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# Sizing Up Shapes 方圆之间

REBECCA L. JOHNSON (美) 著

外语教学与研究出版社

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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。

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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北京 BEIJING



京权图字：01-2005-2588

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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外语教学与研究出版社在中华人民共和国境内(不包括香港、澳门特别行政区及台湾省)独家出版、发行。

## 图书在版编目(CIP)数据

方圆之间 = Sizing Up Shapes/(美)约翰逊  
(Johnson, R. L.)著. —北京:外语教学与研究出版社, 2005.3

(国家地理科学探索丛书; 注释版. 科学背  
后的数学)

ISBN 7-5600-4724-6

I. 方… II. 约… III. 英语—语言读物  
IV. H319.4

中国版本图书馆 CIP 数据核字 (2005)  
第 020474 号

出 版 人: 李朋义

责任编辑: 周 晶

美术编辑: 孙莉明

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: 北京画中画印刷有限公司

开 本: 740×975 1/16

印 张: 1.5

版 次: 2005 年 6 月第 1 版

2005 年 6 月第 1 次印刷

书 号: ISBN 7-5600-4724-6

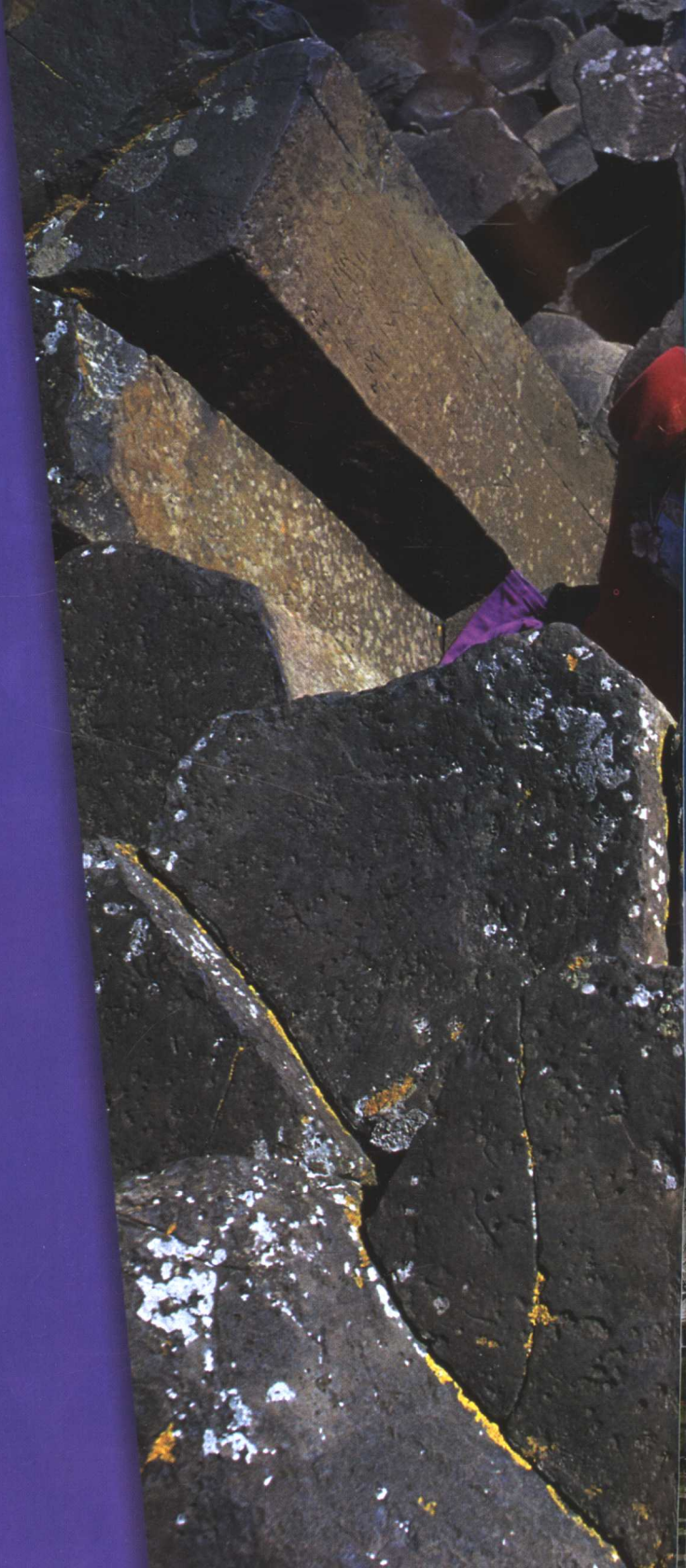
定 价: 5.90 元

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1. triangle	<i>n.</i>	三角形
2. spiral	<i>adj.</i>	螺旋的；螺旋的
3. building block		基础材料
4. combine	<i>v.</i>	结合；组合
5. complex	<i>adj.</i>	复杂的
6. pattern	<i>n.</i>	形状
7. structure	<i>n.</i>	结构
8. rocket	<i>n.</i>	火箭
9. dinosaur	<i>n.</i>	恐龙
10. skeleton	<i>n.</i>	骨骼
11. smart	<i>adj.</i>	聪明的；高明的
12. measure	<i>v.</i>	测量



# Shapes Are Everywhere

## 形状无处不在

The world is full of shapes. Circles, squares, triangles<sup>1</sup>—and every shape in between. What shapes do you see in a leaf? How about in a snail's spiral<sup>2</sup> shell? What other shapes do you see around you?



**S**imple shapes are like building blocks<sup>3</sup>. They can be combined<sup>4</sup> to make complex<sup>5</sup> patterns<sup>6</sup> and structures<sup>7</sup>. Shapes play a big role in science. Can you imagine designing a rocket<sup>8</sup> or putting together a dinosaur<sup>9</sup> skeleton<sup>10</sup> without knowing something about shapes? When it comes to being smart<sup>11</sup> about shapes, math is key. Using math, you can measure<sup>12</sup> and compare shapes. You can put them to work, too!

Sizing up shapes can be a lot of fun. And the best way to join the fun is to see shapes in action. That's what some scientists are doing right now as they e-mail one another from the field. Let's take a look.

(注释见第4页)





