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PHYSICAL SCIENCE

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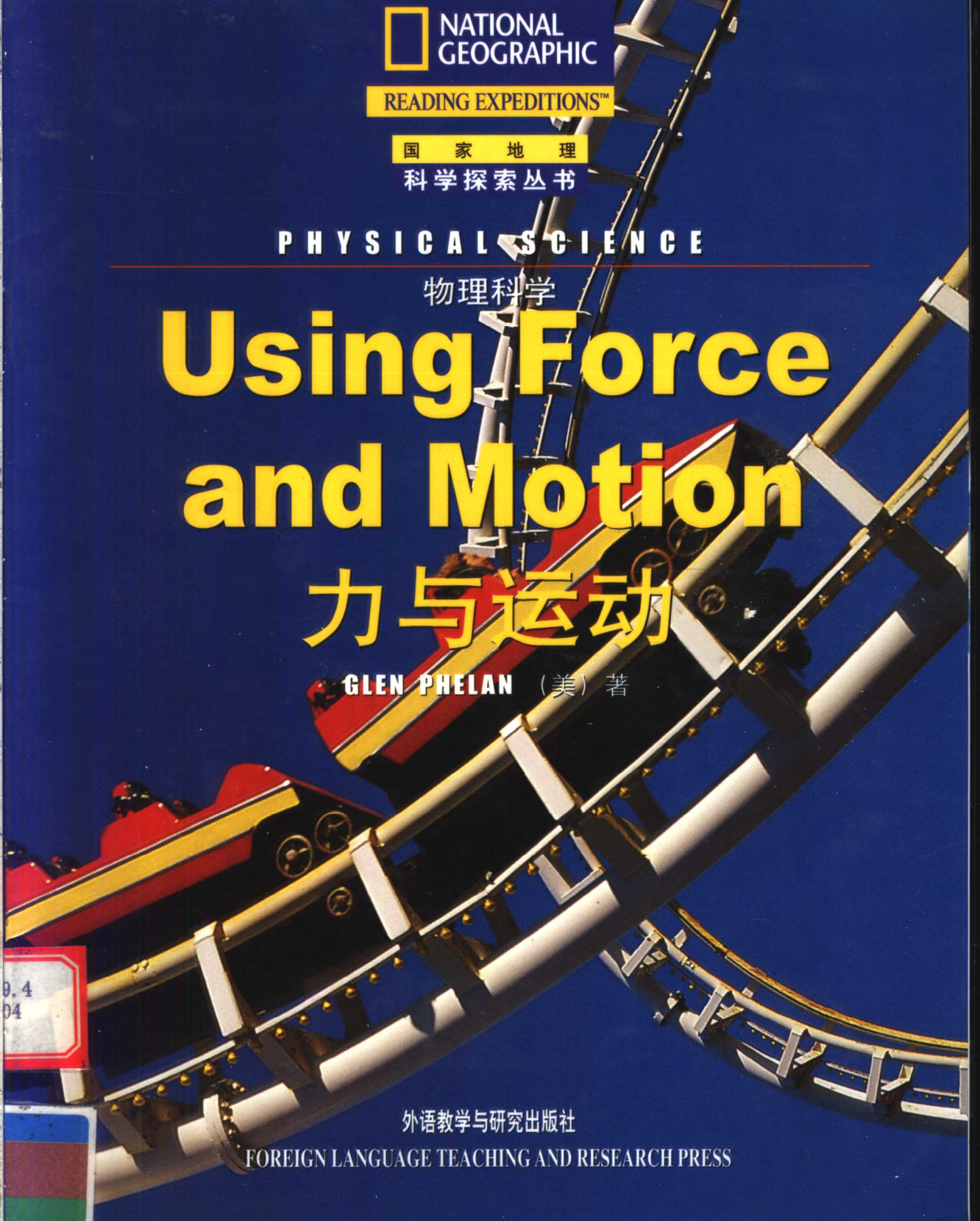
Using Force and Motion

