



NATIONAL
GEOGRAPHIC

READING EXPEDITIONS™

国家地理
科学探索丛书

PHYSICAL SCIENCE

物理科学

Using Force and Motion 力与运动

GLEN PHELAN (美) 著

外语教学与研究出版社

FOREIGN LANGUAGE TEACHING AND RESEARCH PRESS

(京)新登字 155 号

京权图字: 01 - 2003 - 3246

图书在版编目(CIP)数据

物理科学 力与运动/(美)费伦(Phelan, G.)著;李文平注. —北京:外语教学与研究出版社, 2003.
9

(国家地理科学探索丛书·自然科学系列)

ISBN 7 - 5600 - 3524 - 8

I. 物… II. ①费… ②李… III. 英语—语言读物, 物理学 IV. H319.4:O

中国版本图书馆 CIP 数据核字(2003)第 051738 号

Copyright © (2002) National Geographic Society. All rights reserved.

Copyright © (2003) (in English-Chinese bilingual) National Geographic Society. All rights reserved.

国家地理科学探索丛书(英文注释版)由美国北极星传媒有限公司策划并授权出版。

物理科学

力与运动

GLEN PHELAN (美) 著

李文平 注

* * *

责任编辑: 余 军

出版发行: 外语教学与研究出版社

社 址: 北京市西三环北路 19 号 (100089)

网 址: <http://www.fltrp.com>

印 刷: 北京瑞宝画中画印刷有限公司

开 本: 740×975 1/16

印 张: 2

版 次: 2003 年 11 月第 1 版 2003 年 11 月第 1 次印刷

书 号: ISBN 7 - 5600 - 3524 - 8/H·1760

定 价: 5.90 元

* * *

如有印刷、装订质量问题出版社负责调换

制售盗版必究 举报查实奖励 (010)68917826

版权保护办公室举报电话: (010)68917519

致读者

如果你希望读到地道的英语，在享受英语阅读乐趣的同时又能增长知识、开拓视野，这套由外语教学与研究出版社与美国国家地理学会合作出版的“国家地理科学探索丛书”正是你的选择。

“国家地理科学探索丛书”分为9个系列，内容涉及自然科学和社会研究，秉承《国家地理》杂志图文并茂的特色，书中配有大量精彩的图片，文字通俗易懂、深入浅出，将科学性和趣味性完美结合，称得上是一套精致的小百科。

这套丛书以英文注释形式出版，注释由国内重点中学教学经验丰富的英语教师完成。特别值得推荐的是本套丛书在提高青少年读者英语阅读能力的同时，还注重培养他们的科学探索精神、动手能力、逻辑思维能力和沟通能力。

本丛书既适合学生自学，又可用于课堂教学。丛书各个系列均配有一本教师用书，内容包括背景知识介绍、技能训练提示、评估测试、多项选择题及答案等详尽的教学指导，是对课堂教学的极好补充。

本套丛书是适合中学生及英语爱好者的知识读物。

国家地理科学探索丛书

自然科学系列

地球科学

火山与地震
环绕我们的大洋
天气与气候
地球历史揭秘
探索太空

人体

人体机器
了解大脑
战胜疾病
保持健康
健康的选择

物理科学

物质无处不在
神奇的光和声
机械运动
走进电的世界
力与运动

生命科学

神奇的动物
植物的力量
你和你的基因
观察细胞
保护地球母亲

今日科学聚焦

让全世界人都吃饱
全球变暖
濒危物种
能源利用
漫游因特网

实地科学探索

探索古代文明
水下探宝
恐龙探究
保护灵长类动物
保护海洋

社会研究系列

文明的进程

中国
埃及
希腊
墨西哥
罗马

美国之旅

东北部
东南部
西南部
中西部
西部

别小看孩子

孩子关心地球
孩子理财
孩子是消费者
孩子掌握信息沟通



 NATIONAL
GEOGRAPHIC

国 家 地 理
科学探索丛书

P H Y S I C A L S C I E N C E

物理科学

Using Force and Motion

力与运动

GLEN PHELAN (美) 著
李文平 注

外语教学与研究出版社

FOREIGN LANGUAGE TEACHING AND RESEARCH PRESS

北京 BEIJING

Contents

目 录

Introduction 4

引言

Pushing Forward

向前推

Chapter 1 6

第一章

Pushing and Pulling:

A World in Motion

推与拉：运动着的世界

Chapter 2 12

第二章

Laws of Motion:

Action and Reaction

运动定律：作用力与反作用力

Picture This 20

读图地带

Forces Behind the Motion

运动背后的作用力

A skateboarder grips his board as he goes airborne in a skating competition in San Francisco, California.

A skateboarder is captured in mid-air, performing a trick above a large crowd of spectators at a skate park. The scene is set against a clear blue sky, with the orange-brown ramp visible at the bottom. The crowd is densely packed in the bleachers, and the overall atmosphere is one of excitement and action.

Chapter 3 22

第三章

*Getting Around in the 21st Century:
Future Motion*

周游21世纪：未来的运动

Thinking Like a Scientist 26

像科学家一样思考

Hands-on Science 28

亲身实践

Force and Friction

作用力与摩擦力

Science Notebook 30

科学备忘录

Index 31

索引

Introduction
引言

Pushing Forward

向前推



She pedals¹ as fast as she can along the rocky² course. She struggles³ up a hill and then makes her way over rocks down the other side. Her bike is holding up⁴, but her leg muscles⁵ sure are tired. And she has four more miles to ride!

Mountain biking looks dangerous⁶—and it can be, especially when you're riding across rocky terrain⁷. One wrong move can send you flying through the air. However, this mountain biker knows the mountain well. She's ridden on this path dozens of⁸ times and knows every hill, every turn, every bump⁹. She also knows something about forces¹⁰ and motion¹¹.

Biking is all about forces. In fact, forces also make walking, swinging¹², throwing, and any other kind of motion possible. Forces are basically pushes and pulls. Understanding forces and motion can make a person better not only at biking but also at a lot of other activities¹³. So use a little force now to turn the page—a world of motion awaits¹⁴!

- | | | |
|--------------|------|-----------|
| 1. pedal | v. | 踩动踏板; 骑车 |
| 2. rocky | adj. | 多岩石的; 岩石的 |
| 3. struggle | v. | 奋力 |
| 4. hold up | | 继续下去 |
| 5. muscle | n. | 肌肉 |
| 6. dangerous | adj. | 危险的 |
| 7. terrain | n. | 地势; 地形 |
| 8. dozens of | | 许多 |
| 9. bump | n. | 颠簸的地方 |
| 10. force | n. | 力 |
| 11. motion | n. | 运动 |
| 12. swing | v. | 摇摆 |
| 13. activity | n. | 活动 |
| 14. await | v. | 等候; 期待 |
| 15. Utah | | 犹他州 |