### E-mail from the Field

**Subject:** It's a Long Way Down

**From:** [t.juarez@peacecorps.org](mailto:t.juarez@peacecorps.org)

**To:** [weatherhill@holyokey.edu](mailto:weatherhill@holyokey.edu), [z.lu@mobot.org](mailto:z.lu@mobot.org)

Hi guys,

*Hola* from Honduras<sup>1</sup>! We're building a bridge across a wild river here in the mountains. The river's at the bottom of a deep gorge<sup>2</sup>. There's a huge drop just behind our camp. Talk about living on the edge!

At the moment we're welding<sup>3</sup> together the bridge's steel supports. They have to be strong to stand up under heavy trucks and herds<sup>4</sup> of cattle.

Remember back in science class when we built bridges out of toothpicks? Who would have guessed that I'd be building the real thing!

Toni



# Strong Support

## 有力的支撑

Toni knows that building bridges is a challenge, especially in remote<sup>5</sup> places. The bridge has to be strong enough to support a lot of weight. But it also has to be made with materials<sup>6</sup> that are light enough to be hauled<sup>7</sup> up steep<sup>8</sup> mountain slopes<sup>9</sup>.

Toni's bridge will be like the one in the picture. See any familiar shapes? That's right—triangles! This bridge is made of large frameworks<sup>10</sup> of steel, called trusses<sup>11</sup>, arranged in a pattern of triangles. A bridge with such a truss system is fairly lightweight. But it can support very heavy loads. All because of the simple triangle. What makes this shape so special? How do other shapes stack up<sup>12</sup>?

- |               |             |           |
|---------------|-------------|-----------|
| 1. Honduras   |             | 洪都拉斯      |
| 2. gorge      | <i>n.</i>   | 峡谷        |
| 3. weld       | <i>v.</i>   | 焊接        |
| 4. herd       | <i>n.</i>   | 牧群 (尤指牛群) |
| 5. remote     | <i>adj.</i> | 偏僻的       |
| 6. material   | <i>n.</i>   | 材料        |
| 7. haul       | <i>v.</i>   | (用力) 拖, 拉 |
| 8. steep      | <i>adj.</i> | 陡峭的       |
| 9. slope      | <i>n.</i>   | 斜坡        |
| 10. framework | <i>n.</i>   | 构架        |
| 11. truss     | <i>n.</i>   | 桁架; 托臂    |
| 12. stack up  |             | 情况如何      |



## Starting Simple

A triangle is the simplest polygon. A polygon is a many-sided shape with sides that are straight line segments<sup>1</sup>. Different kinds of polygons have different numbers of sides. A square is a polygon with four sides that are all equal in length.