力与运动

GLEN PHELAN （美）著



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力与运动
GLEN PHELAN (美) **著**
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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。

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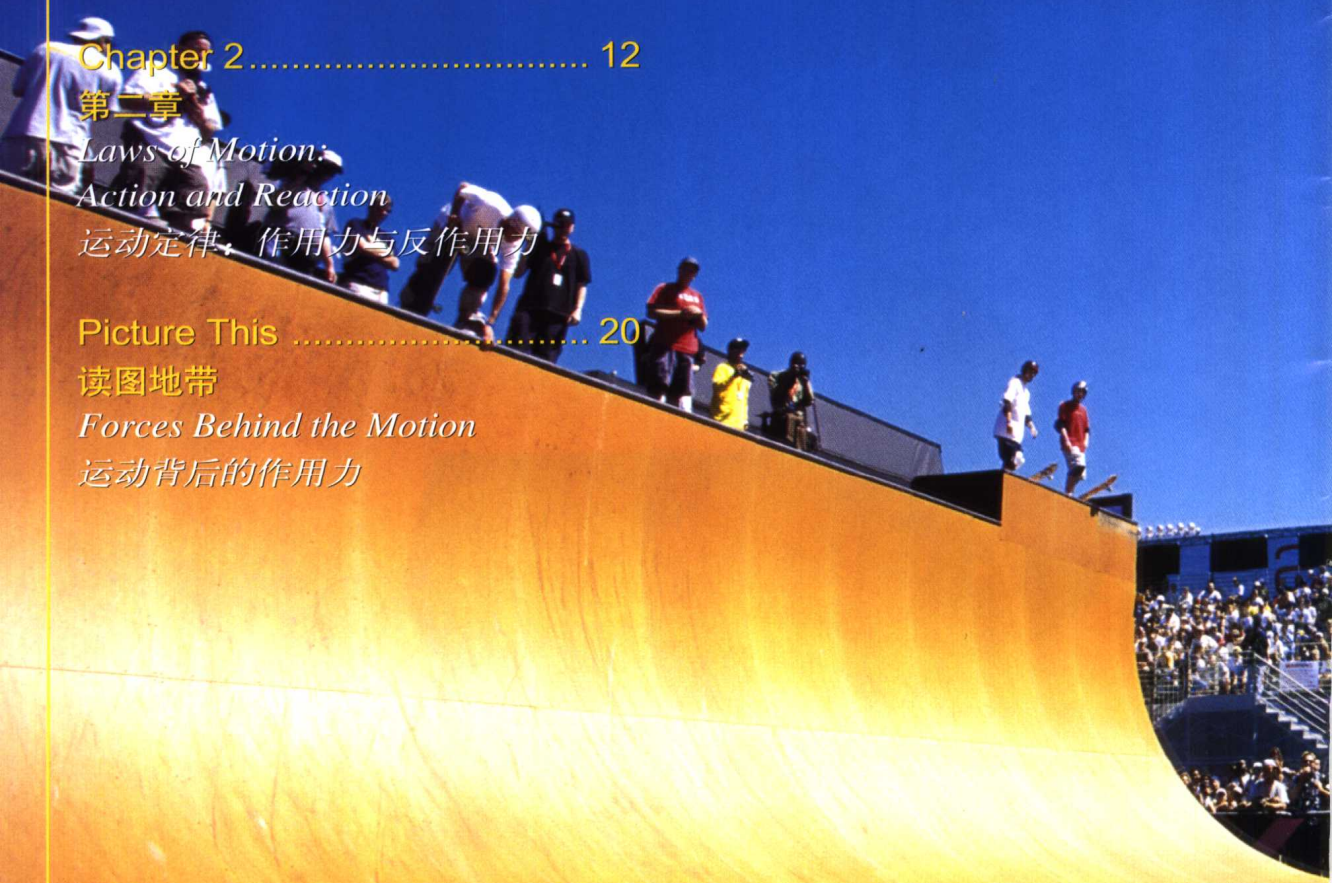
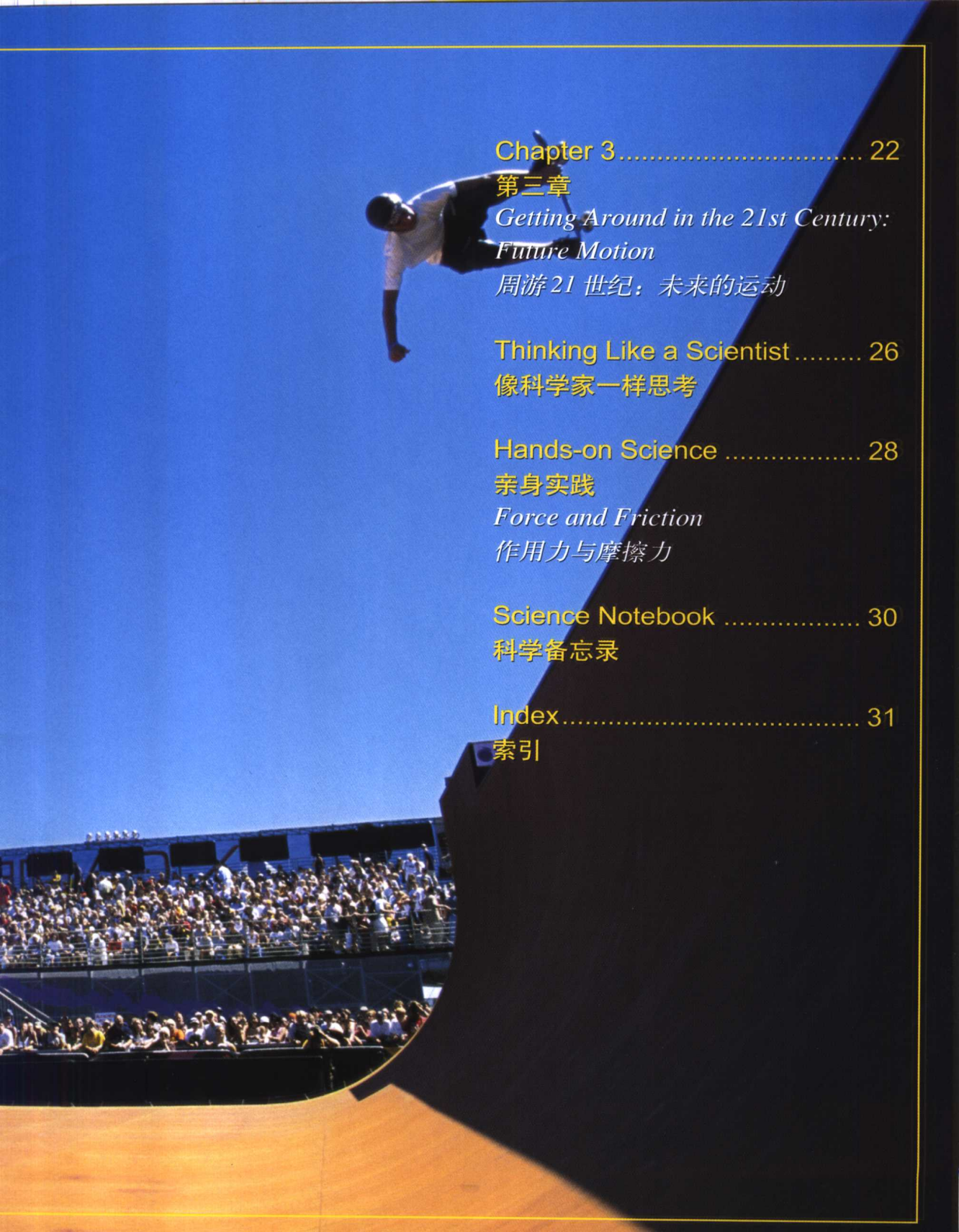


