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英文注释

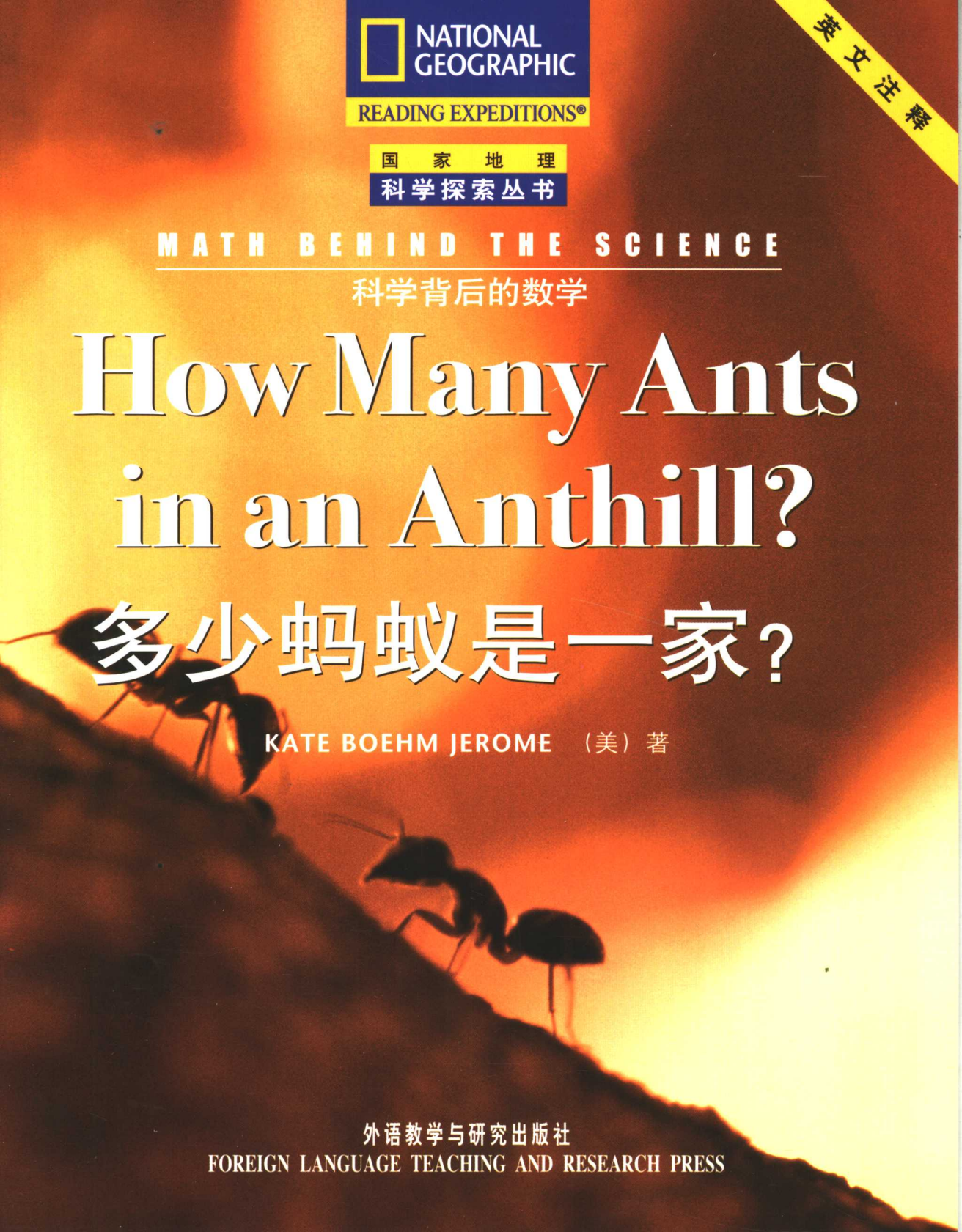
MATH BEHIND THE SCIENCE

科学背后的数学

How Many Ants in an Anthill?

多少蚂蚁是一家？

KATE BOEHM JEROME （美）著



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本套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。

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A scientist measures an armadillo in Florida.