## A Test of Strength

You might think a square is a pretty strong shape. After all, the sides of many buildings are squares. Okay, let's put it to the test.

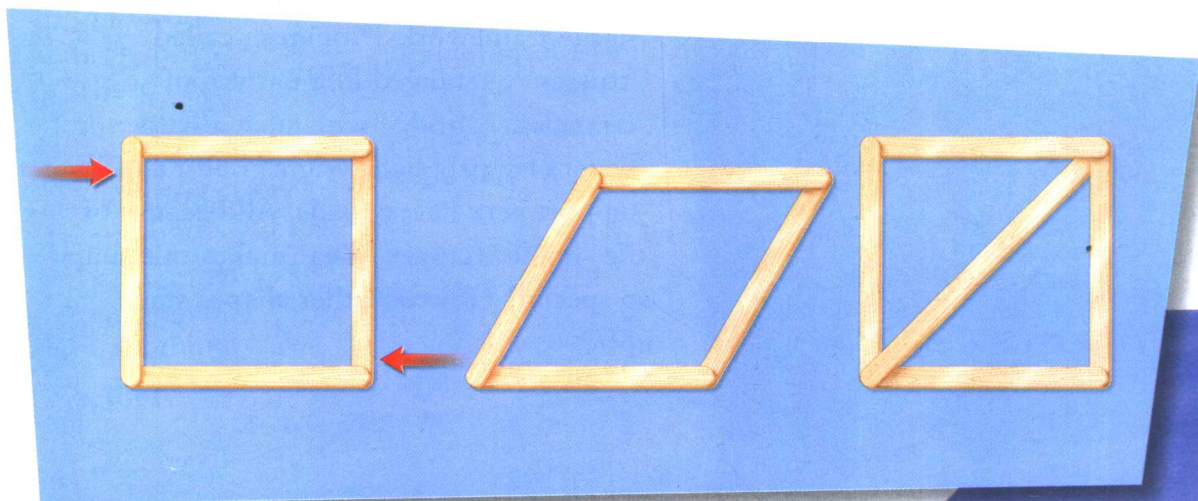
Suppose you make a square from craft sticks<sup>2</sup> that you glue together at the ends. Let the glue dry. Then you can toss<sup>3</sup> the square in the air and let it land flat on the ground without breaking. Strong shape, right? But what happens when you push on the two

sides of the square as shown below? It doesn't take much force to make the square lose its shape.

How can you make the square stronger? One way is to add a brace<sup>4</sup> diagonally<sup>5</sup> between two of the corners. That makes the square rigid<sup>6</sup>. Now it won't change shape easily. By the way, do you see what the brace makes? Right, two triangles!

Architects<sup>7</sup>, engineers, and builders know all about strong shapes. That's why if you remove<sup>8</sup> the bricks or wallboard from a wall, you'll see a lot of triangles formed by braces and other parts.

- |                 |      |                |
|-----------------|------|----------------|
| 1. line segment |      | 线段             |
| 2. craft stick  |      | (此处指) 做手工用的小木棍 |
| 3. toss         | v.   | 扔; 抛           |
| 4. brace        | n.   | (斜) 撑柱; 拉条     |
| 5. diagonally   | adv. | 对角线地           |
| 6. rigid        | adj. | 坚固的            |
| 7. architect    | n.   | 建筑师            |
| 8. remove       | v.   | 移开; 拿去         |



