you. In the same way that you learn chemistry and biology, to learn physics you need to make observations. When you are looking at something with your eyes, you are making an observation. Making good observations is the first and most important step when you are trying to understand physics.

When you make an observation, try to notice everything you can about what you are observing. If you are at the movie theater getting popcorn, try noticing the popcorn machine. Where does the popcorn go in? Where does it come out? What is moving on the machine? What is staying still? Notice the popcorn when it comes out. Is it hot or is it cold? These kinds of observations are important if you want to think like a scientist.

1.5 Summary

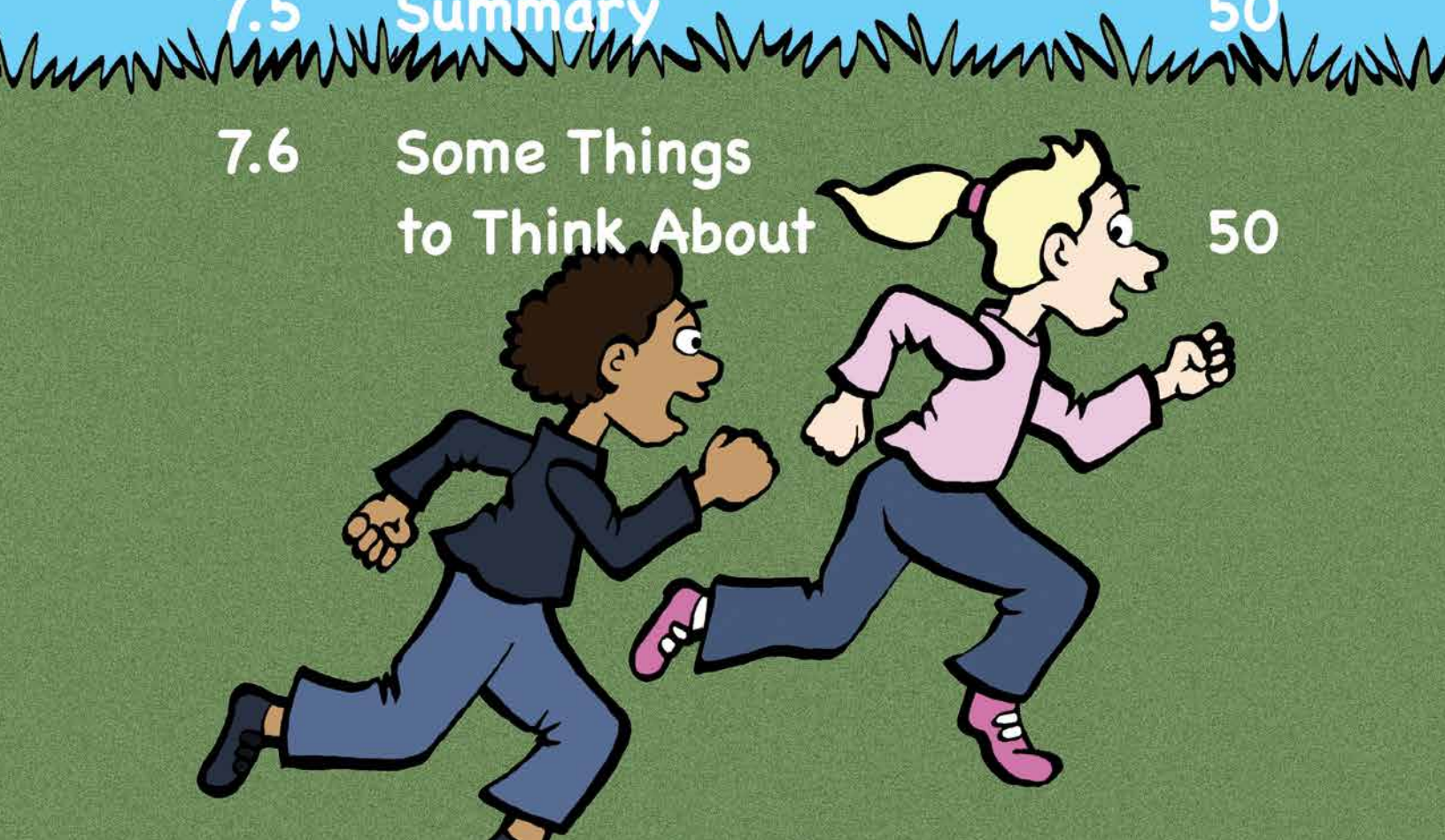
- Physics is about studying the way things behave and then figuring out the rules those things follow that make them behave that way.

- Objects, like balls, planes, and birds, always obey the rules of physics.
- The rules of physics are true no matter where you are on the Earth.
- Physicists don't make the rules, they discover the rules.
- To think like a scientist, you must make good observations.

1.6 Some Things to Think About

- Go outside and throw a ball. Now throw a feather. How would you explain what happens?
- What do you think you could learn by dropping two balls off a tower?
- What do you think would happen if you were playing a ball game and the ball did not have to follow any rules of physics?
- The next time you go somewhere in a car, observe everything you can about the car and how the different parts work. Make a list!

Chapter 7 Linear Motion



7.1 Introduction

In Chapter 4 we explored kinetic energy, or moving energy. In this chapter we are going to look at a specific kind of motion called linear motion. Linear motion is simply motion that occurs along a line. If you push a hockey puck straight in front of you, it has linear motion. If you throw a baseball straight into the catcher's mitt, it has linear motion.

7.2 How Far?

Did you know that everything is moving? Even objects you think are standing still are moving. Your house is moving and even mountains are moving! You can tell houses and mountains are moving because you can see the Sun shine on them in the morning and then stop shining on them at night. Your house and the mountains around you are moving

because the Earth is moving as it spins around and around on its axis. The Earth is also moving around the Sun.

Physicists say that motion is relative. This means that we measure the motion of an object by comparing it to other objects. Physicists use the term speed to mean how fast an object moves. The speed of an object is *relative* to the objects surrounding it. For example, if a police officer pulls you over and hands you a speeding ticket, it is because you were moving too fast compared to him, the road, and the houses around him.

The speed of an object is the measure of how far it goes in a given time. If you start at your back porch and run to the back wall of your yard and it takes you three minutes, you ran that distance at a certain speed. But if your friend runs to the back wall of your yard and finishes the same distance in only one minute, then your friend ran faster than you did. A physicist would say your friend ran with more speed.

7.3 Average Speed

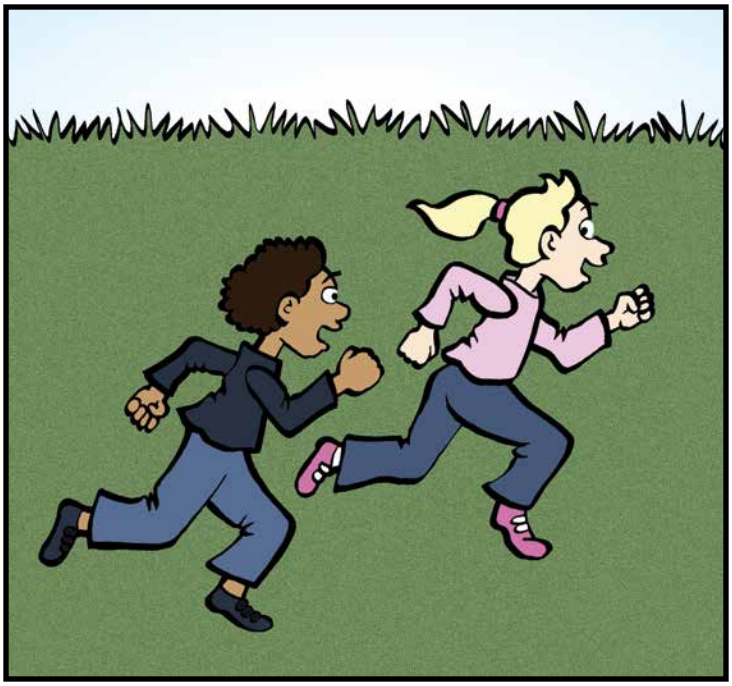
Physicists like to study details. If you ran to the back wall three times, a physicist would observe your speed the first time, the second time, and the third time you ran. The physicist would clock how fast you ran each time and would record three separate times. The speed at which you ran might have been affected by different things. For instance, if you got more tired each time you ran, your speed might have been slower the second time you ran and even slower the third time.

Imagine that you want to know on average how fast you can run to the back wall of your yard. To find your average speed you would add all three of your times together and then divide by three. This would tell you on average how fast you ran.

Knowing your average speed is useful information. You might find out that on average you can run to the back wall in two minutes, but on days when you feel really good you can run this distance on average in less than two minutes. By

recording your average speed each day and making notes about how you were feeling and other things such as what you had for breakfast, you can compare your good days and your bad days and learn about what helps you run faster.

7.4 Acceleration



Imagine that you are running to the back wall and suddenly your friend starts to run beside you. You might try to win the race, so you speed up! Then as you get near the end, you might start to get tired and have to slow down.

When you started to run faster, you changed your acceleration. In physics, acceleration is the change in speed of a moving object for a given time. For example, if you roll a marble down a ramp, you can watch it accelerate as it gets closer to the ground. The marble will start slowly and then gradually speed up. Depending on how long your ramp is, the marble might be moving very fast when it hits the ground. Because the marble speeds up as it travels down the ramp, physicists say it accelerates—changes its speed as it moves.

7.5 Summary

- Linear motion is the motion of an object in a straight line.
- Speed is how fast an object travels.
- Average speed is calculated by measuring the speed of an object several times, adding the speeds together, and dividing the total by the number of times the speed was measured.
- An object accelerates when it changes its speed while it is moving.

7.6 Some Things to Think About

- Do you think a car has linear motion? Why or why not?
- How far can you run in 2 minutes?
  - across the backyard
  - to the neighbors house
  - to the grocery store
  - to the next city
  - across your country
  - some other distance

- What do you think would be the most helpful to you if you want to be able to run faster?

  a good breakfast

  new shoes

  practicing every day

  running in a race

  something else

- How would you explain acceleration in your own words?