INTRODUCTION
引 言

Questions That Count
数字问题

Science is all about asking questions. *How many ants are in an anthill? How tall is a giant redwood[1] tree? How long does it take to travel to the moon?* There seems to be no end to the things we want to know.

To answer all these questions, scientists need to gather good information, or data[2]. But they could not do this if they did not understand one very important link—the math behind the science.

Scientists use math as a tool to understand data. So do you. Think about measurement. You need measuring skills to answer questions about amounts[3]. *How long? How many? How much?* You also need to understand measurement in order to estimate and compare.

But measurement doesn't really mean much until you use it. To understand the power of the math behind the science, you need to see it in action. Some scientists are putting math to work right now as they e-mail one another from the field. Let's take a look.

1. redwood *n.* 红杉
2. datum *n.* (*pl.* data) 资料；数据
3. amount *n.* 量；数量

E-mail from the Field

Subject: Incredible[1] Insects[2]
From: hunter@usc.org
To: amyseeker@yst.org, jcortez@nasa.gov

Greetings from the rain forests[3] of Costa Rica[4]!

It's hot and wet, but the soggy[5] days are worth it. You wouldn't believe the size of one of the beetles[6] I'm studying down here. It's called a Hercules beetle[7]—named after the Greek[8] hero known for his strength. These beetles live up to[9] their name, too. The largest ones can carry up to 2 kilograms. That's over 4 pounds! Come to think of it, that's about what my laptop computer[10] weighs. Hmmm . . . I'd better keep an eye on these super-size bugs!

Drop me an e-mail when you get a chance.

(注释见第7页)