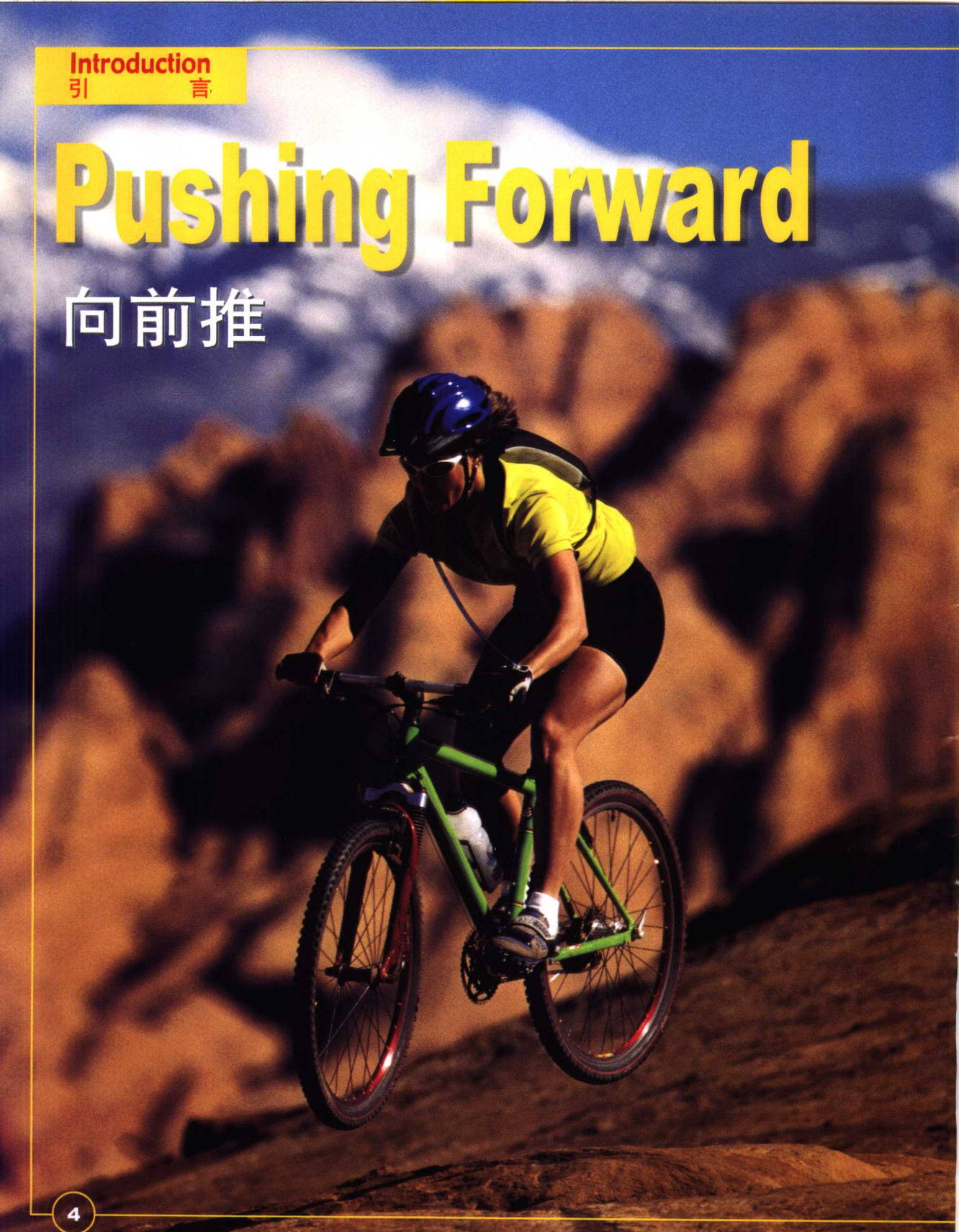
A skateboarder grips his board as he goes airborne in a skating competition in San Francisco, California.