FOCUS ON

Grades K-4

ELEMENTARY PHYSICS

Laboratory Notebook

3rd Edition

Rebecca W. Keller, PhD

REAL SCIENCE 4 Kids

Real Science-4-Kids

Illustrations: Janet Moneymaker

Focus On Elementary Physics Laboratory Notebook—3rd Edition
ISBN 978-1-941181-43-0

Published by Gravitas Publications Inc.
www.gravitaspublications.com
www.realscience4kids.com

A Note From the Author

Hi!

In this curriculum you are going to learn the first step of the scientific method:

Making good observations!

In the science of physics, making good observations is very important.

Each experiment in this notebook has several different sections. In the section called *Observe It*, you will be asked to make observations. In the *Think About It* section you will answer questions. There is a section called *What Did You Discover?* where you will write down or draw what you observed from the experiment. And finally, in the section *Why?* you will learn about the reasons why you may have observed certain things during your experiment.

These experiments will help you learn the first step of the scientific method and.....they're lots of fun!

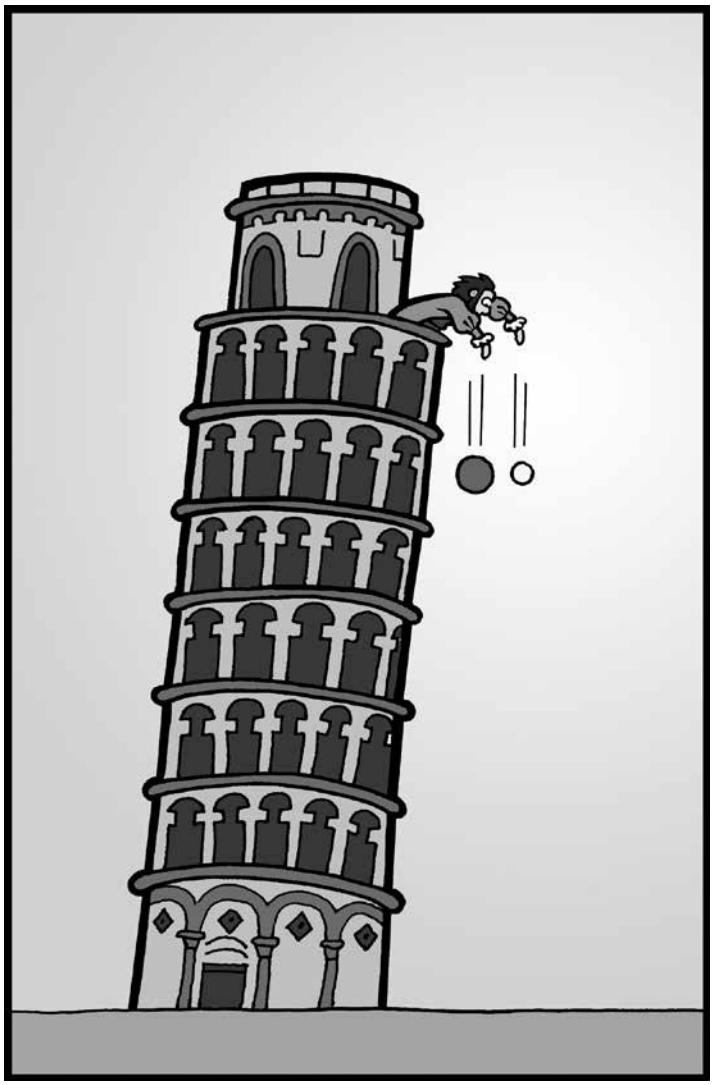
Enjoy!

Rebecca W. Keller, PhD

Contents

Experiment 1

Falling Objects



I. Observe It

❶ Take two tennis balls and hold them at chest level with your arms pointing straight out in front of you.

❷ Release the two objects from both hands at the same time.

❸ Watch carefully to see how they land.

❹ In the following box use words or pictures to record what you see.

❺ Repeat Steps ❶-❹ several times using different objects, such as:

- An orange and an apple.
- A tennis ball and a rubber ball.
- An apple and a tennis ball.
- A rubber ball and an apple.
- An orange and a tennis ball.

Object 1 _____

Object 2 _____

Object 1 _____

Object 2 _____

Object 1 _____

Object 2 _____

Object 1 _____

Object 2 _____

Object 1 _____

Object 2 _____

Object 1 _____

Object 2 _____

Object 1 _____

Object 2 _____

II. Think About It

❶ Did the objects fall at the same speed? How can you tell?

❷ Are there any changes you could make to your experiment? Holding the objects higher? Holding the objects lower? Describe changes you can make.

❸ Repeat the experiment for one set of objects using one change you thought about.

❹ Record your observations on the next page.

Object 1 _____

Object 2 _____

Change to Experiment _____

_____

_____

_____

_____

_____

_____

_____

_____

III. What Did You Discover?

❶ Was it easy or difficult to release the objects at the same time? Why or why not?

❷ Was it easy or difficult to observe the objects falling? Why or why not?

❸ For each of the pairs of objects, did both objects land at the same time? Why or why not?

❹ Did the changes you chose to make to your experiment make a difference? Why or why not?

IV. Why?

Galileo Galilei discovered that when he let two objects of different weights fall from the same height, they always landed at the same time. This seems the opposite of what you might think would happen. It seems like a heavier object would fall faster than a lighter object. But this is not what happens. Your observations showed that two objects of different weights will hit the ground at the same time. Why?

Things fall because of gravity. Gravity is a force that makes the objects on Earth stay on Earth. (You will learn about forces in a following chapter.) Gravity pulls everything down towards the center of the Earth. When you hold two objects in your hands, gravity is pulling on them. Every object has gravity pulling on it all the time. Gravity pulls on apples in the same way that it pulls on tennis balls. Gravity pulls on oranges in the same way that it pulls on rubber balls. Everything has the same force of gravity pulling on it at the same time. So an apple (which is heavier than a tennis ball) has the same amount of gravity pulling on it as the tennis ball. Both the tennis ball and the apple start off with exactly the same amount of gravity pulling on them at the same time, and the amount of gravity pulling on them never changes.

Once the objects are released, they fall at the same speed because they have the same amount of gravity pulling on them at the same time. It doesn't matter how heavy they are. That is what Galileo and YOU discovered by doing this experiment.

V. Just For Fun

What do you think would happen if you dropped an orange and a cotton ball or a feather at the same time? Why?

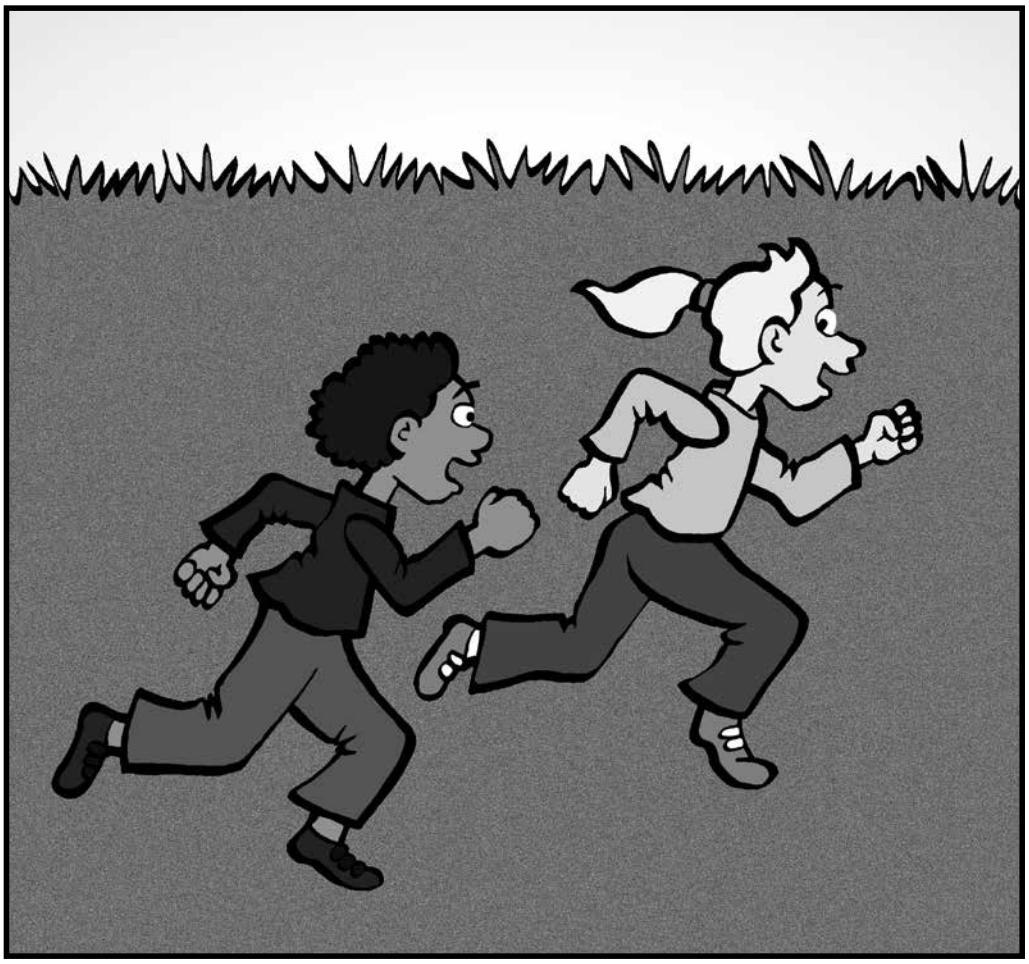
Try it. Record your observations.

Object 1 *Orange*

Object 2 *Cotton Ball (or Feather)*

Experiment 7

Speed It Up!



Introduction

Understanding speed is an important concept in physics. In this experiment you will explore how to measure speed.

I. Think About It

How long does it take for you to run from one end of your yard (or park) to the other? If it is a short distance, can you run fast? If it is a longer distance, does it take longer? Do you think you can run at the same speed the entire distance? Or do you think you'll have to run fast and then slow down to make it the entire distance?