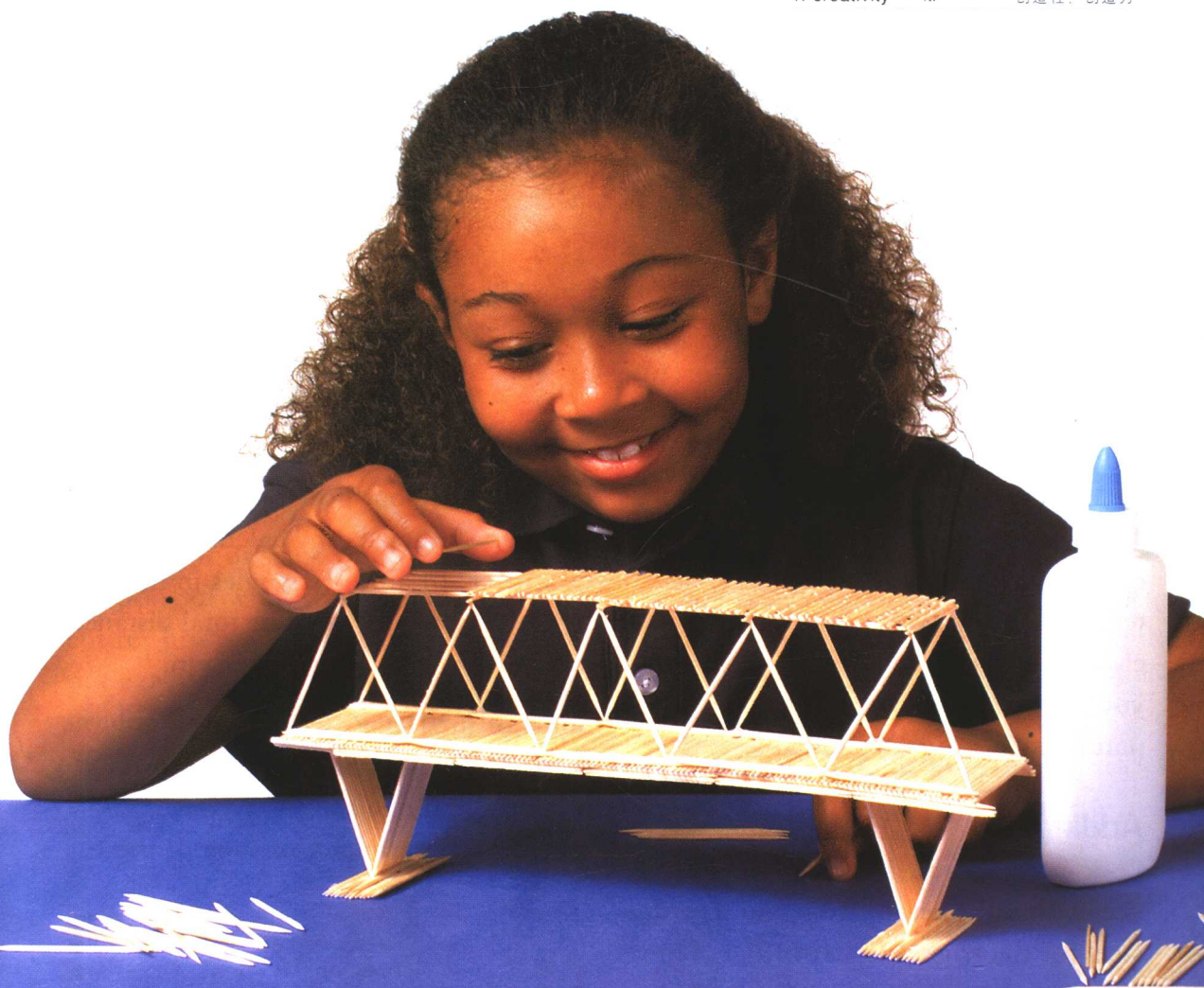


## Toothpick Bridges

Would you walk across a bridge made of toothpicks? That wouldn't be a good idea. Those materials just aren't strong enough to support a lot of weight over time. But you'd be surprised how strong a toothpick model of a bridge can be—if it uses the right shapes.

Some students used their creativity<sup>1</sup> and knowledge about shapes to build bridges made of toothpicks. These young engineers came up with some interesting designs—strong ones, too. Some bridges held over 100 kilograms (about 220 pounds)!

1. creativity *n.* 创造性; 创造力





## Find the Triangles

Triangles pop up in all sorts of places—even in nature. Check out the terrifying<sup>1</sup> teeth of a great white shark<sup>2</sup>! Where else have you seen triangles? Why do you think they are so common both in nature and in objects made by people?

## Adding Up

Back in Honduras, Toni's bridge is taking shape. Months before, Toni had to order steel for the trusses in her bridge. How

did she figure out how much steel she needed? She started by calculating<sup>3</sup> the perimeter<sup>4</sup> of all the triangles in the bridge. The perimeter is the total distance around the outside of a polygon.