Introduction
引　　言

Pushing Forward

向前推



She pedals[1] as fast as she can along the rocky[2] course. She struggles[3] up a hill and then makes her way over rocks down the other side. Her bike is holding up[4], but her leg muscles[5] sure are tired. And she has four more miles to ride!

Mountain biking looks dangerous[6]—and it can be, especially when you're riding across rocky terrain[7]. 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 of[8] times and knows every hill, every turn, every bump[9]. She also knows something about forces[10] and motion[11].

Biking is all about forces. In fact, forces also make walking, swinging[12], 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 activities[13]. So use a little force now to turn the page—a world of motion awaits[14]!

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, Utah[15].

Chapter 第一章 1

Pushing and Pulling:

A World in Motion

推与拉：运动着的世界

If there were a sound track[1] for the person and the kayak[2], what sounds might you hear? Did you know that all these sounds are caused by forces and motion?

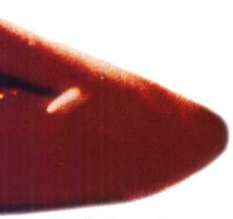
Everywhere you look, things are moving. What's moving around you right now? Cars may be rolling[3] by outside. Someone may be walking up the stairs. The wind might be blowing the leaves on trees. Even your eyes are moving as you read these words. From the blood flowing[4] in your body to Earth moving 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 objects[5] are moving in the picture? What makes each object move? Think about it. The paddle[6] 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 string[7]. Forces make all objects move. Forces also make objects slow down, speed up, change direction[8], or stop.

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



A kayaker paddles through the white water rapids[9] of the Wenatchee River in Washington State[10].

Gravity pulls the skydivers toward Earth.

"What Goes Up . . ."

Can you finish that phrase? Sure. "What goes up, must come down." This familiar[1] saying describes[2] a force that affects[3] you every second of the day—gravity[4]. When your pencil rolls off the desk, it falls to the floor because of gravity. Snow drifts[5] gently to the ground because of gravity. Gravity even keeps you on Earth's surface[6].

Gravity is a force that pulls any two objects together. Gravity acts on anything that has mass[7], 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 giant[8] blob[9]? Because the pull of gravity between objects depends on[10] 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 drop[11] the book, it falls down—toward Earth, not toward you. Or, more accurately[12], Earth and the book pull each other. It's like a tug-of-war[13] 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	*adj.*	熟悉的
2.	describe	*v.*	描述
3.	affect	*v.*	影响
4.	gravity	*n.*	重力；地球引力
5.	drift	*v.*	飘
6.	surface	*n.*	表面
7.	mass	*n.*	质量
8.	giant	*adj.*	巨大的
9.	blob	*n.*	一团；一堆
10.	depend on		取决于
11.	drop	*v.*	使落下
12.	accurately	*adv.*	准确地；精确地
13.	tug-of-war	*n.*	拔河(游戏)

Gravity in Space

Earth's gravity holds objects on Earth's surface. Gravity also affects things in outer space[1]. Imagine[2] holding a string with a ball attached[3] to one end. You can twirl[4] the ball around your head by pulling on the string. That's how Earth's gravity keeps a space shuttle[5] and satellites in orbit[6]. Earth pulls these objects into a circular[7] path around itself. Gravity also keeps the moon in orbit around Earth and Earth in orbit around the sun.

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

Earth's gravity keeps the space shuttle in orbit.

What if...?

... astronauts[8] got taller in space?

They do! On Earth, gravity holds our bones[9] tightly[10] together. In space, the force of gravity is less. So bones in the spine[11] move farther apart. Astronauts who spend weeks in space can get up to two inches taller! Back on Earth, they return to their usual height[12].

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 bounces[1], slows down, and comes to a stop. Why doesn't it just keep on rolling? A force called friction[2] acts on the ball to make it slow down and stop.