Write your ideas below.

Thoughts About Running

II. Observe It

Pick a distance you can run and mark the starting and ending points. Using your feet, measure the distance by walking heel-to-toe between the two points. Count your steps and record the distance in "feet" below.

Now start a timer and run from the starting point to the ending point. Check the timer and see how long it takes.

Repeat this five times and record your answers below.

Times	
1	
2	
3	
4	
5	

Calculate your average speed. Add the above five times together and record the total time. Divide by 5 and record the time.

Total time _____ divided by 5 = _____ average speed

III. What Did You Discover?

❶ How fast did you go on your first run?

❷ How fast did you go on your last run?

❸ What was your average speed?

❹ On your first run, did you run faster or slower than your average speed? Why?

❺ On your last run, did you run faster or slower than your average speed? Why?

❻ How far did you run? (How many feet did you measure?)

IV. Why?

In physics, the speed of an object is important to know. It is easy to measure the speed of an object that has linear motion—that is, an object that is moving from one point to the next in a straight line. You can measure your speed as you run by simply carrying a timer with you or having someone time you as you run. You can also find your average speed by repeating the run several times and averaging the times you record.

V. Just For Fun

How fast can your parent or friend run? Have them repeat the experiment using the same distance. Record their times. Calculate their average speed. Is their speed faster or slower than yours?

Times	
1	
2	
3	
4	
5	

Calculate the average speed. Add the above five times together and record the total time. Divide by 5 and record the time.

Total Time _____ Divided By 5 = _____ Average Speed

Grades K-4

FOCUS ON ELEMENTARY PHYSICS

Teacher's Manual

3rd Edition

Rebecca W. Keller, PhD

REAL SCIENCE 4 Kids

Real Science-4-Kids

Illustrations: Janet Moneymaker

Focus On Elementary Physics Teacher's Manual—3rd Edition
ISBN 978-1-941181-44-7

Published by Gravitas Publications Inc.
www.gravitaspublications.com
www.realscience4kids.com

A Note From the Author

This curriculum is designed to provide an introduction to physics for students in the elementary level grades. *Focus On Elementary Physics—3rd Edition* is intended to be used as the first step in developing a framework for the study of real scientific concepts and terminology in physics. This *Teacher's Manual* will help you guide students through the series of experiments in the *Laboratory Notebook*. These experiments will help the students develop the skills needed for the first step in the scientific method — making good observations.

There are several sections in each chapter. The section called *Observe It* helps the students explore how to make good observations. The *Think About It* section provides questions for the students to think about and use to make further observations. In every chapter there is a *What Did You Discover?* section that gives the students an opportunity to summarize the observations they have made. A section called *Why?* provides a short explanation of what students may or may not have observed. And finally, in each chapter there is a section called *Just For Fun* that contains an additional activity.

The experiments take up to 1 hour. The materials needed for each experiment are listed on the next page and also at the beginning of each experiment.

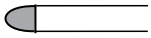
Enjoy!

Rebecca W. Keller, PhD

Materials at a Glance

Experiment 1	Experiment 3	Experiment 4	Experiment 5	Experiment 6
2 tennis balls other objects such as: apple orange rubber ball cotton ball or feather	large marshmallow tennis ball objects such as: rubber ball lemon or lime rock banana pliers	toy car stiff cardboard or board (approximately .3 meter wide x 1 meter long [1 foot x 3 feet]) several marshmallows **Optional** pennies tape	2 marbles 3 playing cards shallow jar top vinegar baking soda measuring spoons **Suggested** dominoes blocks electric car electric train marshmallow tongue depressor steel ball other objects chosen by the student	1 small glass marble 1 large glass marble
Experiment 2				
clock or stopwatch				

Experiment 7	Experiment 8	Experiment 9	Experiment 10	Experiment 11
stopwatch or clock an area to run in items for marking the beginning and ending of the running distance	4 plastic or Styrofoam cups with the mouth larger than the base 2 long poles (dowels work well or any two long sticks that are the same thickness from end to end) tape a cylinder, 10-13 cm long (4-5 inches) [any cylindrical object, such as a pencil, a dowel, a cylindrical block, or a cylindrical drinking glass that is not tapered; a paper towel tube may be used if it is filled with sand and the ends taped] chalk	3-5 large lemons knife 3-5 copper pennies older than 1982 3-5 galvanized (zinc coated) nails LED (recommended: 20mA 2 pin LED bulb, any color)* 4-6 pairs alligator clips [duct tape can be substituted for alligator clips] plastic coated copper wire, .6-1.2 m (2-4 feet) wire clippers small Phillips screwdriver	2-3 rubber balloons string or thread, at least 2 meters (6 feet) cut in half scissors different materials to rub the balloon on, such as: cotton clothing silk clothing wool clothing wooden surface plaster wall metal surface leather surface	lemon battery supplies (see *Lemon Energy* experiment) suggested test materials: Styrofoam plastic block cotton ball nickel coin metal paperclip plastic paperclip glass of water table salt, 15 ml (1 Tbsp.)
				Experiment 12
				two bar magnets with the poles labeled "N" and "S"

* A browser search can be used to look for an electronic parts store in your area. Or you can search on "20mA LED bulb 2 pin" to find an online supplier. An LED with flexible pins may be easier to use.
It should look something like this: 

Materials: Quantities Needed for All Experiments

Equipment

alligator clips, 4-6 pairs [duct tape can be substituted for alligator clips]
ball, rubber
balls, tennis, 2
clock or stopwatch
cylinder, 10-13 cm long (4-5 inches) [such as a pencil, a dowel, a cylindrical block, or a cylindrical drinking glass that is not tapered; a paper towel tube may be used if it is filled with sand and the ends taped]
jar top, shallow
knife
magnets, bar, 2, with the poles labeled "N" and "S"
marble, glass, small
marble, glass, large
marbles, 2
measuring spoons
pennies, 3-5 copper, older than 1982
playing cards, 3
pliers
poles, 2 long (dowels or any two long sticks that are the same thickness from end to end)
scissors
screwdriver, small Phillips
toy car
wire clippers

Optional

pennies

Suggested

ball, steel
blocks
car, electric
coin, nickel
dominoes
train, electric

Materials

balloons, 2-3 rubber
cardboard, stiff, or board (approx .3 meter wide x 1 meter long [1 foot x 3 feet])
chalk
cotton balls
cups, 4 plastic or Styrofoam with the mouth larger than the base
feather
items for marking the beginning and ending of a running distance
LED (recommended: 20mA 2 pin LED bulb, any color)*
materials, misc., to rub a balloon on, such as:
  cotton clothing
  silk clothing
  wool clothing
  wooden surface
  plaster wall
  metal surface
  leather surface
nails, 3-5 galvanized (zinc coated)
objects, misc.
rock
string or thread, at least 2 meters (6 feet) cut in half
tape
wire, copper, plastic coated, .6-1.2 m (2-4 feet) or more

Suggested Test Materials:

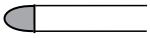
paperclip, metal
paperclip, plastic
Styrofoam, 1 piece
table salt, 15 ml (1 Tbsp.)
tongue depressor

Foods

apple
baking soda
banana
lemon, 6-10 large
lemon or lime
marshmallow, large, several
orange
vinegar

Other

an area to run in

* A browser search can be used to look for an electronic parts store in your area. Or you can search on "20mA LED bulb 2 pin" to find an online supplier. An LED with flexible pins may be easier to use.
It should look something like this: 

Contents

Experiment 1

Falling Objects

Materials Needed

- 2 tennis balls
- other objects such as:
  apple
  orange
  rubber ball
  cotton ball or feather

Objectives

In this experiment students will try to determine if Galileo was right.

The objectives of this lesson are to have students:

- Compare their own observations with a scientific discovery.
- Compare different observations.

Experiment

I. Observe It

In this section students will observe how two objects fall when they are released at the same time.

Read this section of the *Laboratory Notebook* with your students.

❶ Have the students hold a tennis ball in each hand with their arms outstretched at chest level.

❷ Have the students release the two tennis balls at the same time.

❸ Help them observe how the objects land on the ground. Guide their inquiry with the following questions.

- *Did both objects land at the same time?*
- *Is one object heavier or lighter than the other object?*
- *Do you think it matters how high you hold the objects? Why or why not?*
- *Do you think the shape of the object matters? Why or why not?*

❹ Help the students record their observations in the *Observe It* section of their *Laboratory Notebook* (see example on next page).

❺ Have the students repeat the experiment using different combinations of objects. Have them compare at least four different pairs of objects. For each set of objects, help the students record their observations in the boxes provided.

In the spaces next to **Object 1** and **Object 2**, have the students write the names of the objects they will be dropping. Then have them draw or write a description of what they see. Help them make good observations by asking questions such as:

- How heavy does Object 1 feel in your hand?
- How heavy does Object 2 feel in your hand?
- Does Object 1 feel heavier or lighter in your hand than Object 2?
- Is it easy to release both objects at the same time? Why or why not?
- Describe the shape of Object 1.
- Describe the shape of Object 2.

Object 1 *apple*

Object 2 *tennis ball*

(Answers will vary.)

The apple feels heavier in my hand than the tennis ball.

When I drop the objects, I have a hard time seeing which one lands first. They look like they land together, but I am not sure.

I can release the objects at the same time from my hands.

The apple is a different shape than the tennis ball, but they still land at the same time.

II. Think About It

Read the questions with your students.

❶ Have the students think about their experiment and make observations about how easy or difficult it was to determine if the objects fell at the same speed.

- *Could you see the objects fall to the floor?*
- *Could you determine if both objects hit the floor at the same time?*
- *Was it easy or difficult to release the objects from both hands at the same time?*

❷ Help the students think about ways to vary their experiment.

