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英文注释

MATH BEHIND THE SCIENCE

科学背后的数学

Crunching Numbers

咀嚼数字

REBECCA L. JOHNSON (美) 著

外语教学与研究出版社

FOREIGN LANGUAGE TEACHING AND RESEARCH PRESS

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这套丛书秉承《国家地理》杂志图文并茂的特色，在书中配有大量精彩的图片，文字地道易懂、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全书。特别值得一提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。

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TABLE OF CONTENTS

目 录

Introduction5

引言

Numbers that Boggle the Mind

让人头大的数字

Estimating7

估算

Millions of Monarchs

无数的黑脉金斑蝶

Spreadsheets13

空白表格程序

Simple Cells

单细胞生物

Computers17

计算机

The Ultimate Number Crunchers

最大的数字处理工具

Math Mentor20

数学顾问

Words Count!

词汇的作用！

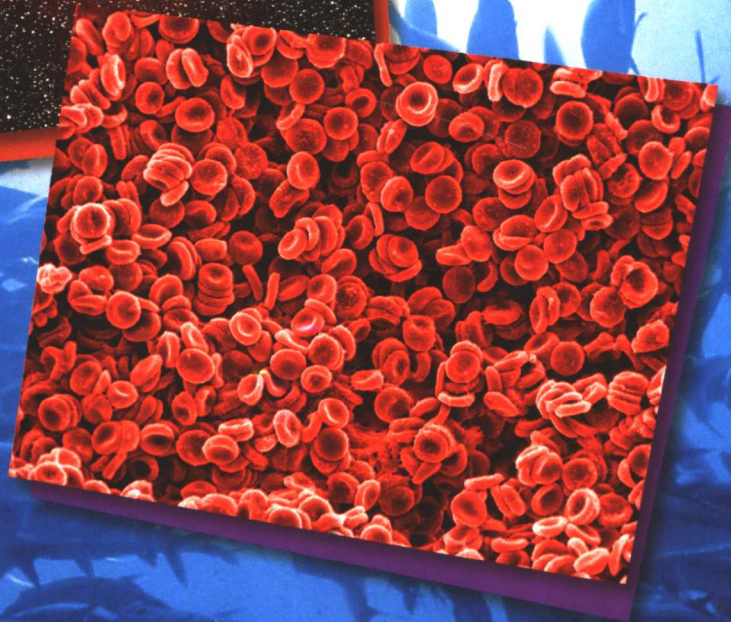
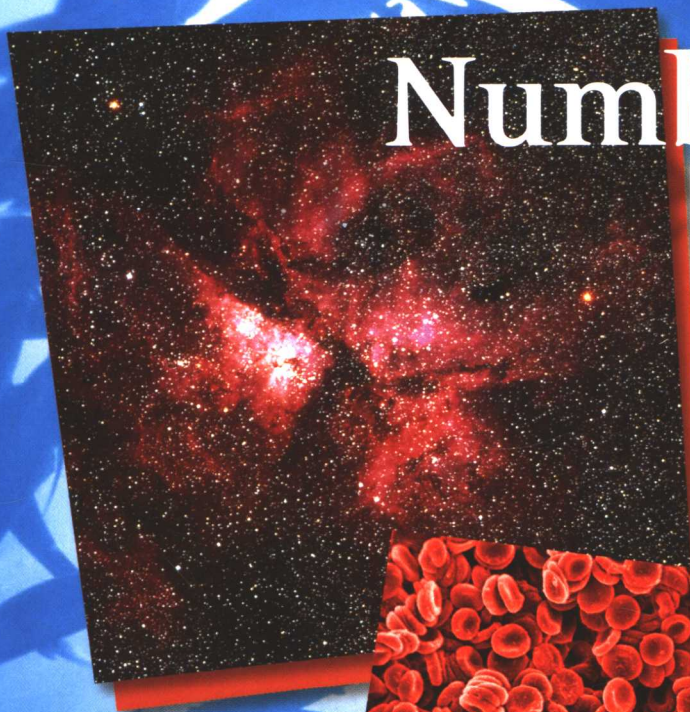
Math Notebook22

数学备忘录

Index23

索引

Numbers that



Boggle the Mind

让人头大的数字

Have you ever looked at the stars and wondered how many are out there in the sky? Astronomers¹ say that there are billions² of galaxies³. Each galaxy contains⁴ billions of stars.

Our lives are full of numbers. Some are easy. How many months are there until your next birthday? Some numbers are so huge they boggle the mind. How many cells are in your body? How many fish are in the ocean?