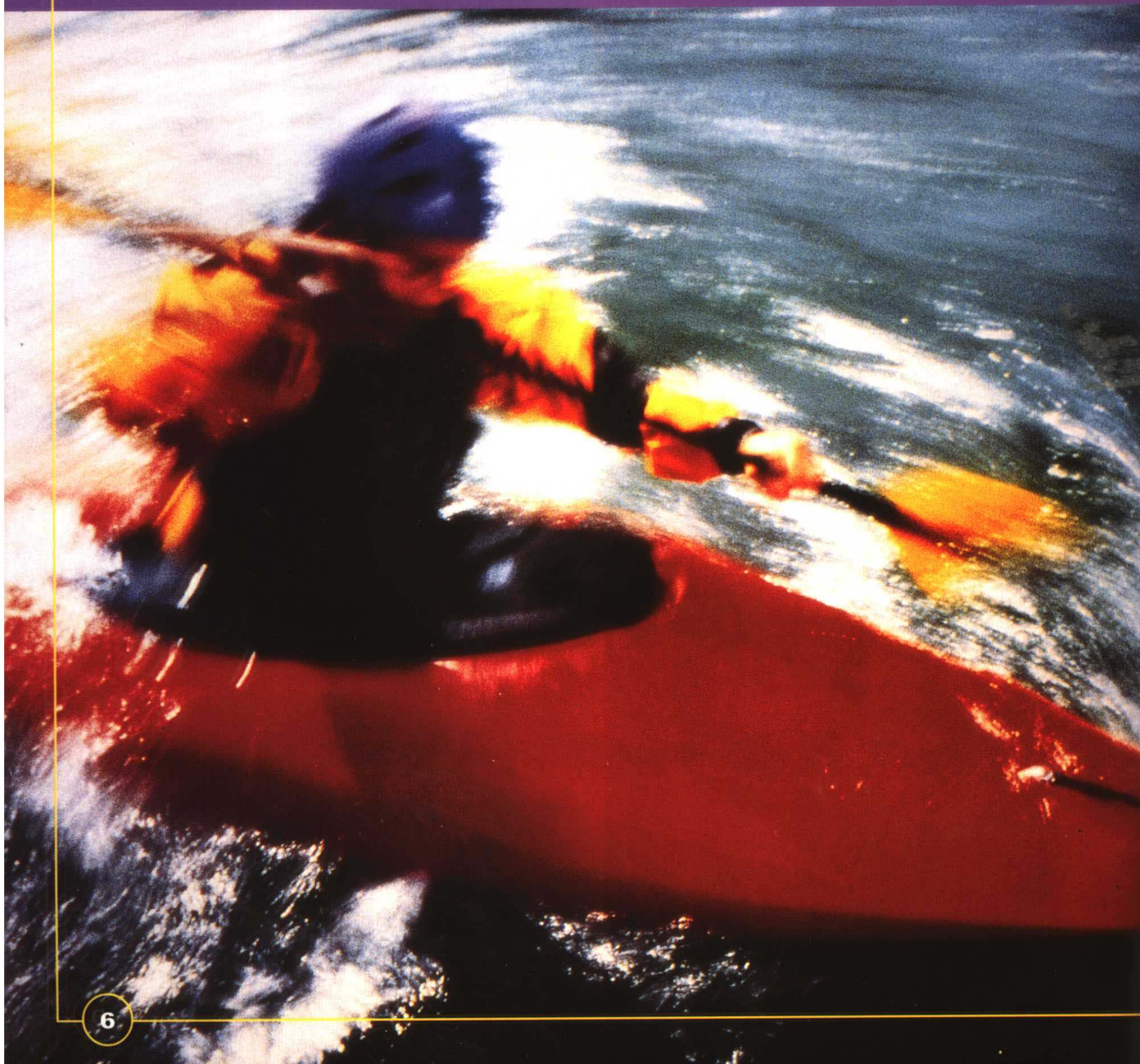
◀ **A mountain biker speeds down rough terrain near Moab, Utah¹⁵.**



Pushing and Pulling:

A World in Motion

推与拉：运动着的世界



If there were a sound track¹ for the person and the kayak², what sounds might you hear? Did you know that all these sounds are caused by forces³ and motion?

Everywhere you look, things are moving. What's moving around you right now? Cars may be rolling³ by outside. Someone may be walking up the stairs. The wind might be blowing the leaves on trees. Even your eyes are moving as you read these words. From the blood flowing⁴ in your body to Earth moving around the sun, we live in a world of motion.

Forces Make It Go

Take another look at the picture of the person in the kayak. What objects⁵ are moving in the picture? What makes each object move? Think about it. The paddle⁶ and the kayak don't move by themselves. Something makes them move. That something is called a force. A force can be a push or it can be a pull. The paddle gets a big pull from the person's arms to push the kayak through the water. The kayak also gets a push from the water that is rushing behind and around it.