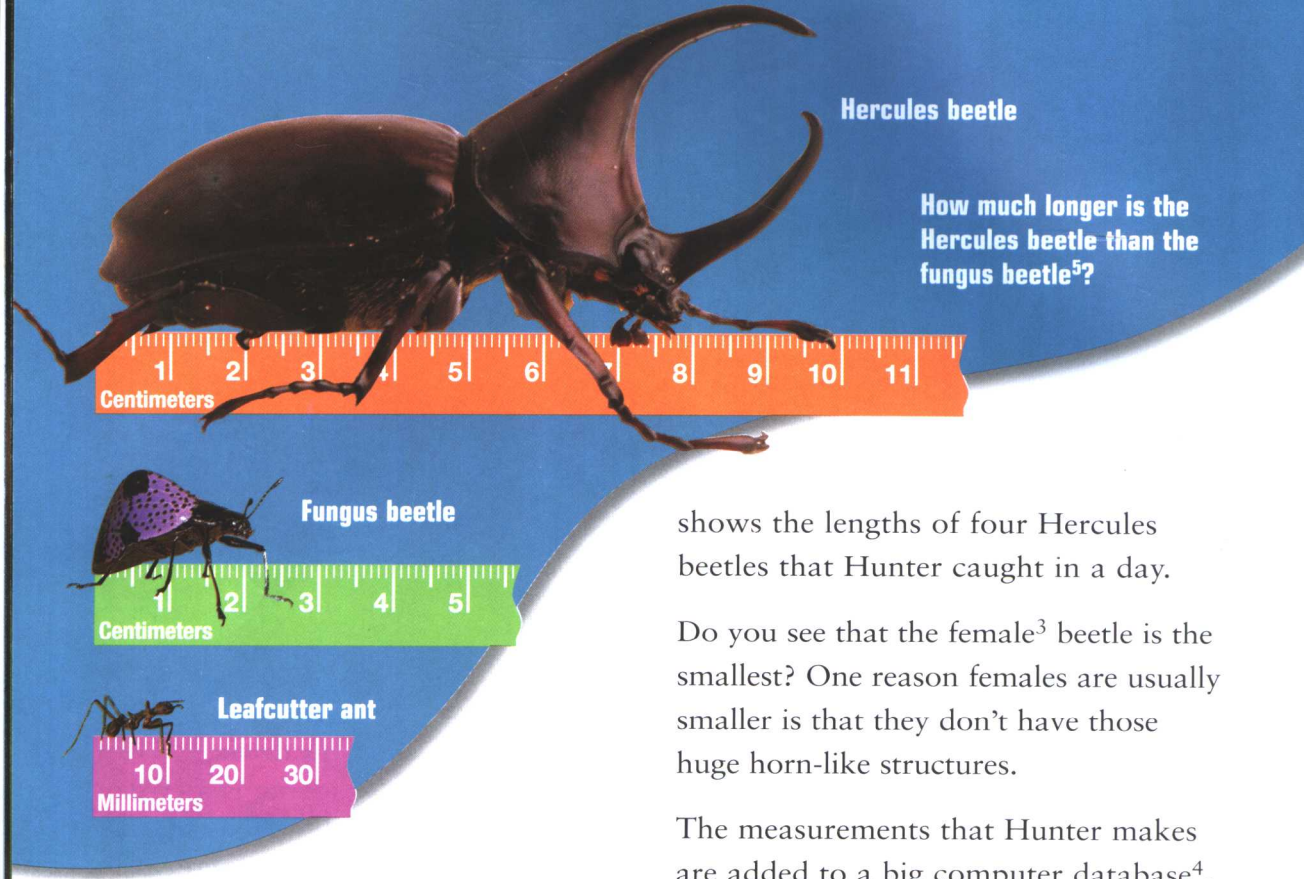
Hunter

Measuring Little Monsters
测量小怪物

The Hercules beetle that Hunter is studying is a large, scary-looking[11] insect. The male[12] beetles have horn-like structures[13] that add to their length and frightening[14] appearance[15]. Lucky for Hunter, though, Hercules beetles are harmless[16] to people.

So how long is this beetle compared to other insects on the rain forest floor? The scale that Hunter uses to measure the Hercules beetle puts it all in perspective[17].

1. incredible	*adj.*	不可思议的
2. insect	*n.*	昆虫；虫
3. rain forest		（热带）雨林
4. Costa Rica		哥斯达黎加
5. soggy	*adj.*	有湿气的
6. beetle	*n.*	甲虫
7. Hercules beetle		巨大犀金龟
8. Greek	*adj.*	希腊的
9. live up to		符合
10. laptop computer		便携式电脑
11. scary-looking	*adj.*	样子骇人的
12. male	*adj.*	雄的
13. structure	*n.*	结构
14. frightening	*adj.*	骇人的
15. appearance	*n.*	外表
16. harmless	*adj.*	无害的
17. in perspective		关系恰当地



Choose Your Scale

Most small insects are measured in millimeters (mm). For example, the body of the leafcutter[1] ant shown above is about 10 mm long.

But a Hercules beetle can be ten times longer! So Hunter uses the larger scale of the ruler—the centimeter (cm) scale—when he measures this giant insect (1 cm = 10 mm).

Taking Good Measure

Scientists take many measurements to find the size ranges[2] of different animals. The table on the next page shows the lengths of four Hercules beetles that Hunter caught in a day.

Do you see that the female[3] beetle is the smallest? One reason females are usually smaller is that they don't have those huge horn-like structures.

The measurements that Hunter makes are added to a big computer database[4]. After studying many measurements taken over many years, researchers know that male Hercules beetles range from about 5 to 16 cm in length. That means the largest male Hercules beetles are longer than your whole hand!

1. leafcutter	*n.*	南美切叶蚁
2. range	*n.*	（变化等的）幅度
3. female	*adj.*	雌的
4. database	*n.*	数据库；资料库
5. fungus beetle		伪瓢虫科的一种虫

Date	Location[4]	Length of beetle	Gender[5]
9/23	1	7.5 cm	female
9/23	2	10.2 cm	male
9/23	3	12.2 cm	male
9/23	4	11.3 cm	male

Weighing In

If a fly landed on your shoulder, you might not feel it. But you would feel a Hercules beetle. Some males can weigh more than 80 grams (about 2.8 ounces). That's almost three times more than a mouse weighs!

As Hunter points out in his e-mail, Hercules beetles are very strong for their size. How does he know? By observing[1] and measuring. For example, if researchers observe a beetle carrying wood, the researchers can weigh that wood. This provides more data about the insect.

Let's say a beetle weighs 80 grams. However, it can carry a piece of wood that weighs 2,000 grams (2 kilograms, or about 4.4 pounds). That means the wood weighs 25 times more than the beetle.