In science class you'll see a lot of big numbers. But you'll also discover some tricks⁵ and tools that make working with those numbers easier. These "number crunchers" range⁶ from simple math strategies⁷ to the world's most powerful computers. Want some actual⁸ experience with number crunching? Several scientists are doing some major⁹ number crunching as they e-mail one another from the field. Let's take a look and discover the math behind the science.

- | | | | | | |
|---------------|-----------|--------|-------------|-------------|-------------|
| 1. astronomer | <i>n.</i> | 天文学家 | 6. range | <i>v.</i> | (在一定范围内) 变动 |
| 2. billion | <i>n.</i> | 大量; 无数 | 7. strategy | <i>n.</i> | 对策 |
| 3. galaxy | <i>n.</i> | 星系 | 8. actual | <i>adj.</i> | 实际的 |
| 4. contain | <i>v.</i> | 包含 | 9. major | <i>adj.</i> | 较重要的; 主要的 |
| 5. trick | <i>n.</i> | 技巧; 窍门 | | | |

E-mail from the Field

Subject: Butterfly Heaven

From: j.kinsman@ndsu.edu

To: a.christopoulos@biotek.com, ismet.mesan@ncep.noaa.gov

Hello from the mountains of central Mexico! Everything here is COVERED with orange and black monarch butterflies. Counting them is a challenge. There are millions here. By getting a handle on² their numbers, we can predict³ how many will fly back to the United States this spring.

Drop me an e-mail when you get a chance, and tell me what you're up to.

Your insect-loving⁴ friend,

Jake



- | | |
|--------------------|------------|
| 1. Mexico | 墨西哥 |
| 2. get a handle on | 掌握 |
| 3. predict | v. 预料; 预计 |
| 4. insect-loving | adj. 热爱昆虫的 |

Millions of Monarchs

无数的黑脉金斑蝶

You've probably seen monarch butterflies in the summertime, flitting¹ from flower to flower. But did you know that monarchs are long-distance travelers?

At the end of summer, millions of monarchs in the United States and Canada head² south. They migrate³ thousands of miles to a mountain range⁴ in Mexico where they spend the winter. In spring, they fly back north.

Jake is studying this marvelous⁵ movement. By counting the butterflies in their wintering grounds, he can figure out how the size of the monarch population⁶ changes from year to year. But counting millions of insects takes some serious number crunching.

1. flit	v.	轻快地飞
2. head	v.	朝特定方向行进
3. migrate	v.	迁徙
4. mountain range		山脉
5. marvelous	adj.	令人惊奇的
6. population	n.	种群

Around and About

Obviously¹ Jake can't count every monarch. Instead he counts the number of monarchs in a small space. By doing this, he gets a sample² of the population. Using the sample, he can then estimate how many monarchs there are in a larger area. To estimate means to come

close to a correct answer. Estimating is an important number-crunching strategy in math.

For example, Jake counts 278 monarchs covering a single tree branch. The tree has 14 similar branches also covered with more monarchs. To estimate the number of monarchs in the tree, Jake

- | | |
|--------------|-------------|
| 1. obviously | <i>adv.</i> |
| 2. sample | <i>n.</i> |

显然
样本



multiplies¹ 278 by 14 to get 3,892.

A Handy² Tool

Jake uses a calculator³ to help him multiply quickly as he's counting monarchs. Calculators are one of the simplest number-crunching tools. You can do math quickly with just the touch of a button.

Handy as they are, calculators are no substitute⁴ for thinking or



learning how to add, subtract⁵, multiply, and divide⁶. These are basic math skills that everyone needs to know. Suppose you used your calculator to multiply 278 by 14 and got 19.86. The powerful “calculator” in your head—your brain—should tell you that the answer isn't right!

- | | | |
|---------------|------|-----|
| 1. multiply | v. | 乘 |
| 2. handy | adj. | 方便的 |
| 3. calculator | n. | 计算器 |
| 4. substitute | n. | 代替物 |
| 5. subtract | v. | 做减法 |
| 6. divide | v. | 做除法 |



Keep It Simple

Jake's estimates are just the beginning. His goal is to figure out about how many monarchs there are per square kilometer. He knows that in this part of the forest, each square kilometer contains about 50 trees.

Jake could multiply 50 trees by 3,892 monarchs per tree to come up with the number of monarchs in one square kilometer. But to make the calculation simpler, he decides to round¹ the number of monarchs per tree.

Rounding is a type of estimating. It makes big numbers easier to crunch, either in your head or with a tool like a calculator.