What about a kite? It moves because of the push of the wind and the pull on the string⁷. Forces make all objects move. Forces also make objects slow down, speed up, change direction⁸, or stop.



- | | | | | | |
|-----------|-----------|----------------------|----------------------|-----------|-------|
| 1. track | <i>n.</i> | 轨道, 痕迹 | 6. paddle | <i>n.</i> | 桨 |
| 2. kayak | <i>n.</i> | (最初系因纽特人使用的)划子, 轻便小艇 | 7. string | <i>n.</i> | 细绳, 线 |
| 3. roll | <i>v.</i> | 行驶, 滚动 | 8. direction | <i>n.</i> | 方向 |
| 4. flow | <i>v.</i> | 流, 流动 | 9. rapid | <i>n.</i> | 急流 |
| 5. object | <i>n.</i> | 物体 | 10. Washington State | | 华盛顿州 |

A kayaker paddles through the white water rapids⁹ of the Wenatchee River in Washington State¹⁰.



“What Goes Up . . .”

Can you finish that phrase? Sure. “What goes up, must come down.” This familiar¹ saying describes² a force that affects³ you every second of the day—gravity⁴. When your pencil rolls off the desk, it falls to the floor because of gravity. Snow drifts⁵ gently to the ground because of gravity. Gravity even keeps you on Earth’s surface⁶.

Gravity is a force that pulls any two objects together. Gravity acts on anything that has mass⁷, or some amount of matter. Every object has mass. So every object is pulling on every other object. Then why isn’t everything on Earth pulled together into one giant⁸ blob⁹? Because the pull of gravity between objects depends on¹⁰ the mass of the objects. The more mass, the bigger the pull. This book and you are pulling on each other right now. Honest. But the pull is too small for you to

notice. Earth, however, has a lot more mass than you or the book. So it pulls really hard. That’s why if you drop¹¹ the book, it falls down—toward Earth, not toward you. Or, more accurately¹², Earth and the book pull each other. It’s like a tug-of-war¹³ that Earth wins! Earth pulls on you too. That’s what keeps you on the ground and lets you move around on Earth’s surface.

- | | | |
|----------------|-------------|---------|
| 1. familiar | <i>adj.</i> | 熟悉的 |
| 2. describe | <i>v.</i> | 描述 |
| 3. affect | <i>v.</i> | 影响 |
| 4. gravity | <i>n.</i> | 重力；地球引力 |
| 5. drift | <i>v.</i> | 飘 |
| 6. surface | <i>n.</i> | 表面 |
| 7. mass | <i>n.</i> | 质量 |
| 8. giant | <i>adj.</i> | 巨大的 |
| 9. blob | <i>n.</i> | 一团；一堆 |
| 10. depend on | | 取决于 |
| 11. drop | <i>v.</i> | 使落下 |
| 12. accurately | <i>adv.</i> | 准确地；精确地 |
| 13. tug-of-war | <i>n.</i> | 拔河(游戏) |

Gravity in Space

Earth's gravity holds objects on Earth's surface. Gravity also affects things in outer space¹. Imagine² holding a string with a ball attached³ to one end. You can twirl⁴ the ball around your head by pulling on the string. That's how Earth's gravity keeps a space shuttle⁵ and satellites in orbit⁶. Earth pulls these objects into a circular⁷ path around itself. Gravity also keeps the moon in orbit around Earth and Earth in orbit around the sun.