- *If they can't see the objects fall to the floor, maybe they can get a parent, sibling, or friend to make the observations.*
- *Could they use a mirror to more easily see the objects hit the floor?*
- *What would happen if the objects were dropped from a greater height? Students could stand on a sturdy chair or bench to see if greater height makes a difference.*
- *What would happen if the objects were dropped from a lower height? Students could release the objects at waist or knee height.*

❸ Help the students repeat the experiment for one of their object pairs. Have them vary only one parameter at a time for one set of objects. For example, they may want to hold the objects higher and have a friend observe how they fall. But this is changing two parameters (the height and the observer), and if the results varied, the students couldn't tell which change to the experiment brought about the variation. Explain to them that scientists try to change only one parameter at a time so that they can make comparisons to previous experiments, noting what difference, if any, changing that one parameter had on the experimental results.

❹ Help the students record their observations.

III. What Did You Discover?

Read the questions with your students.

❶-❹ The questions can be answered verbally or in writing. With these questions help the students think about their observations. There are no right answers to these questions, and it is important for the students to write or discuss what they actually observed.

IV. Why?

Read this section of the *Laboratory Notebook* with your students.

Help the students understand that two objects of different weights will fall to Earth at the same speed. Both objects have the same amount of gravity pulling on them at the same time, so both objects start with the same force. Because both objects have the same force, they will both fall to the Earth at the same speed since the speed of an object is independent of its weight.

V. Just For Fun

Read this section of the *Laboratory Notebook* with your students.

The students can try an experiment with an object that is much lighter than the objects they have been using. A cotton ball or a feather would work. They will discover that if an object is too light, it will float to the ground and not fall at the same time as a heavier object. However, tell them that if the two objects are put in a vacuum, they will fall at the same time. Even an apple and a feather or cotton ball will fall at the same time. In a vacuum there is no air resistance. Outside the vacuum, the air pushes up on the cotton ball, and because the cotton ball is light enough, the air will slow it down.

Experiment 7

Speed It Up!

Materials Needed

- stopwatch or clock
- an area to run in
- items for marking the beginning and ending of the running distance

Objectives

In this experiment, students will explore how to calculate speed using basic tools.

The objectives of this lesson are for students to:

- Use suitable tools, techniques, and quantitative measurements when appropriate.
- Use a simple tool to make measurements.

Experiment

I. Think About It

Read this section of the *Laboratory Notebook* with your students.

Have the students think about different distances they might run. If running is not possible for the students, explore other ways they can measure distance traveled over time. They could measure a rolling ball or how fast a pet can run a certain distance.

Explore open inquiry with questions such as the following:

- *Do you think you can run the length of the yard?*
- *Do you think you can run the length of the block?*
- *Do you think you can run the length of the football stadium?*
- *Do you think you can run the length of the city?*

Help the students think about distance, how far they might be able to run, and that shorter distances will be easier to run than longer distances. Help them pick a distance to run that is suitable for them. Again, if running is not possible, then have them select a different object they can measure, such as a rolling ball, a baseball being thrown, a bowling ball, how fast a pet runs, or how fast a parent, friend, or teacher can run.

II. Observe It

Read this section of the *Laboratory Notebook* with your students.

Help the students mark a distance they can run. Have them use their feet as the measuring tool by walking heel-to-toe and counting the steps. Explain that this won't be an accurate measurement but rather an estimation. "Experiencing" the length of a distance by using their own feet gives them a sense of space that using a ruler or measuring tape would not.

Have the student run the distance between the two points they mark. They can either hold the stopwatch or timer themselves, or you can time them. However, pick one method and stick to it for all five runs. Switching the way the time is measured can introduce error.

Help them record their results in the table provided.

Help the students calculate their average speed by adding all the speeds together and dividing by the number of runs (5 if they ran 5 times).

III. What Did You Discover?

Read this section of the *Laboratory Notebook* with your students.

❶-❻ Have the students answer the questions. These can be answered orally or in writing. There are no right answers and their answers will depend on what they actually observed.

IV. Why?

Read this section of the *Laboratory Notebook* with your students.

Discuss any questions that might come up.

V. Just For Fun

Read this section of the *Laboratory Notebook* with your students.

Have the students measure how fast you or a friend can run the same distance that was measured in the first part of the experiment for the same number of times. Have them use the timer or stopwatch to record the times in the chart provided. Then have them calculate the average speed and compare it to their own average.

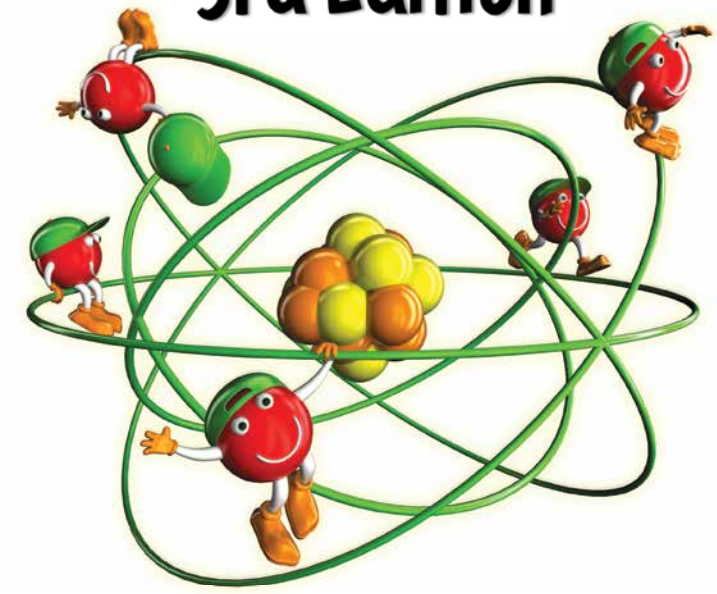
FOCUS ON

Grades K-4

ELEMENTARY PHYSICS

LESSON PLAN

3rd Edition



Rebecca W. Keller, PhD

REAL SCIENCE 4 Kids

Real Science-4-Kids

Focus On Elementary Physics Lesson Plan—3rd Edition

Published by Gravitas Publications Inc.
www.gravitaspublications.com
www.realscience4kids.com

LESSON PLAN INSTRUCTIONS

This *Lesson Plan* accompanies *Focus On Elementary Physics Student Textbook, Laboratory Notebook,* and *Teacher's Manual—3rd Edition*. It is designed to be flexible to accommodate a varying schedule as you go through the year's study. And it makes it easy to chart weekly study sessions and create a portfolio of your student's yearlong performance. The PDF format allows you to print pages as you need them.

This Lesson Plan file includes:

- Weekly Sheets
- Sticker Templates
- Self-Review Sheet
- Self-Test Sheet

Materials recommended but not included:

- 3-ring binder
- Indexing dividers (3)
- Labels—24 per sheet,1.5" x 1.5" (Avery 22805)

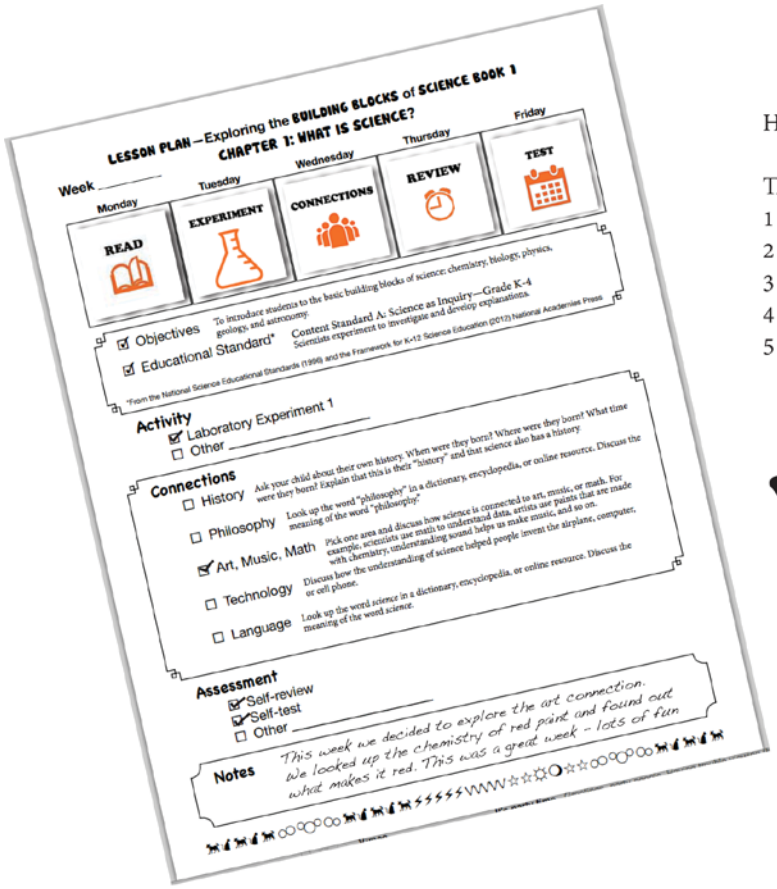
Use the Weekly Sheets to map out daily activities and keep track of student progress. For each week you decide when to read the text, do the experiment, explore the optional connections, review the text, and administer tests. For those families and schools needing to provide records of student performance and show compliance to standards, there is a section on the Weekly Sheets that shows how the content aligns to the National Science Standards.

To use this Lesson Plan:

- Print the Weekly Sheets
- Print Self-Review Sheets
- Print Self-Test Sheets
- Print the stickers on 1.5" x 1.5" labels
- Place all the printed sheets in a three-ring binder separated by index dividers

At the beginning of each week, use the squares under each weekday to plan your daily activities. You can attach printed stickers to the appropriate boxes or write in the daily activities. At the end of the week, use the Notes section to record student progress and performance for that week.

WEEKLY LESSON PLAN SAMPLES


LESSON PLAN—Exploring the BUILDING BLOCKS of SCIENCE BOOK 1
CHAPTER 1: WHAT IS SCIENCE?