Doesn't sound like a big deal? Think again. If you could lift 25 times your weight, you could pick up a grizzly bear[2]! No wonder Hunter is impressed[3] with his super-size beetles!

1. observe *v.* 观察
2. grizzly bear 灰熊
3. impress *v.* 给……深刻印象
4. location *n.* 地点
5. gender *n.* （生理上的）性

Figuring It Out!

Can you figure out the average size of the male beetles that Hunter caught?

Add the three lengths together.

$$\begin{array}{r} 10.2 \text{ cm} \\ 12.2 \text{ cm} \\ +\ 11.3 \text{ cm} \\ \hline 33.7 \text{ cm} \end{array}$$

Then divide that answer by 3.

$$33.7 \text{ cm} \div 3 \approx 11.2 \text{ cm}$$

The average size of the male beetles is about 11.2 centimeters.

Subject: ISS[1] Update[2]
From: jcortez@nasa.gov
To: amyseeker@yst.org, hunter@usc.org

Good to hear from you, Hunter. That's one big bug you've got there!

I'm still working here in Houston[3] at NASA[4] headquarters[5] supporting the astronauts[6] on the International Space Station. I love it! Where else can you work with so many great scientists from all over the world?

Lately I've been working on the backpacks[7] for the space suits[8]. These backpacks weigh about 113 kilograms (about 249 pounds). Good thing they will seem weightless in space.

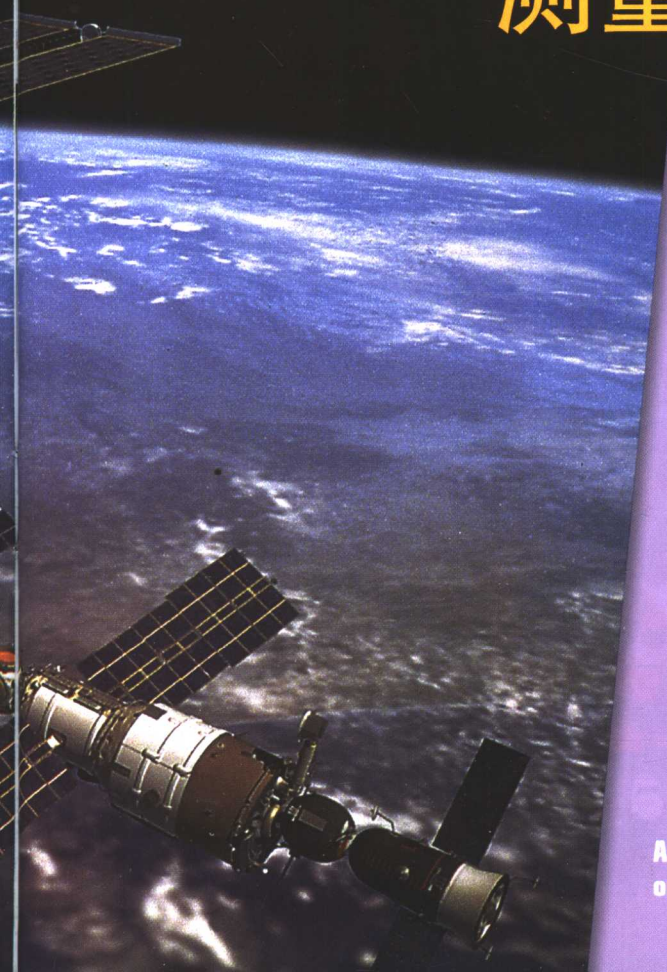
Hope Seeker checks in soon. Stay dry!

Juan

1. ISS 国际空间站
2. update *n.* 新的情况
3. Houston 休斯敦
4. NASA （美国）国家航空和航天局
5. headquarters *n.* （机关的）总部
6. astronaut *n.* 宇航员
7. backpack *n.* 背包
8. space suit 宇航服

The Universal Language of Measurement

测量的通用语言



Juan is working on the largest global space partnership[1] ever undertaken[2]. Sixteen countries are working together to build the International Space Station (ISS).

As you can imagine, building a laboratory 380 kilometers (about 236 miles) above Earth is no easy task. Before the ISS is complete, more than 100 different sections[3] will have to be put together. And it will take more than 40 spaceflights to deliver[4] all the pieces.