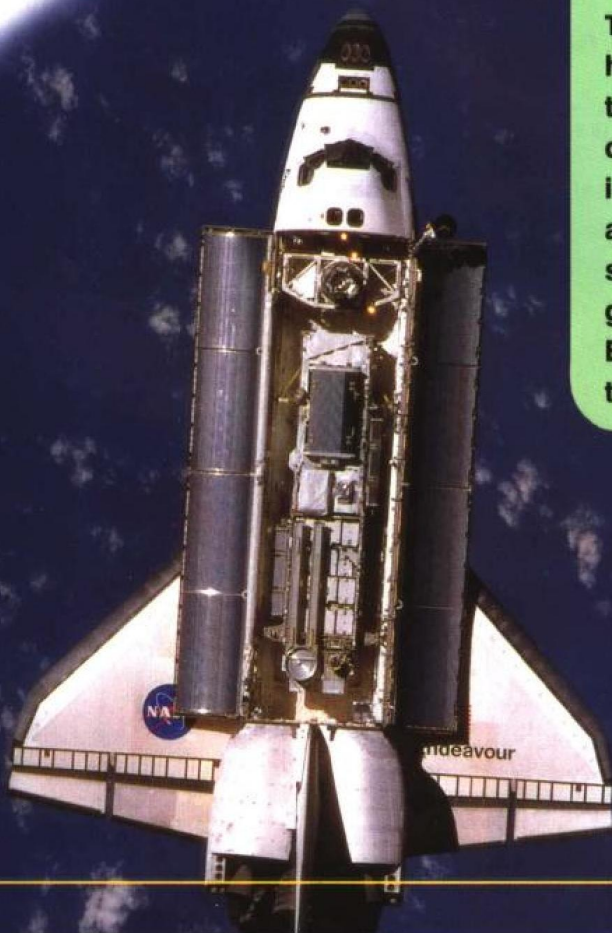
Earth's gravity keeps the space shuttle in orbit.

1. outer space		外层空间, 宇宙空间
2. imagine	<i>v.</i>	想像, 设想
3. attach	<i>v.</i>	缚, 系
4. twirl	<i>v.</i>	转动
5. space shuttle		航天飞机
6. orbit	<i>n.</i>	轨道
7. circular	<i>adj.</i>	圆的
8. astronaut	<i>n.</i>	宇航员
9. bone	<i>n.</i>	骨头
10. tightly	<i>adv.</i>	紧紧地
11. spine	<i>n.</i>	脊椎
12. height	<i>n.</i>	高度

What if...?

... astronauts⁸ got taller in space?

They do! On Earth, gravity holds our bones⁹ tightly¹⁰ together. In space, the force of gravity is less. So bones in the spine¹¹ move farther apart. Astronauts who spend weeks in space can get up to two inches taller! Back on Earth, they return to their usual height¹².



Slow Down!

You know that when you hit a baseball high into the air, it comes down because of gravity. After it hits the ground, the ball bounces¹, slows down, and comes to a stop. Why doesn't it just keep on rolling? A force called friction² acts on the ball to make it slow down and stop.