Week _____

Monday	Tuesday	Wednesday	Thursday	Friday
READ	EXPERIMENT	CONNECTIONS	REVIEW	TEST

☑ Objectives — To introduce students to the basic building blocks of science: chemistry, biology, physics, geology, and astronomy.
☑ Educational Standard* — Content Standard A: Science as Inquiry—Grade K-4 Scientists experiment to investigate and develop explanations.
*From the National Science Educational Standards (1996) and the Framework for K-12 Science Education (2012) National Academies Press

Activity
☑ Laboratory Experiment 1
☐ Other _____

Connections
☐ History — Ask your child about their own history. When were they born? Where were they born? What time were they born? Explain that this is their "history" and that science also has a history.
☐ Philosophy — Look up the word "philosophy" in a dictionary, encyclopedia, or online resource. Discuss the meaning of the word "philosophy."
☑ Art, Music, Math — Pick one area and discuss how science is connected to art, music, or math. For example, scientists use math to understand data, artists use paints that are made with chemistry, understanding sound helps us make music, and so on.
☐ Technology — Discuss how the understanding of science helped people invent the airplane, computer, or cell phone.
☐ Language — Look up the word science in a dictionary, encyclopedia, or online resource. Discuss the meaning of the word science.

Assessment
☑ Self-review
☑ Self-test
☐ Other _____

Notes This week we decided to explore the art connection. We looked up the chemistry of red paint and found out what makes it red. This was a great week - lots of fun

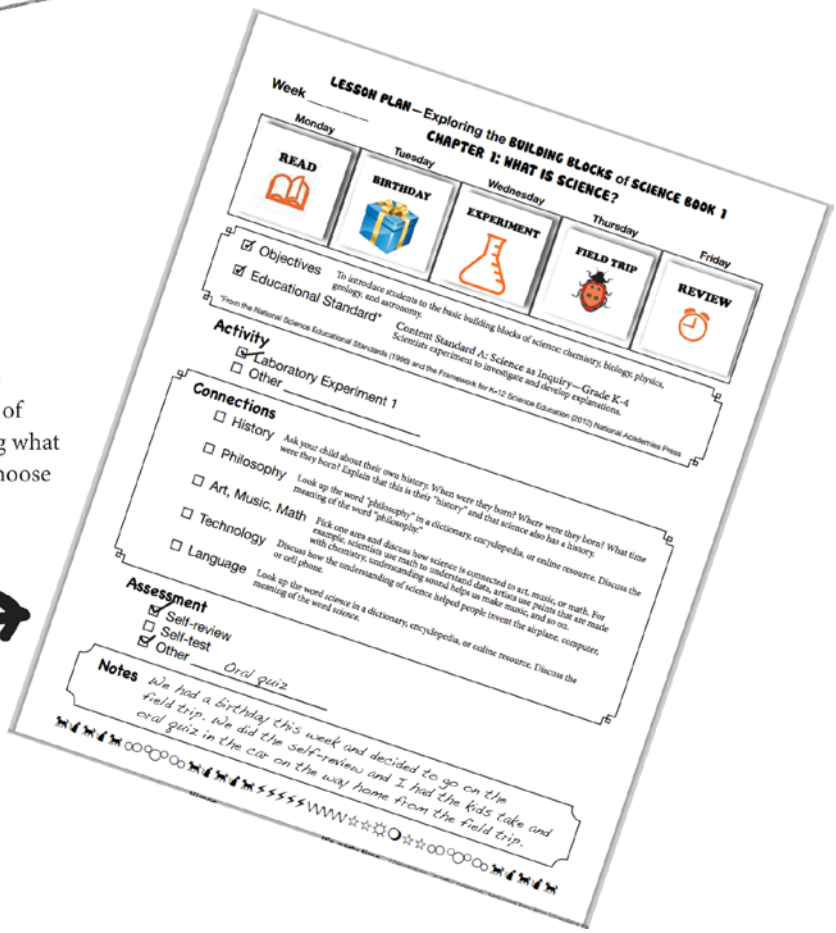
Here is a sample of a normal week.

The recommended sequence is
1 - Read the student textbook on the first day.
2 - Do the laboratory experiment on the second day.
3 - Pick one or more connections to explore on the third day.
4 - Do the self-review sheet on the fourth day.
5 - Administer the self-test or another exam on the fifth day.

Here is a sample of a week with other activities

1- Find at least one day to READ the text.
2 - Find a day to perform the EXPERIMENT.
3 - Find a day to do the REVIEW or TEST.

Any activity that is missed can be rescheduled for the following week. However, keep to the main sequence of reading the text, doing the experiment, and reviewing what has been covered. If an activity needs to be missed, choose the CONNECTIONS or SELF-TEST.


LESSON PLAN—Exploring the BUILDING BLOCKS of SCIENCE BOOK 1
CHAPTER 1: WHAT IS SCIENCE?

Week _____

Monday	Tuesday	Wednesday	Thursday	Friday
READ	BIRTHDAY	EXPERIMENT	FIELD TRIP	REVIEW

☑ Objectives — To introduce students to the basic building blocks of science: chemistry, biology, physics, geology, and astronomy.
☑ Educational Standard* — Content Standard A: Science as Inquiry—Grade K-4 Scientists experiment to investigate and develop explanations.
*From the National Science Educational Standards (1996) and the Framework for K-12 Science Education (2012) National Academies Press

Activity
☑ Laboratory Experiment 1
☐ Other _____

Connections
☐ History — Ask your child about their own history. When were they born? Where were they born? What time were they born? Explain that this is their "history" and that science also has a history.
☐ Philosophy — Look up the word "philosophy" in a dictionary, encyclopedia, or online resource. Discuss the meaning of the word "philosophy."
☐ Art, Music, Math — Pick one area and discuss how science is connected to art, music, or math. For example, scientists use math to understand data, artists use paints that are made with chemistry, understanding sound helps us make music, and so on.
☐ Technology — Discuss how the understanding of science helped people invent the airplane, computer, or cell phone.
☐ Language — Look up the word science in a dictionary, encyclopedia, or online resource. Discuss the meaning of the word science.

Assessment
☑ Self-review
☐ Self-test
☑ Other Oral quiz

Notes We had a birthday this week and decided to go on the field trip. We did the self-review and I had the kids take and oral quiz in the car on the way home from the field trip.

Week _____ **CHAPTER 1: WHAT IT PHYSICS?**

Monday	Tuesday	Wednesday	Thursday	Friday

☑ Objectives To introduce students to the scientific discipline called physics.

☑ Educational Standard* **Content Standard 3-PS2.A**
Patterns of an object's motion can be measured and observed.

*From the Next Generation Science Standards (NGSS)

Activity

- ☐ Laboratory Experiment 1
- ☐ Other _____

Connections

- ☐ History Look up Galileo Galilei on the internet or in the library. Discuss Galileo's famous gravity experiment and explore how his experiment seems to contradict common sense.
- ☐ Philosophy Look up the Greek philosopher Aristotle on the internet or in the library. Discuss how Aristotle had ideas about how things move that were later challenged by Galileo.
- ☐ Art, Music, Math Explore how physics follows rules like math follows rules. For example, 2 + 2 = 4 (base 10) regardless of where you are in the universe.
- ☐ Technology Explore how technology has advanced as our knowledge of physics has increased—e.g., air travel, computers, cell phones, medical equipment, etc.
- ☐ Language Look up the word *physics* in a dictionary, encyclopedia, or online resource. Discuss the meaning of the word *physics*.

Assessment

- ☐ Self-review
- ☐ Self-test
- ☐ Other _____

Notes

Week _____

CHAPTER 7: LINEAR MOTION

Monday	Tuesday	Wednesday	Thursday	Friday

☑ Objectives To introduce students to the concept of linear motion.

☑ Educational Standard* **Content Standard 4-PS3-2 / 4-PS3.B**
Make observations showing energy can be transferred.

*From the Next Generation Science Standards (NGSS)

Activity

☐ Laboratory Experiment 7
☐ Other _____

Connections

☐ History Look up Isaac Newton and discuss how his work helped us understand linear motion.

☐ Philosophy Explore how our understanding of linear motion has changed the way we think about the world.

☐ Art, Music, Math Explore how mathematics helps us understand linear motion.

☐ Technology Discuss how a stop watch is used to measure speed.

☐ Language Look up the word *acceleration* in a dictionary or encyclopedia.
Discuss the meaning of the word *acceleration.*

Assessment

☐ Self-review
☐ Self-test
☐ Other _____

Notes

SELF-REVIEW

Think about all of the ideas, concepts, and facts you read about in this chapter. In the space below, write down everything you've learned.

Date _____ **Chapter** _____

SELF-TEST

Imagine you are the teacher and you are giving your students an exam. In the space below, write 5 questions you would ask a student based on the information you learned in this chapter.

Date _____ **Chapter** _____

READ

READ

READ

READ

REVIEW

REVIEW

REVIEW

REVIEW

EXPERIMENT

EXPERIMENT

EXPERIMENT

EXPERIMENT

CONNECTIONS

CONNECTIONS

CONNECTIONS

CONNECTIONS

TEST

TEST

TEST

TEST

READ

READ

READ

READ

HOLIDAY

HOLIDAY

HOLIDAY

HOLIDAY

FIELD TRIP

FIELD TRIP

FIELD TRIP

FIELD TRIP

BIRTHDAY

BIRTHDAY

BIRTHDAY

BIRTHDAY

REST DAY

REST DAY

REST DAY

REST DAY

REST DAY

REST DAY

REST DAY

REST DAY

SICK DAY

SICK DAY

SICK DAY

SICK DAY

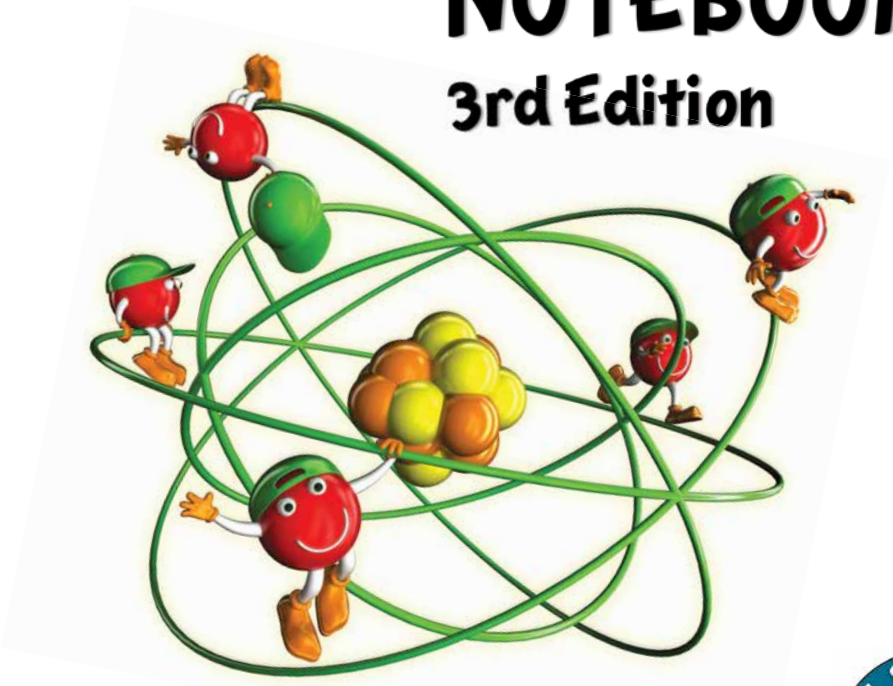
Grades K-4

FOCUS ON ELEMENTARY

PHYSICS

STUDY NOTEBOOK

3rd Edition



Rebecca W. Keller, PhD

REAL SCIENCE 4 Kids

(Print this page and glue to the front of your Study Notebook.)