1. partnership	*n.*	合作关系
2. undertake	*v.*	开始进行，从事
3. section	*n.*	部件
4. deliver	*v.*	传送，运载
5. space shuttle		航天飞机
6. crew	*n.*	一队工作人员
7. solar panel		太阳电池板

A space shuttle[5] crew[6] sets up solar panels[7] on the International Space Station.

Setting the Standard

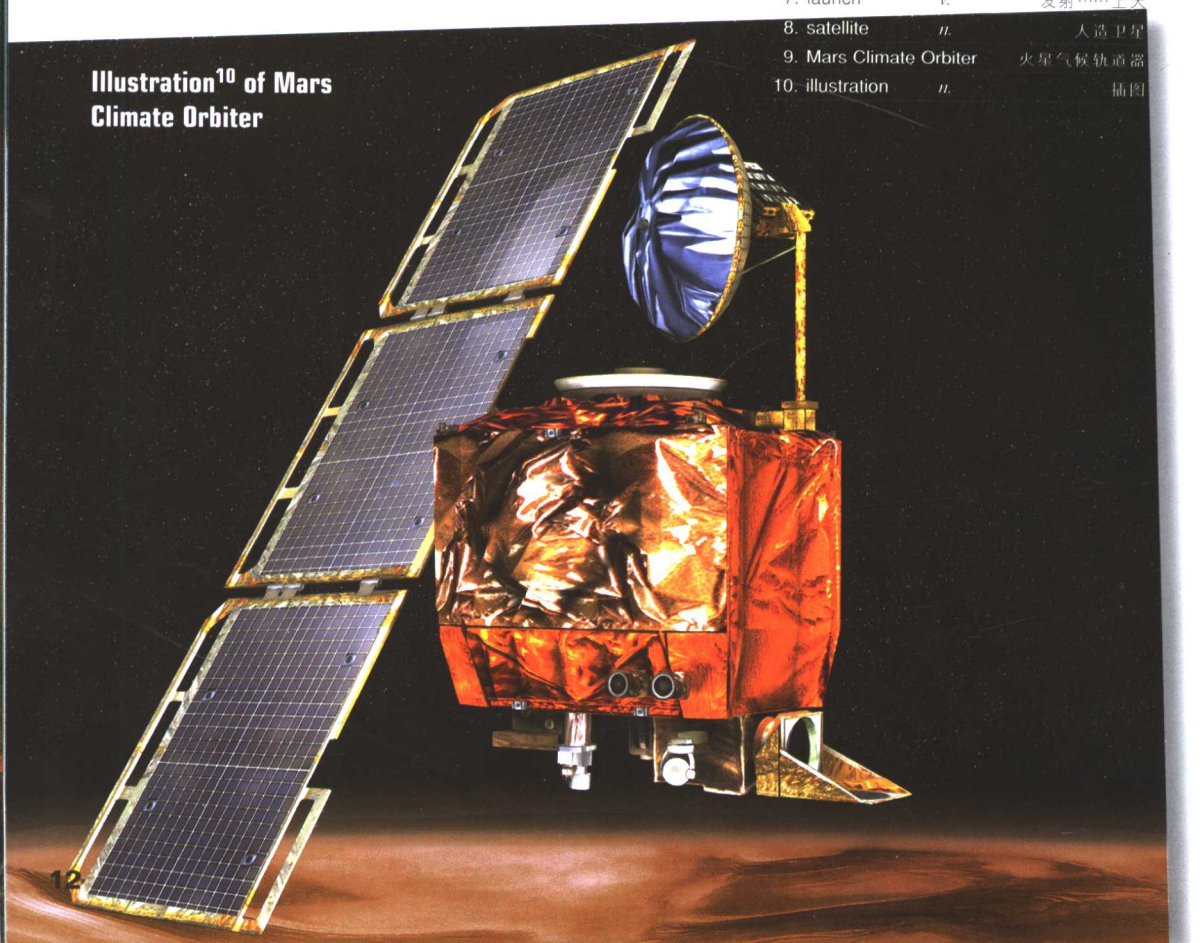
How can scientists who live in different countries and speak different languages build a space station together? It takes an amazing[1] amount of cooperation[2] and planning. One thing makes the job easier. The scientists all use the same system of measurement—the metric system.