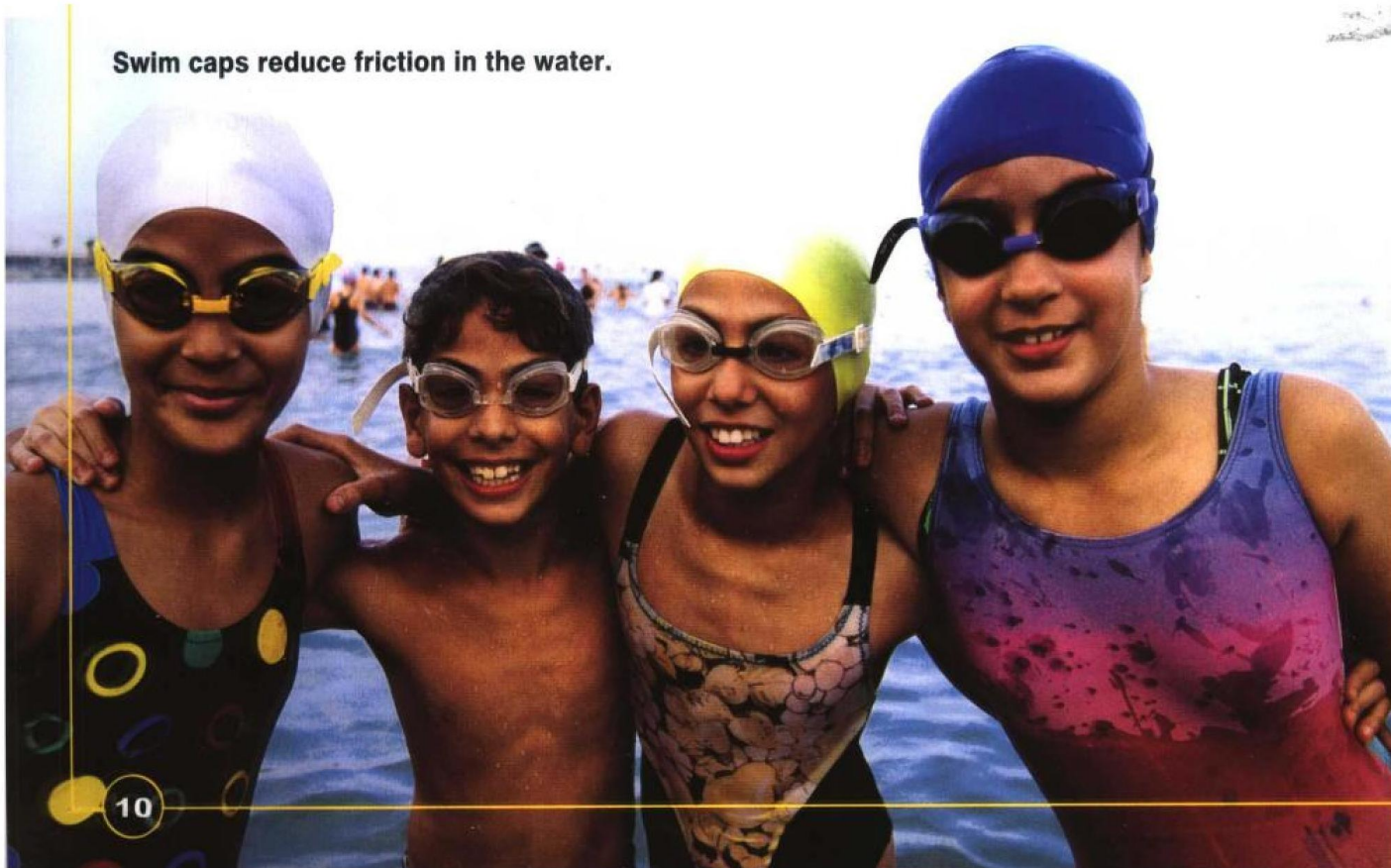
Friction is a force that resists³ motion when two objects, like the ball and the ground, rub⁴ against each other. Friction slows or stops objects, or keeps them from moving.

Friction—More or Less

A world without friction is hard to imagine. For example, we need friction to walk. Friction keeps one foot from slipping⁵ so that your other foot can move forward. The same thing applies⁶ to someone in a wheelchair⁷. When a wheelchair rolls, the wheels push against the ground and the chair rolls forward. Without friction, the wheels would just spin⁸. Even though we need friction, too much of it can be a problem. When the moving parts of machines rub against one another, friction wears down⁹ the parts. That's why we add lubricants¹⁰ like oil and grease¹¹ to machines. The lubricant reduces¹²

1. bounce	v.	弹起。弹跳	7. wheelchair	n.	轮椅
2. friction	n.	摩擦力	8. spin	v.	旋转
3. resist	v.	抵抗。阻止	9. wear down		(使)磨损。(使)损耗
4. rub	v.	摩擦。擦	10. lubricant	n.	润滑剂
5. slip	v.	滑。滑动	11. grease	n.	油脂 润滑脂
6. apply	v.	应用。实施	12. reduce	v.	减少

Swim caps reduce friction in the water.