Real Science-4-Kids

Illustrations: Janet Moneymaker

Focus On Elementary Physics Study Notebook — 3rd Edition

Published by Gravitas Publications Inc.
Real Science-4-Kids®
www.realscience4kids.com
www.gravitaspublications.com

FOCUS ON ELEMENTARY PHYSICS STUDY NOTEBOOK

This Study Notebook has activities for you to do that will help you learn the ideas presented in each chapter of the Student Textbook.

Materials you will need

- 8.5 x 11 white paper
- color printer
- scissors
- glue or clear tape
- colored pencils
- 1 manila file folder
- 3 brad paper fasteners or 3-ring binder
- 3-hole punch

STEP 1 Printing

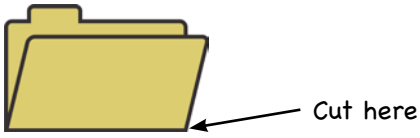
- Download the Study Notebook file for the chapter you are reading.
- Use the printer settings: portrait, letter, 8.5 x 11.
- Print the pages single sided.

STEP 2 Activities

- The little blue boxes on the left-hand side of the main pages show you which section of the Student Textbook has the information for that activity.
- For the chapter you are studying, do the activities on the two main pages (those that have page numbers at the bottom): fill in the blanks, answer questions, and follow the directions for other types of activities.
- On the **Stuff to Cut Out** pages, follow the directions for cutting out the pieces and gluing or taping them to the main pages.

STEP 3 Make the Study Notebook pages into a Book

- Cut the file folder in half along the fold.
- Use a 3-hole punch to make holes along the cut edge of the file folder pieces.



- Use the two pieces for the front and back covers.
- As you complete each chapter, punch holes in the pages and insert them between the front and back covers of your Study Notebook.

This is YOUR book! Add color to the pages along with doodles, squiggles, and notes in the margins. The backs of the pages are great for writing observations and ideas. Add your own pages with more ideas, observations, questions, science news you have heard about, and anything else you want to remember.

Punch holes on this edge.

1. What Is Physics?

Physics

1.2 is the S T _ D _ of the ways things behave in the physical world.

1.2 **Who** are these **SCIENTISTS?**

I'm a Greek from ancient times. I studied motion.

Ar _ s _ _ t _ e

I'm an Italian astronomer from long ago. I used physics to understand how things move.

G _ li _ _ o

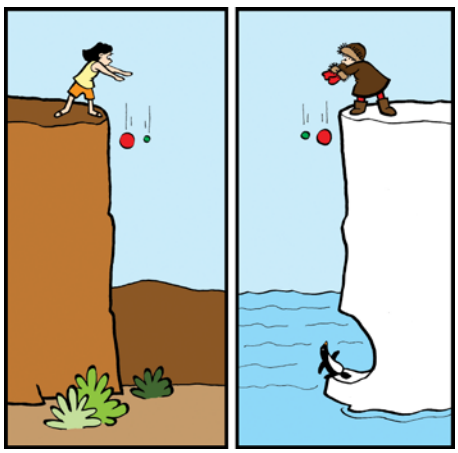
I'm an English physicist and mathematician from long ago. I used math to understand the rules of physics

N _ wt _ n

Question:
What do **YOU** need to do to **think** like a **SCIENTIST**?

Answer:
Make **good**
OB _ _ RV _ TIO _ _ !

1.3



A **RULE** of **ph _ si _ s**:
What **goes** _ _ — **comes** _ _ _ _!

What makes a **ball** come back **down**?
What keeps **YOU** from **flying** off **Earth**?
GR _ V _ _ Y!

Punch holes on this edge.

1.3

(See following page for directions.)

Glue **TAB 1.3** Here

New **LAW OF PHYSICS #3.**

Draw what you can do.

What I can do!

1.4

Be a PHYSICIST!

Do this little experiment.

1. Make a pile of different objects that are safe to throw and that won't break.
2. Take your pile of stuff outside.
3. Throw the objects one item at a time, observing what happens each time. Observe details about each object and details about what happens when you throw each object.
4. What do you notice? Do features such as the weight, shape, or size of the object make a difference in the results?

5. What did you learn about how things move?

Stuff to Cut Out for Chapter 1

Cut out each of these pieces on their solid outline. Put glue on the back of the bar that has the **TAB** number. Glue to the Study Notebook page, matching the **TAB** numbers.

Take this piece and match **yellow TAB 1.3** to the **green GLUE TAB 1.3 HERE** in Section 1.3 on page 2.

TAB 1.3

Glue **TAB 1.3A** Here

New **LAW OF PHYSICS #2.**

_____

_____

What I can do!

_____

_____

Draw what you can do.

Take this piece and match **yellow TAB 1.3A** to the **green GLUE TAB 1.3A HERE** in Section 1.3 on page 2.

TAB 1.3A

Glue **TAB 1.3B** Here

New **LAW OF PHYSICS #1.**

_____

_____

What I can do!

_____

_____

Draw what you can do.

Take this piece and match **yellow TAB 1.3B** to the **green GLUE TAB 1.3B HERE** in Section 1.3 on page 2.

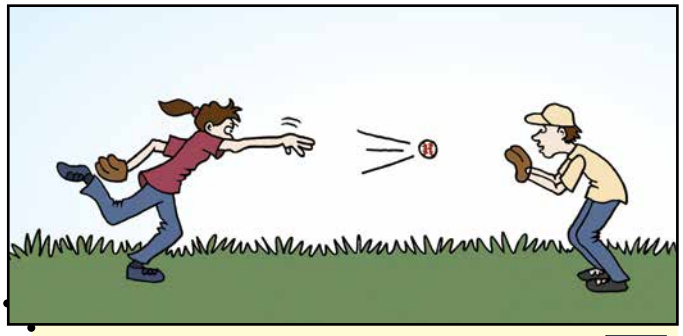
TAB 1.3B

Imagine That!

The **LAWS OF PHYSICS** determine what things ***your body*** can **do**, for example, how high you can jump. Think of **3 things** you think you'd be able to do if you could make your own new **LAWS OF PHYSICS**.

7. Linear Motion

L _ _ _ _ _ M _ _ _ _ _
is M _ _ _ _ _
that **occurs along a line.**



7.1 In the drawing above, do **YOU** think the **ball** has **LINEAR MOTION**?

YES! NO!

Why?

_____

_____

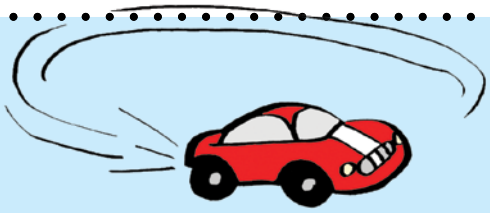
_____

7.2 When **physicists** say **motion is relative,** they mean that the **motion:** (Circle one)

Has to do with family members moving from one place to another.

Is measured by comparing the motion of one object to the motion of another.

7.1



Review (Also see Book 1)

Another name for **m _ _ ing e _ _ _ gy** is **k _ _ _ _ _ _ e _ _ _ _ _ .**

7.2
7.3

WHO is *fastest?*

The _____ of an object is the measure of how far it goes in a given time. If you and **3** friends wanted to figure out who ran the fastest, how would you do it?

_____

_____

_____

Now you want to figure out the **average speed** that the **4** of you ran. How would you do it?

_____

_____

Punch holes on this edge.

Punch holes on this edge.

7.2

HELP! The MOUNTAINS are *moving!*

Recall from astronomy that **Earth** has **two different motions**. It **moves** around the **SUN**, and it **revolves** around its **axis**.

If an **earthquake** or **volcano** is **NOT** happening,

in what ways are the **MOUNTAINS** moving and how can we observe this?

7.4

Be a physicist!

Do this little **acceleration** experiment. (Write your observations on the back of the page.)

Make a ramp by raising one end of a big piece of cardboard and propping it up with a chair or other object. Find several ball shaped objects of different sizes. One at a time, place an object at the top of the ramp and let it roll down. What do you observe about acceleration? Do you think acceleration is affected by the object's mass and/or size? If the balls have different types of surfaces, do you think acceleration is affected by friction? If you apply force to the object by pushing it, is the acceleration affected? What happens if you make one end of the ramp higher or lower? Longer or shorter?

7.2
7.3
7.4

Glue **TAB 7.3** Here

GO FASTER! GO SLOWER!

In **physics**, the **cha _ _ _** in **sp _ _ _** of an **ob _ _ _ _** for a given time is called **ACC _ _ _ R _ _ ION**. Make a list of some objects you have observed **ACC _ _ _ R _ _ ING** and how it happened. (Continue your list on the back.)