The metric system that scientists like Juan use was first introduced in France in the 1790s. Eventually[3] it became the universal language of scientific measurement. The metric system ensures[4] that all scientists use the same standards to measure and report data.

A Costly[5] Mistake

But mistakes occasionally[6] do happen. In 1998 scientists at NASA (National Aeronautics and Space Administration) launched[7] a satellite[8] called the Mars Climate Orbiter[9]. The Orbiter traveled in space toward the planet Mars for 286 days. It was supposed to drop into an

1. amazing	*adj.*	令人吃惊的
2. cooperation	*n.*	合作；协作
3. eventually	*adv.*	最终
4. ensure	*v.*	保证
5. costly	*adj.*	代价高的
6. occasionally	*adv.*	偶尔
7. launch	*v.*	发射……上天
8. satellite	*n.*	人造卫星
9. Mars Climate Orbiter		火星气候轨道器
10. illustration	*n.*	插图



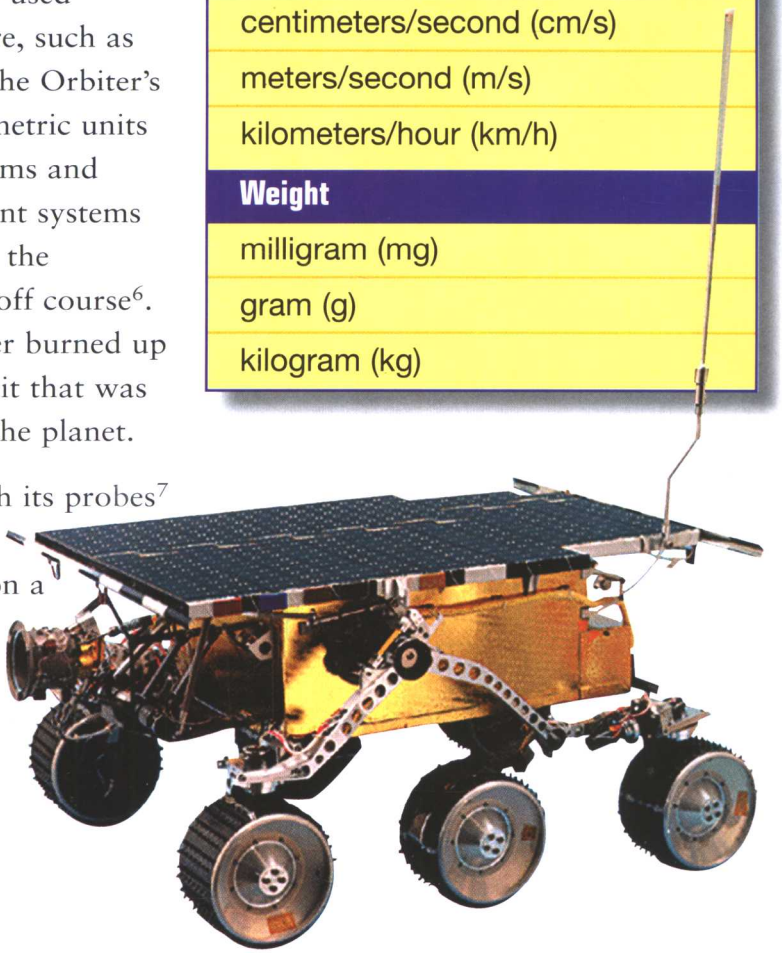
Illustration[10] of Mars Climate Orbiter

orbit[1] around the planet. Then it would send back information about climate and weather patterns[2] on Mars. Unfortunately, the spacecraft[3] never made its correct orbit. By September of 1999 it was considered lost.

What happened to the spacecraft? NASA later found out that a math error was at least partially[4] to blame for its loss. One team of engineers used customary[5] units of measure, such as pounds and feet, to direct the Orbiter's flight. Another team used metric units of measure, such as kilograms and meters. Because two different systems of measurement were used, the spacecraft was slowly sent off course[6]. Scientists believe the Orbiter burned up when it entered a Mars orbit that was too close to the surface of the planet.

NASA is back on track with its probes[7] to Mars. But it learned a valuable lesson: Everyone on a project[8] must use the same system of measurement.