Some of the largest triangles in the trusses had two sides that measured 6 meters and one side that measured 3 meters. The perimeter of each of these

- |                      |             |
|----------------------|-------------|
| 1. terrifying        | <i>adj.</i> |
| 2. great white shark |             |
| 3. calculate         | <i>v.</i>   |
| 4. perimeter         | <i>n.</i>   |

可怕的  
大白鲨  
计算  
周长





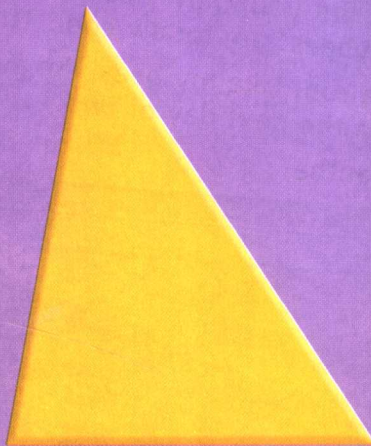
triangles is  $6\text{ m} + 6\text{ m} + 3\text{ m} = 15\text{ m}$

That's a lot of steel. But it was only a fraction<sup>1</sup> of what was needed for the entire<sup>2</sup> bridge. Math helped Toni figure out exactly<sup>3</sup> how much steel she needed. Getting it up the side of the mountain, however, was another challenge altogether!

- |             |             |         |
|-------------|-------------|---------|
| 1. fraction | <i>n.</i>   | 一部分；小部分 |
| 2. entire   | <i>adj.</i> | 整个的     |
| 3. exactly  | <i>adv.</i> | 精确地；确切地 |

## Figuring It Out!

Can you figure out the perimeter of the triangle shown below?



Here's how:

1. First, find the length of each side (5 cm, 6 cm, and 7 cm).
2. Then add the lengths of the three sides together.  
 $5\text{cm} + 6\text{cm} + 7\text{cm} = 18\text{ cm}$
3. The perimeter of the triangle is 18 centimeters.



# E-mail from the Field

**Subject:** The Buzz<sup>1</sup> from Africa<sup>2</sup>

**From:** [weatherhill@holyokey.edu](mailto:weatherhill@holyokey.edu)

**To:** [z.lu@mobot.org](mailto:z.lu@mobot.org), [t.juarez@peacecorps.org](mailto:t.juarez@peacecorps.org)

Nice to hear from you, Toni. All I can say is "Don't look down!" I'm in Zimbabwe<sup>3</sup> studying some of the most interesting critters<sup>4</sup> around—bees! I know that may not sound as exciting as tracking<sup>5</sup> lions. But you know how much I love insects<sup>6</sup>. And these African honeybees<sup>7</sup> are totally cool. They build the most amazing<sup>8</sup> hives<sup>9</sup>! Gotta run. Like my bees, I'm awfully<sup>10</sup> busy. Hope to hear from Zhi in the next day or two.

Samantha



- |             |             |          |
|-------------|-------------|----------|
| 1. buzz     | <i>n.</i>   | (蜂的) 嗡嗡声 |
| 2. Africa   |             | 非洲       |
| 3. Zimbabwe |             | 津巴布韦     |
| 4. critter  | <i>n.</i>   | 生物       |
| 5. track    | <i>v.</i>   | 跟踪, 追踪   |
| 6. insect   | <i>n.</i>   | 昆虫       |
| 7. honeybee | <i>n.</i>   | 蜜蜂       |
| 8. amazing  | <i>adj.</i> | 令人吃惊的    |
| 9. hive     | <i>n.</i>   | 蜂巢       |
| 10. awfully | <i>adv.</i> | 非常       |



# Sweet Shapes

## 甜蜜的形状

**H**oneybees are social<sup>1</sup> insects. They live together in large groups called colonies<sup>2</sup>. All the members of a honeybee colony work together to find food. They also build a home called a hive.

Inside the hive are big slabs<sup>3</sup> of honeycomb<sup>4</sup>, or comb<sup>5</sup>. The combs are built out of wax<sup>6</sup> that the honeybees make. If you look at a honeycomb carefully, you can see that it's made of hundreds of little cells<sup>7</sup>. Honeybees begin their lives in these little cells. Nearly all the bees in a hive are workers<sup>8</sup>. They each hatch<sup>9</sup> from an egg that the queen bee<sup>10</sup> laid at the bottom of a cell. Most of the cells that aren't being used for raising new bees are packed with sweet, sticky honey.