Stuff to Cut Out for Chapter 7

Cut out the piece below on its solid outline and match **yellow TAB 7.3** to the **green Glue TAB 7.3 Here** on page 14.

Glue **TAB 7.2** Here

TAB 7.3

What Is Your Average Speed?

Imagine you are training for a race. You are keeping track of how long it takes you to run a certain distance. You now have a list of 10 different times. How would you calculate your average speed? Why could it be helpful to know your average speed?

Cut out the piece below on its solid outline and match **yellow TAB 7.2** to the **green Glue TAB 7.2 Here** on page 14.

TAB 7.2

Speedy!

Physicists say that the *speed* of an **ob**____ is **REL** _ _ _ **V** _ to the **ob**____**s** surrounding it.

If you are riding in a car, what is one observation you can make that can tell you whether you are moving fast or slow?

GRAVITAS PUBLICATIONS

Name _____ **Date** _____

Focus On Elementary Physics 3rd Edition, Midterm 1
Chapters 1-6, 18 questions, 10 points each

1. The rules of physics... (Check all that apply.) (10 points)
   - ☐ Often change.
   - ☐ Describe how a ball that is thrown will travel.
   - ☐ Vary depending on where you live.
   - ☐ Are always obeyed by all objects.
   - ☐ Do not change.

2. Physicists... (10 points)
   - ○ Make their own "rules" for how the world works.
   - ○ Discover the "rules" by observing how the world works.
   - ○ Don't do experiments to find out the "rules."
   - ○ Don't use math to figure out the "rules" for how the world works.

3. Aristotle used math to figure out why two objects dropped from the same height will hit the ground at the same time. (10 points)
   - ○ True
   - ○ False

Focus On Elementary Physics 3rd Edition, Midterm 2
Chapters 7-12, 18 questions, 10 points each

1. Saying that motion is relative means that we measure... (10 points)
   - ○ How many times you can run across the backyard.
   - ○ How fast your father, sister, or other family member is traveling.
   - ○ Your average speed in running across the backyard several times.
   - ○ The motion of an object by comparing it to other objects.

2. Match the terms with their definitions. (10 points)

_____ Speed	a. When an object changes its speed while it is moving.
_____ Kinetic energy	b. Moving energy.
_____ Acceleration	c. The motion of an object in a straight line.
_____ Linear motion	d. The measure of how far an object goes in a given time.

3. Linear motion is... (10 points)
   - When you get a speeding ticket.
   - The average of several speeds.
   - The same as acceleration.
   - The motion of an object in a straight line.

Focus On Elementary Physics 3rd Edition, Final Quiz
Chapters 1-12, 24 questions, 10 points each

1. Aristotle discovered why two different size balls dropped at the same time will hit the ground at the same time. (10 points)
   - True
   - False

2. If you drop two balls from the same height at the same time... (10 points)
   - The heavier ball will hit the ground first.
   - They will not be controlled by gravity.
   - They will fall faster in a warm place than a very cold place.
   - They will both hit the ground at the same time.
   - They will not follow the laws of physics.

13. When you are in a race and you start to run faster, you are changing your... (10 points)
   - Acceleration.
   - Breakfast cereal.
   - Gravity.
   - Mass.
   - Force.

14. The speed of an object is _____ the objects surrounding it. (10 points)
   - the same as
   - a measurement of the speed of
   - not related to
   - relative to
   - not important to

Answer Sheet

Focus On Elementary Physics 3rd Edition, Midterm 1
Chapters 1-6, 18 questions, 10 points each

1. Describe how a ball that is thrown will travel., Are always obeyed by all objects., Do not change.
2. Discover the "rules" by observing how the world works.
3. False

Focus On Elementary Physics 3rd Edition, Midterm 2
Chapters 7-12, 18 questions, 10 points each

1. The motion of an object by comparing it to other objects.
2. d, b, a, c
3. The motion of an object in a straight line.

Focus On Elementary Physics 3rd Edition, Final Quiz
Chapters 1-12, 24 questions, 10 points each