Common Metric Units of Measure Used by Scientists
Length
millimeter (mm)
centimeter (cm)
meter (m)
kilometer (km)
Speed
centimeters/second (cm/s)
meters/second (m/s)
kilometers/hour (km/h)
Weight
milligram (mg)
gram (g)
kilogram (kg)



This Pathfinder[9] rover[10], named Sojourner[11], explored[12] Mars in 1997.

1. orbit	*n.*	轨道
2. pattern	*n.*	模式
3. spacecraft	*n.*	航天器
4. partially	*adv.*	部分地
5. customary	*adj.*	习惯上的
6. off course		偏离航向
7. probe	*n.*	探索
8. project	*n.*	科研项目
9. Pathfinder		火星探路者号
10. rover	*n.*	天体登陆车
11. Sojourner		旅居者号
12. explore	*v.*	考察

A Weighty Problem

In his work at NASA, Juan has to deal with two different properties[1] of matter—weight and mass[2]. Mass is a measure of how much matter an object contains[3]. For example, suppose your mass is 27 kilograms (about 59 pounds). That's your mass whether you are standing in your kitchen or floating in space.

Weight is a measure of how strongly gravity[4] pulls on matter. Gravity is a force that pulls any two objects together. The greater the mass, the greater the gravity. Earth has a lot of mass. So it pulls on you enough to keep you "grounded."

1. property	*n.*	属性
2. mass	*n.*	质量
3. contain	*v.*	包含
4. gravity	*n.*	重力；万有引力

Astronaut Mae Jemison floats in microgravity.

When the force of gravity is less, matter weighs less. The moon has only 1/6 the gravity of Earth. So objects weigh 1/6 as much on the moon as they do on Earth. That's why astronauts who went to the moon were able to bounce[1] and jump easily along its surface.

Measuring Mass

Earth's gravity holds the ISS in orbit. But the force of the gravity that the astronauts feel is very low. This extremely[2] low level of gravity is called microgravity[3]. Astronauts in microgravity feel as if they have no weight. Therefore, they float around the space station with ease.

Because of microgravity, it would be useless to measure weight in experiments on the space station. Instead, astronauts measure mass. They do this using a special balance[4] that vibrates[5] the object being measured. An object with greater mass will vibrate more slowly than an object with less mass.

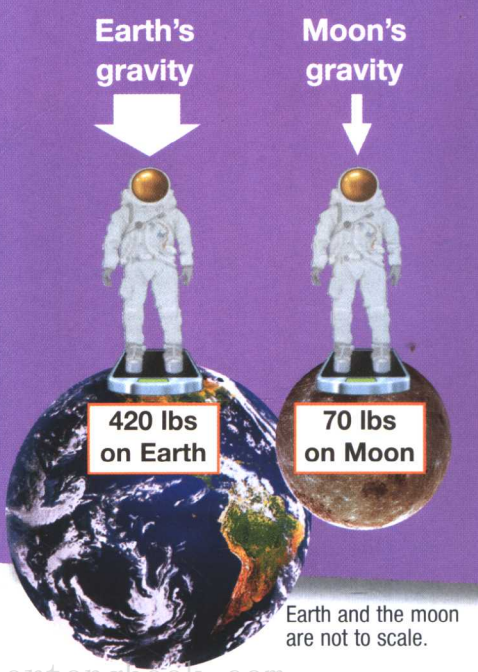
1. bounce	*v.*	跳
2. extremely	*adv.*	非常
3. microgravity	*n.*	微重力
4. balance	*n.*	天平
5. vibrate	*v.*	振动
6. divide	*v.*	除

Figuring It Out!

Did you know that a NASA space suit with a backpack weighs about 260 pounds? When this spacesuit is worn by a 160-pound astronaut, the total weight of the astronaut increases to 420 pounds! That's a pretty heavy load to move around in Earth's gravity—but it's not so bad on the moon.

Remember that the moon has 1/6 the gravity of Earth, so objects weigh only 1/6 as much on the moon as they do on Earth. To find the astronaut's weight on the moon, just divide[6] the weight by 6.

420 lb ÷ 6 = 70 lb



Earth and the moon are not to scale.