- |               |            |         |
|---------------|------------|---------|
| 1. social     | <i>adj</i> | 群居的     |
| 2. colony     | <i>n.</i>  | (生物) 群体 |
| 3. slab       | <i>n.</i>  | 厚板状物    |
| 4. honeycomb  | <i>n.</i>  | 蜜蜂巢     |
| 5. comb       | <i>n.</i>  | 蜂巢      |
| 6. wax        | <i>n.</i>  | 蜂蜡      |
| 7. cell       | <i>n.</i>  | 蜂房巢室    |
| 8. worker     | <i>n.</i>  | 工蜂      |
| 9. hatch      | <i>v.</i>  | 孵出      |
| 10. queen bee |            | 蜂王、后蜂   |





Bee larva<sup>11</sup>

The entrance<sup>1</sup> to each cell has a certain shape. It's a hexagon. That's a polygon with six sides. Bees aren't the only builders that use hexagons. Tiny radiolarians<sup>2</sup> drift<sup>3</sup> through the oceans by the billions<sup>4</sup>. The shells of some of these creatures<sup>5</sup> are filled with hexagon-shaped holes.

### Exactly the Same? . . .

Samantha is traveling around the countryside studying wild African honeybees. She takes very careful measurements at each hive she finds.

From measuring the sizes of the cells that make up the combs, she has found that bees are incredibly<sup>6</sup> precise<sup>7</sup> in their construction<sup>8</sup> techniques<sup>9</sup>.

For example, Samantha has found that most of the cells in the combs are 4.5 millimeters (about 0.18 inch) wide. There are hundreds of these little hexagons, all the same size. In other words, the hexagons are congruent<sup>10</sup>. Polygons are congruent if they are exactly the same size and shape, with equal sides and angles.

1. entrance *n.*
2. radiolarian *n.*
3. drift *v.*

- 入口
- 放射虫
- 漂流

4. billion *n.*
5. creature *n.*
6. incredibly *adv.*
7. precise *adj.*

- 大量；无数
- 生物
- 难以置信地
- 精确的

8. construction *n.*
9. technique *n.*
10. congruent *adj.*
11. larva *n.*

- 建造；构筑
- 技巧；技术
- 全等的
- 幼虫



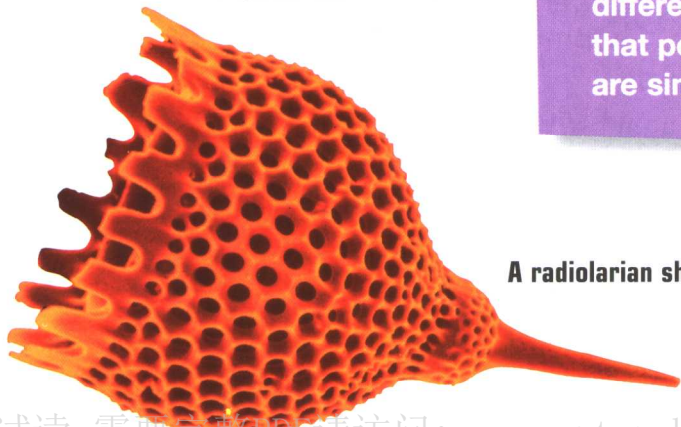
## ... or Just Similar?

But along with the small cells are some larger ones. These cells are 5.5 millimeters (about 0.22 inch) wide. Why the difference? Drones<sup>1</sup>, or male<sup>2</sup> bees, are larger than worker bees and are raised in these larger cells.

So how do these two types of cells compare? Both are hexagons, because they have six sides. But these hexagons are not congruent, because they are not exactly the same size. Instead, they are similar. Polygons that are similar have the same shape, but they may be different sizes.

In her research, Samantha has discovered some interesting things about shapes. Math has helped her figure out how hexagons are alike—and different—deep inside a honeybee's "home sweet home."

- |             |             |     |
|-------------|-------------|-----|
| 1. drone    | <i>n.</i>   | 雄蜂  |
| 2. male     | <i>adj.</i> | 雄的  |
| 3. pentagon | <i>n.</i>   | 五边形 |
| 4. actual   | <i>adj.</i> | 实际的 |



A radiolarian shell (390× actual<sup>4</sup> size)

## Figuring It Out!

A pentagon<sup>3</sup> is a polygon with five sides. Look at the three pentagons below. Can you figure out which are congruent and which are just similar?



Pentagon A



Pentagon B



Pentagon C

1. Remember, to be congruent, polygons must have exactly the same shape and size. That means that only pentagons B and C are congruent.
2. Similar polygons are the same shape, but they can be different sizes. That means that pentagons A, B, and C are similar.