Up or Down?

Jake decides he wants to round his estimate of the number of monarchs per tree to the nearest 1,000. The 3 in 3,892 becomes his rounding digit². Next he looks at the number to the right of the 3, which is 8. Since 8 is greater than 5, he rounds up to 4,000.

- | | | |
|----------------|----|----------|
| 1. round | v. | 把(数)四舍五入 |
| 2. digit | n. | 数字; 数位 |
| 3. breeze | n. | 轻而易举的事 |
| 4. place value | | 位值 |

Now Jake's calculation is easy:

$50 \times 4,000 = 200,000$. So there are about 200,000 monarchs per square kilometer. That's a lot of butterflies!

Estimating and rounding make it easier to work with lots of big numbers. And, if Jake's calculator stops working, doing the calculations with a pencil and some paper will be a breeze³!

Rounding Whole Numbers: As Easy as 1, 2, 3!

1. Select the rounding digit (the place value⁴ to which you want to round).
2. If the number to the right of the rounding digit is less than 5, change it and all other digits to the right to zeros.
3. If the number to the right of the rounding digit is 5 or greater, first add 1 to the rounding digit, then change all digits to the right of the rounding digit to zeros.



Figuring It Out!

What if Jake's estimate for the number of monarchs per tree had been 3,242 instead of 3,892? Can you follow the steps to round 3,242 to the nearest thousand?

- The rounding digit is still 3.

3,242

- The number to the right of 3 is now 2.

3,242

- Since 2 is less than 5, you simply change all the digits to the right of the rounding digit (2, 4, and 2) to zeros.

3,242 → 3,000

You rounded down to 3,000.

E-mail from the Field

Subject: Seeing Double

From: a.christopoulos@biotek.com

To: j.kinsman@ndsu.edu, ismet.mesan@ncep.noaa.gov

Wow! That's a lot of butterflies, Jake. I'm also counting creatures¹ at the moment. But mine are too small to see with just my eyes. I'm using a microscope² to count bacteria³. It's a weird⁴ new species⁵ that my research team and I just brought back from Greenland⁶.

Part of my challenge is to grow lots of these bacteria in the lab. We're going to study them in different experiments. When they're cold, they divide⁷ very slowly. But I've discovered that if I raise the temperature, I can really speed up their doubling time!

Hey, Ismet, what are you up to?

Cheers,

Angela



- | | | |
|---------------|-------------|----------------------------|
| 1. creature | <i>n.</i> | 生物 |
| 2. microscope | <i>n.</i> | 显微镜 |
| 3. bacterium | <i>n.</i> | (<i>pl. bacteria</i>) 细菌 |
| 4. weird | <i>adj.</i> | 奇怪的; 奇特的 |
| 5. species | <i>n.</i> | 物种 |
| 6. Greenland | | 格陵兰 |
| 7. divide | <i>v.</i> | 分裂 |

Simple Cells

单细胞生物

Bacteria are some of the simplest forms of life on Earth. Each is just a single cell in size. Bacteria are everywhere. Some live in soil, others in water. There are bacteria on your skin and inside your stomach. A few kinds of bacteria can cause disease¹. But most are harmless and can even be helpful.

Most bacteria reproduce² by splitting³ in half. Where there was one, suddenly there are two. Those two become four, then eight, and so on. The population doubles every time the bacteria divide.

For her experiments, Angela needs to quickly grow millions of the Greenland bacteria. A number-crunching tool is helping her figure out the best way to complete this task.

- | | | |
|--------------|-----------|----|
| 1. disease | <i>n.</i> | 疾病 |
| 2. reproduce | <i>v.</i> | 繁殖 |
| 3. split | <i>v.</i> | 裂开 |

Cells of a Different Sort

The tool that Angela is using is a computer spreadsheet. You've probably seen paper spreadsheets, like a teacher's grade book or a table that shows the batting averages¹ of baseball players. More complex² spreadsheets can be created with computers.

A computer spreadsheet is a table of

Here's a close look at a bacterium, *Clostridium botulinum*⁸ (about 100,000× actual size), that's similar to the one Angela is researching.

numbers arranged in rows³ and columns⁴. Each number sits in a box, or cell⁵, in the table. Users link each cell to other cells by putting in the mathematical formulas⁶. But you can't see the formulas. The formulas tell the computer to carry out certain calculations. Because the cells in a spreadsheet are linked, if you change a number in one cell, numbers in other cells will change, too.