Friction is a force that resists[3] motion when two objects, like the ball and the ground, rub[4] 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 slipping[5] so that your other foot can move forward. The same thing applies[6] to someone in a wheelchair[7]. When a wheelchair rolls, the wheels push against the ground and the chair rolls forward. Without friction, the wheels would just spin[8]. 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 down[9] the parts. That's why we add lubricants[10] like oil and grease[11] to machines. The lubricant reduces[12]

1.	bounce	*v.*	弹起；弹跳		
2.	friction	*n.*	摩擦力		
3.	resist	*v.*	抵抗；阻止		
4.	rub	*v.*	摩擦；擦		
5.	slip	*v.*	滑；滑动		
6.	apply	*v.*	应用；实施		
7.	wheelchair	*n.*	轮椅		
8.	spin	*v.*	旋转		
9.	wear down		(使)磨损；(使)损耗		
10.	lubricant	*n.*	润滑剂		
11.	grease	*n.*	油脂；润滑脂		
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 slippery[1], thin layer[2] 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. Hikers[3] on the sides of icy mountains want to increase[4] the friction between their feet and the ice. They often wear shoes with long spikes[5] on the bottom[6]. 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 Inventor[7]

Elijah McCoy was born in Canada in 1843. He studied engineering[8] in Scotland[9]. After becoming an engineer and moving to the United States, McCoy found a job as a railroad[10] worker. Soon he began to invent[11] devices[12] that automatically[13] 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.

Chapter 第二章 2

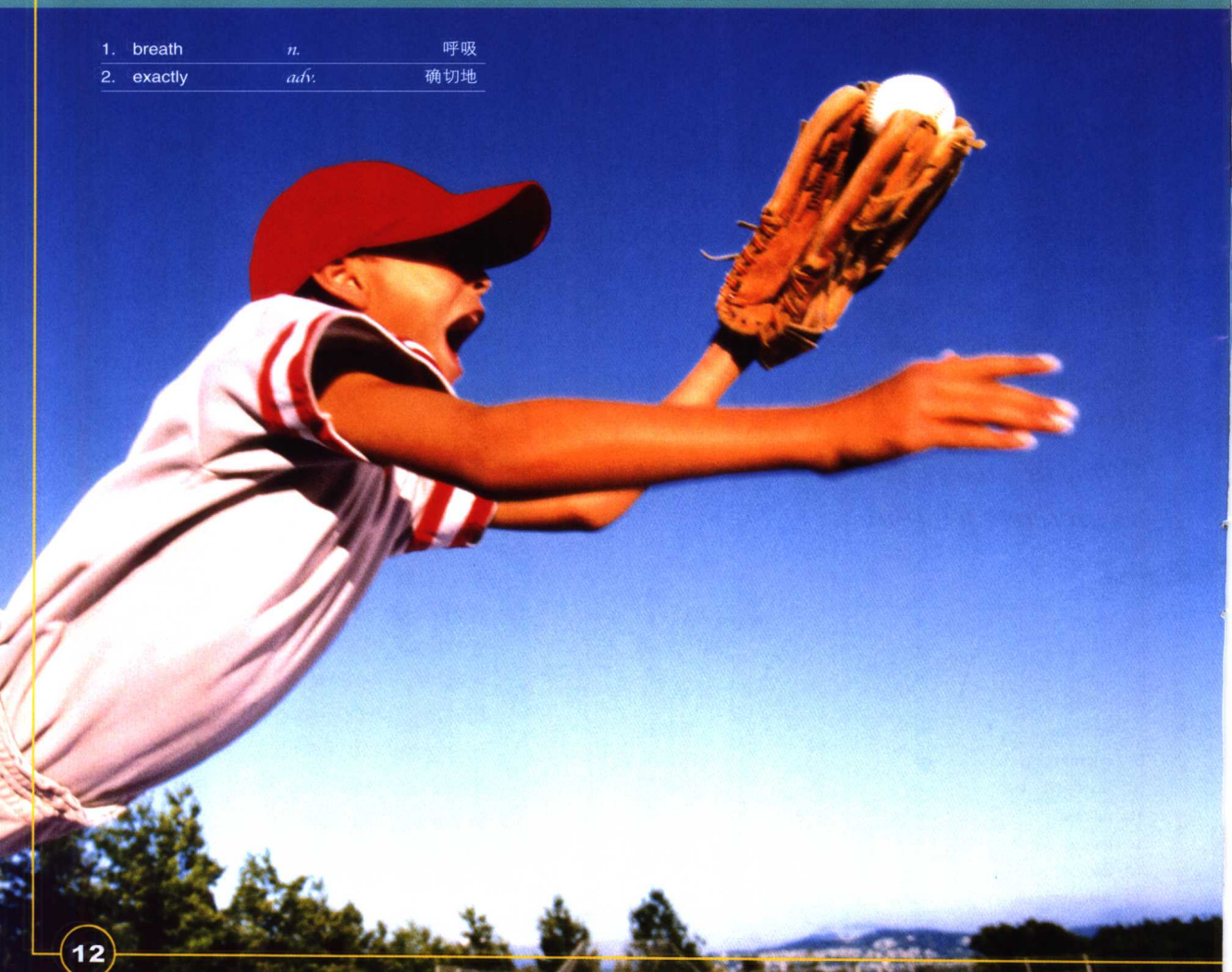
Laws of Motion:

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 breath[1] that you take, there is force and motion. What exactly[2] happens when things get moving?

1. breath *n.* 呼吸
2. exactly *adv.* 确切地



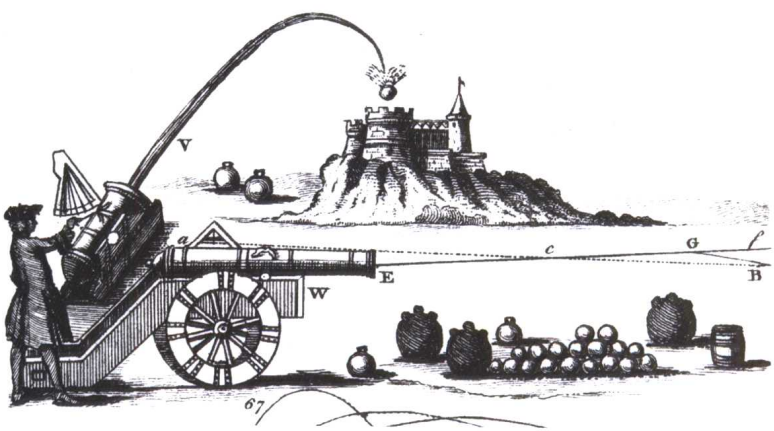
You know that a force is needed to make something move and to make something stop. Those are pretty simple ideas. However, there was a time when even the smartest[1] people didn't know them. They didn't question what others said was true. Then in the 1500s and 1600s, a few people shook things up[2] a bit. One of them was Galileo Galilei[3].

Galileo and Cannonball[4] Science

Galileo was born in Pisa[5], 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 of[6] force." Then it fell straight down. Galileo disagreed[7].

Galileo not only thought about the problem of motion but also did experiments[8] to test his ideas. Through his experiments he concluded[9] 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 curved[10] path. With this knowledge and his skill in math, Galileo could predict[11] the motion of different objects. He was even able to figure out[12] 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	*adj.*	聪明的
2. shake up		动摇(信念)
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)
4. cannonball	*n.*	炮弹
5. Pisa		比萨
6. run out of		用完
7. disagree	*v.*	不同意
8. experiment	*n.*	实验
9. conclude	*v.*	推断；断定
10. curved	*adj.*	弯曲的；曲线的
11. predict	*v.*	预测
12. figure out		计算出；估计
13. print	*n.*	印出的版画



Galileo found that an object thrown forward, like the cannonball in this 18th-century print[13], travels in a curved path.