Because of friction, wheelchairs move forward when the wheels push against the ground.

friction by forming a slippery¹, thin layer² between the moving parts.

What are some other ways that you can reduce friction? Swim caps reduce the friction between a swimmer and the water. This lets the swimmer move faster. Hikers³ on the sides of icy mountains want to increase⁴ the friction between their feet and the ice. They often wear shoes with long spikes⁵ on the bottom⁶. These spikes keep the hiker from slipping.

What are ways that you can reduce or increase friction?

- | | | |
|-------------------|------|---------|
| 1. slippery | adj. | 滑的 |
| 2. layer | n. | 层 |
| 3. hiker | n. | 长途徒步旅行者 |
| 4. increase | v. | 增多, 增强 |
| 5. spike | n. | 钉子 |
| 6. bottom | n. | 底部 |
| 7. inventor | n. | 发明家 |
| 8. engineering | n. | 工程学 |
| 9. Scotland | | 苏格兰 |
| 10. railroad | n. | 铁路 |
| 11. invent | v. | 发明 |
| 12. device | n. | 器械, 装置 |
| 13. automatically | adv. | 自动地 |

Focus On



Elijah McCoy: A Friction-fighting Inventor⁷

Elijah McCoy was born in Canada in 1843. He studied engineering⁸ in Scotland⁹. After becoming an engineer and moving to the United States, McCoy found a job as a railroad¹⁰ worker. Soon he began to invent¹¹ devices¹² that automatically¹³ oiled moving parts of a train. His inventions worked so well that people wanted his devices on their trains. They wanted the “real McCoy,” not some other kind of oiling device. And that is how that saying got started. McCoy invented more than 50 different devices and tools.

Laws of Motion:

Action and Reaction

运动定律：作用力与反作用力

Behind every swing of a bat, each catch that you make, and every breath¹ that you take, there is force and motion. What exactly² happens when things get moving?

- | | | |
|------------|-------------|-----|
| 1. breath | <i>n.</i> | 呼吸 |
| 2. exactly | <i>adv.</i> | 确切地 |



You know that a force is needed to make something move and to make something stop. Those are pretty simple ideas. However, there was a time when even the smartest¹ people didn't know them. They didn't question what others said was true. Then in the 1500s and 1600s, a few people shook things up² a bit. One of them was Galileo Galilei³.

Galileo and Cannonball⁴ Science

Galileo was born in Pisa⁵, Italy. He was interested in how objects move. In the early 1600s, people thought that if you threw an object, it kept going in a straight line until it "ran out of⁶ force." Then it fell straight down. Galileo disagreed⁷.

Galileo not only thought about the problem of motion but also did experiments⁸ to test his ideas. Through his experiments he concluded⁹ that an object does not need a force to keep it moving, only to start it moving. He said an object doesn't run out of force. Instead, other forces act on it to slow it down. Galileo also found that objects thrown forward move in a curved¹⁰ path. With this knowledge and his skill in math, Galileo could predict¹¹ the motion of different objects. He was even able to figure out¹² the exact flight path of a cannonball shot from a cannon. This was an important skill at a time in Italy when many cities were fighting each other.

1. smart	<i>adj.</i>	聪明的	7. disagree	<i>v.</i>	不同意
2. shake up		动摇(信念)	8. experiment	<i>n.</i>	实验
3. Galileo Galilei		伽利略·加利莱伊(意大利数学家、天文学家和物理学家、现代力学和实验物理学创始人)	9. conclude	<i>v.</i>	推断; 断定
4. cannonball	<i>n.</i>	炮弹	10. curved	<i>adj.</i>	弯曲的, 曲线的
5. Pisa		比萨	11. predict	<i>v.</i>	预测
6. run out of		用完	12. figure out		计算出; 估计
			13. print	<i>n.</i>	印出的版画

Galileo found that an object thrown forward, like the cannonball in this 18th-century print¹³, travels in a curved path.