In her research Angela discovered that the Greenland bacteria divided faster at warmer temperatures. Using this information, Angela came up with a mathematical equation⁷ that linked temperature to the time it took the dividing bacteria to reach a population of one million. Then she created a computer spreadsheet that looked like the one below.

- | | | |
|--------------------------|------|-----------|
| 1. batting average | | (棒球) 击球率 |
| 2. complex | adj. | 复杂的 |
| 3. row | n. | 一行 |
| 4. column | n. | 列 |
| 5. cell | n. | 单元 |
| 6. formula | n. | 数学公式; 方程式 |
| 7. equation | n. | 数学等式; 方程式 |
| 8. Clostridium botulinum | | 肉毒梭状芽孢杆菌 |

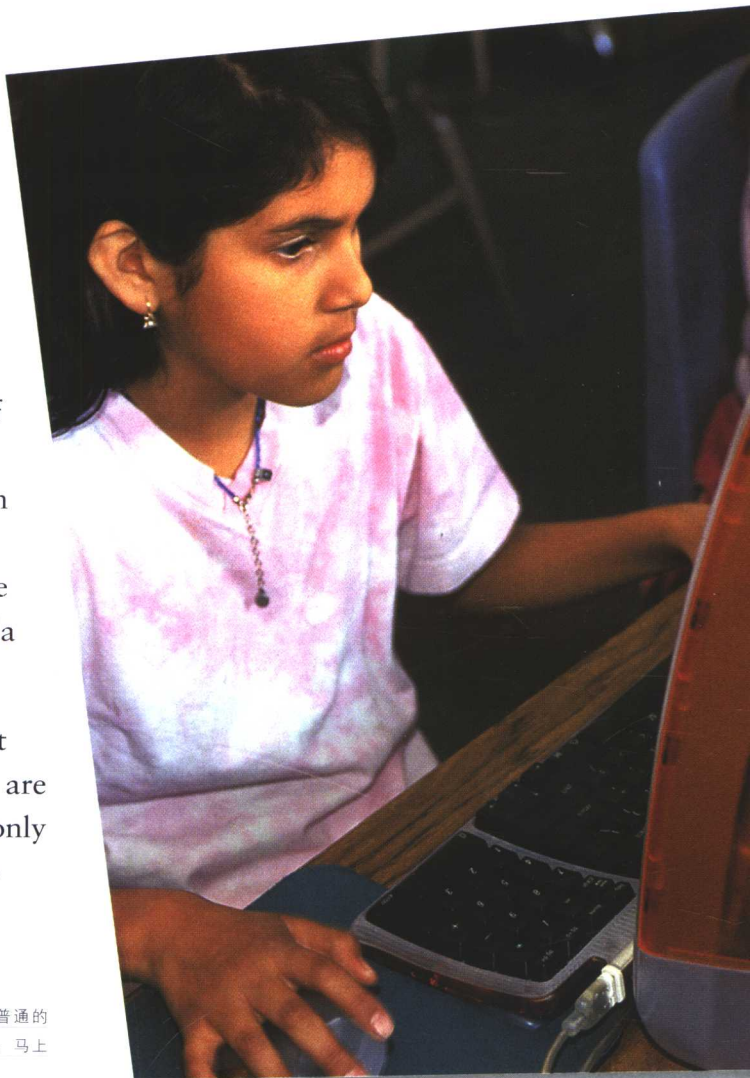
Greenland Bacteria Test 1				
	A	B	C	D
1		Temperature (in °C)	Dividing time (in minutes)	Time needed to produce 1 million bacteria (in hours)
2	Trial 1	5	60	20
3	Trial 2	10	42	14
4	Trial 3	15	35	12

What if . . . ?

How is a spreadsheet different from an ordinary¹ table?

Because of the equations that link the cells, a spreadsheet is great for answering “What if . . . ?” questions. Angela wondered how long it would take to get one million bacteria if they were grown at 13°C. So she changed the number in one cell in the temperature column to 13°C. The spreadsheet instantly² did the necessary calculations, and Angela had her answer: 13 hours.

Like calculators, spreadsheets can't think for themselves. Spreadsheets are very powerful tools. But they are only as good as the math that goes into creating them.



1. ordinary *adj.* 普通的
2. instantly *adv.* 立即；马上

Greenland Bacteria Test 2				
	A	B	C	D
1		Temperature (in °C)	Dividing time (in minutes)	Time needed to produce 1 million bacteria (in hours)
2	Trial 1	5	60	20
3	Trial 2	10	42	14
4	Trial 3	13	39.5	13