1. False
2. They will both hit the ground at the same time.

13. Acceleration.
14. relative to

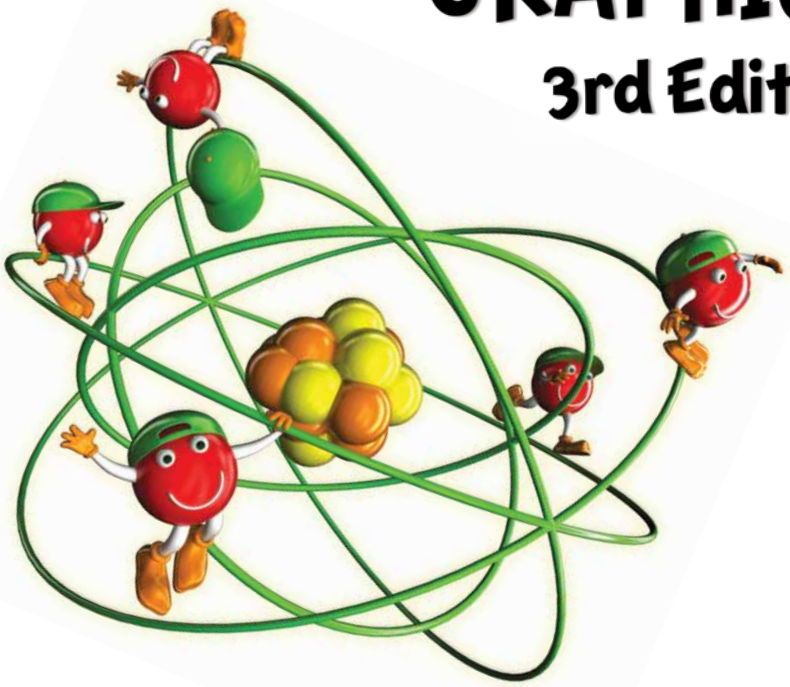
FOCUS ON

Grades K-4

ELEMENTARY PHYSICS

GRAPHICS

3rd Edition



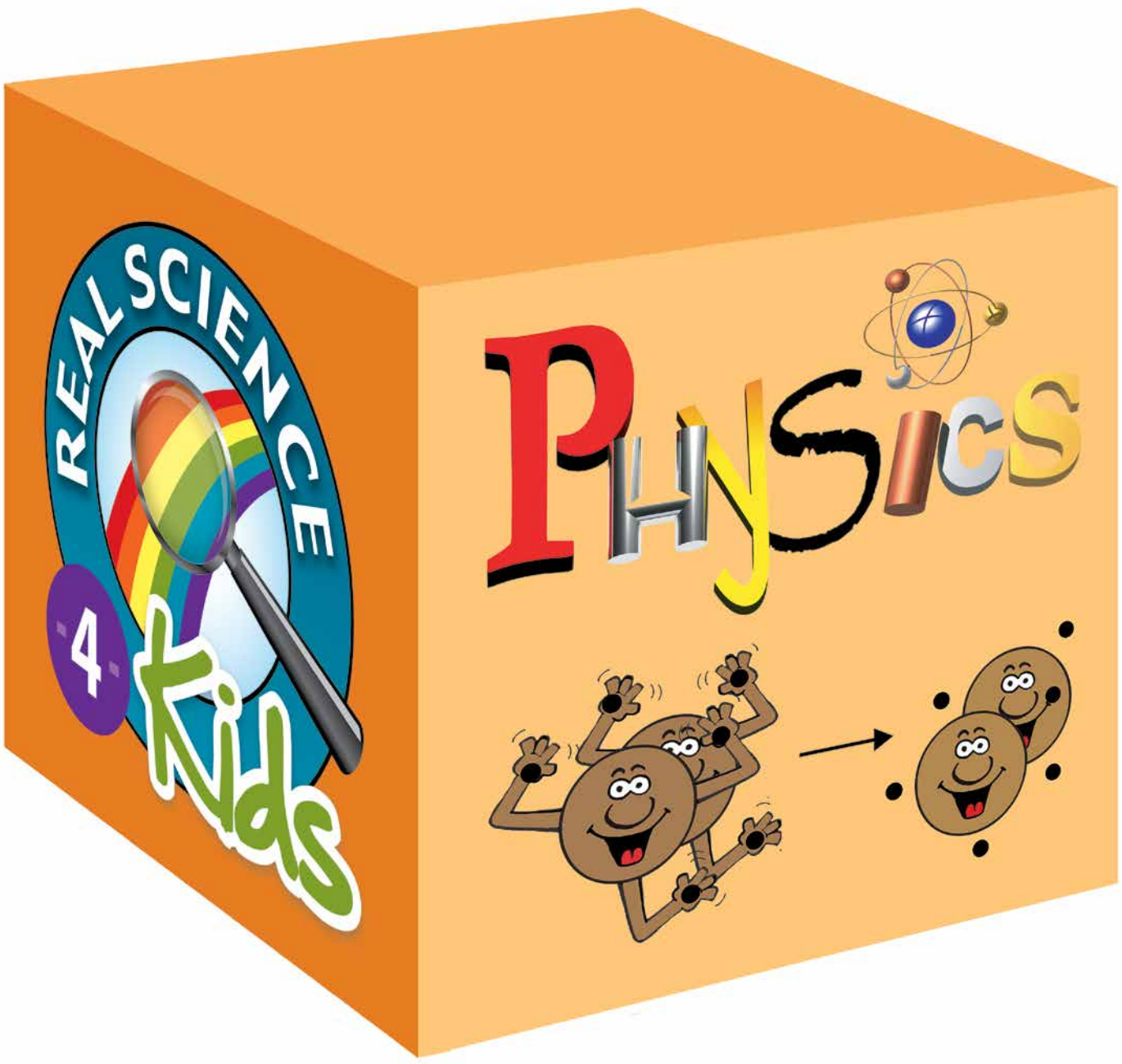
REAL SCIENCE 4 Kids

Real Science-4-Kids

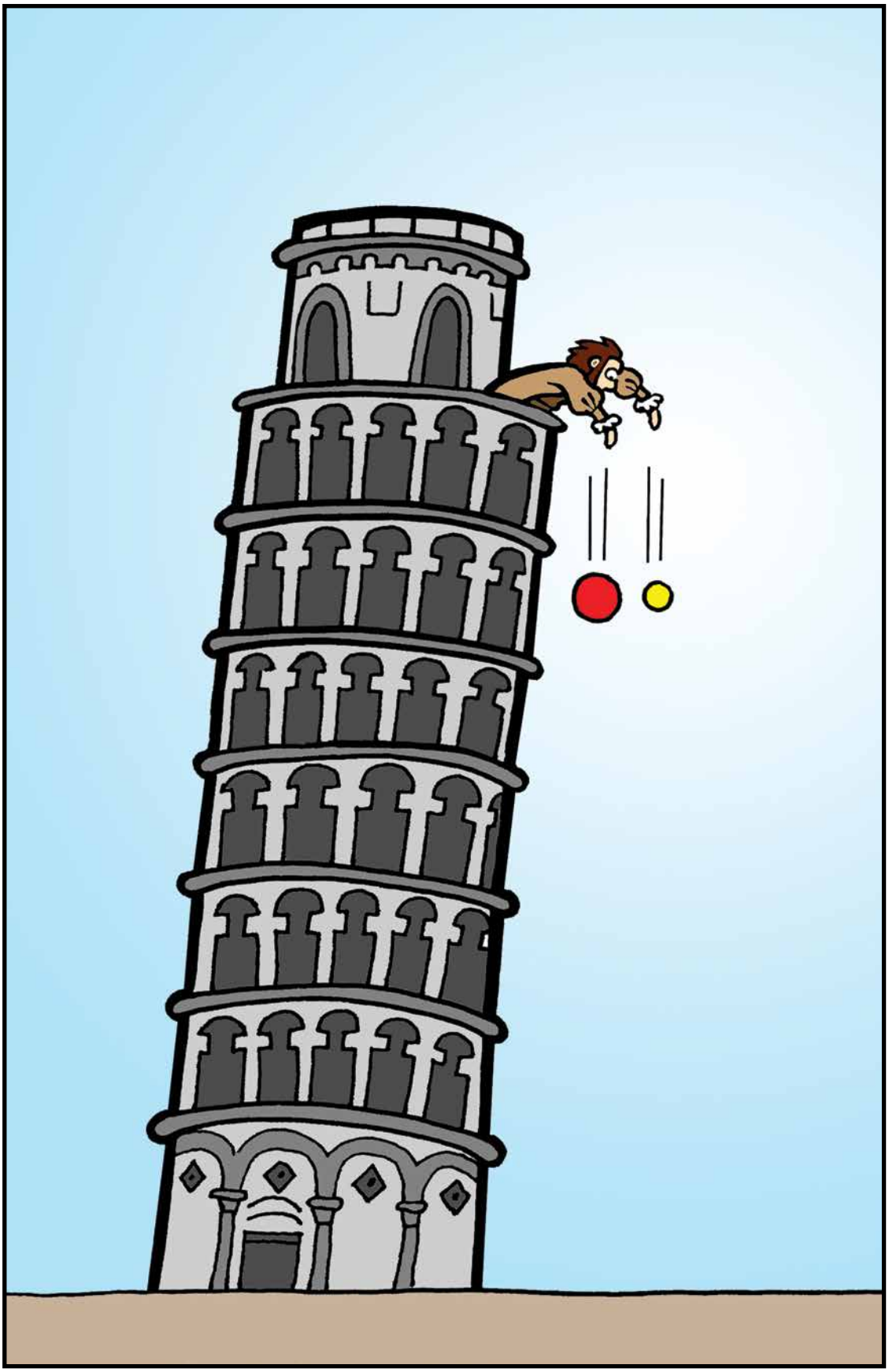
Illustrations: Janet Moneymaker

Focus On Elementary Physics Graphics Package—3rd Edition

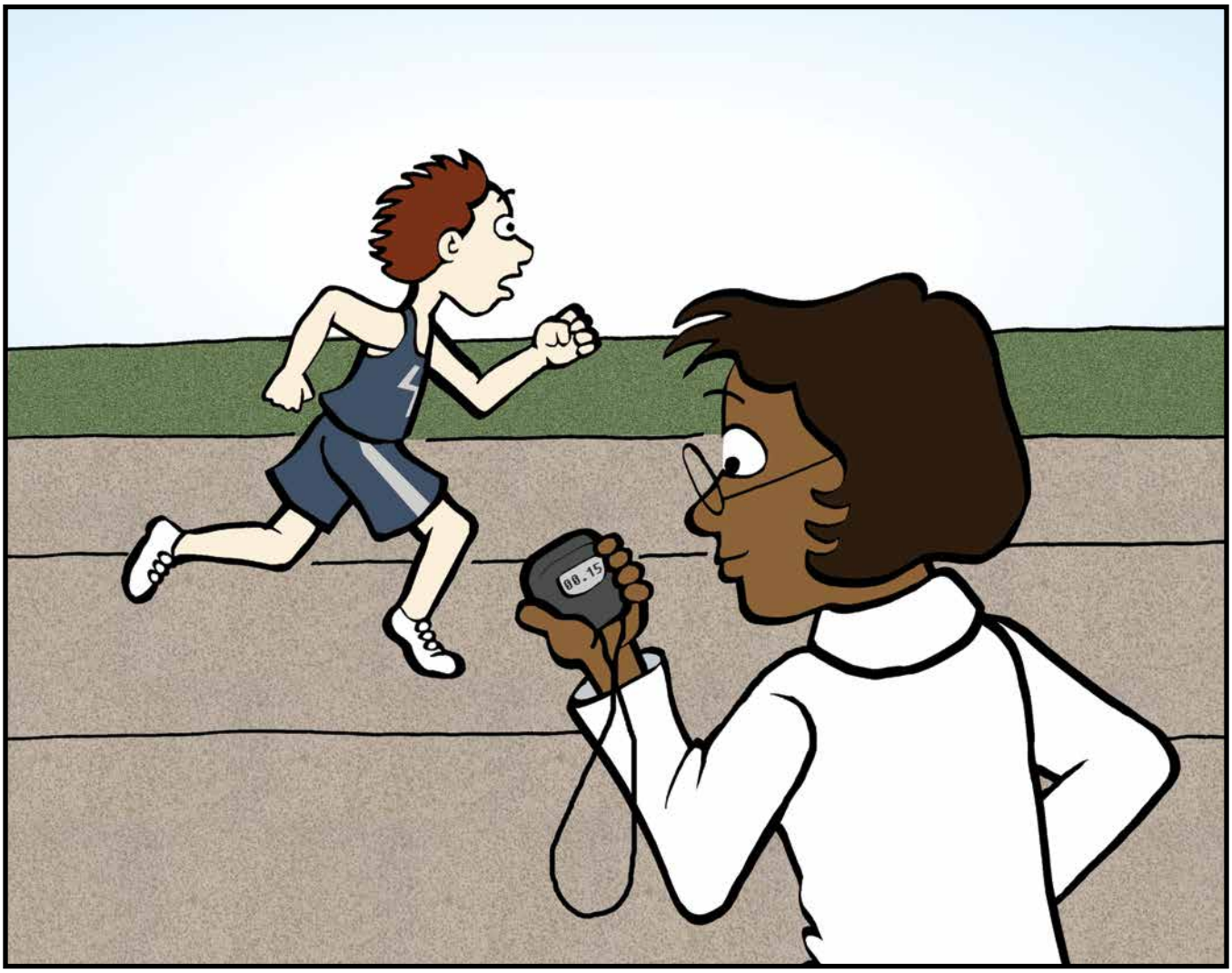
Published by Gravitas Publications Inc.
Real Science-4-Kids®
www.realscience4kids.com
www.gravitaspublications.com



Focus On Elementary Physics 3rd Edition




WELL, SPEED IS RELATIVE.
I KNOW. BUT YOU'RE STILL GETTING A TICKET.
POLICE

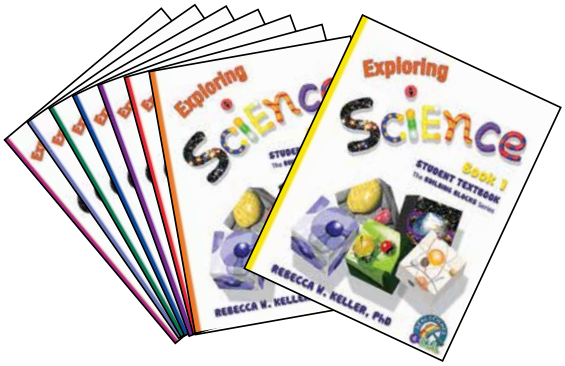

00.15

More REAL SCIENCE-4-KIDS Books

by Rebecca W. Keller, PhD

Building Blocks Series yearlong study program — each Student Textbook has accompanying Laboratory Notebook, Teacher's Manual, Lesson Plan, Study Notebook, Quizzes, and Graphics Package

Exploring Science Book K (Activity Book)
Exploring Science Book 1
Exploring Science Book 2
Exploring Science Book 3
Exploring Science Book 4
Exploring Science Book 5
Exploring Science Book 6
Exploring Science Book 7
Exploring Science Book 8



Focus On Series unit study program — each title has a Student Textbook with accompanying Laboratory Notebook, Teacher's Manual, Lesson Plan, Study Notebook, Quizzes, and Graphics Package

Focus On Elementary Chemistry
Focus On Elementary Biology
Focus On Elementary Physics
Focus On Elementary Geology
Focus On Elementary Astronomy

Focus On Middle School Chemistry
Focus On Middle School Biology
Focus On Middle School Physics
Focus On Middle School Geology
Focus On Middle School Astronomy

Focus On High School Chemistry

Super Simple Science Experiments

21 Super Simple Chemistry Experiments
21 Super Simple Biology Experiments
21 Super Simple Physics Experiments
21 Super Simple Geology Experiments
21 Super Simple Astronomy Experiments
101 Super Simple Science Experiments

Note: A few titles may still be in production.

Gravitas Publications Inc.
www.gravitaspublications.com
www.realscience4kids.com