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MATH BEHIND THE SCIENCE

科学背后的数学

# Thinking It Through 思前想后

KATE BOEHM JEROME (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。

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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# Think About It

## 想想看

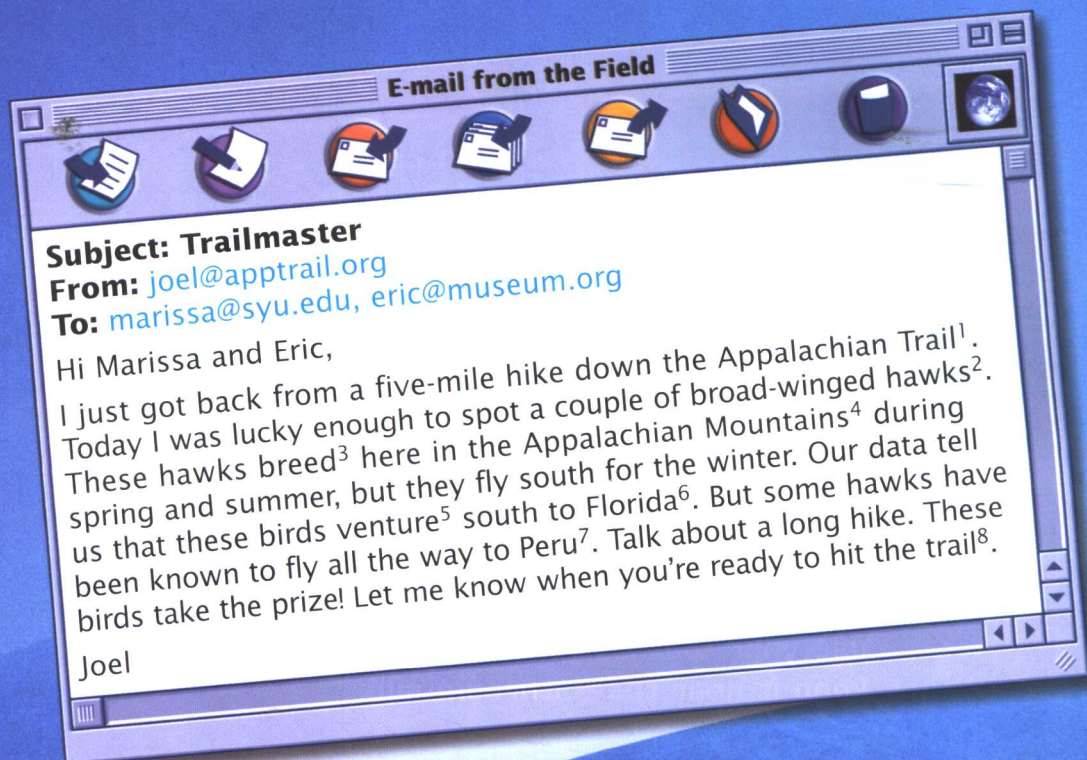
What if you were told to store your toothbrush in your closet? You'd probably say, "That doesn't make sense." And of course, you'd be right. You use your toothbrush every day, so it's logical<sup>1</sup> to keep it near the bathroom sink<sup>2</sup>.

**R**easoning and logical thinking may sound like hard skills to learn, but you practice them all the time. Have you ever figured out the best route<sup>3</sup> between two points? Have you ever built a model? Solving common problems helps you practice reasoning and logical thinking skills every day.

Scientists use reasoning and logical thinking to solve math and science problems. They use these skills when conducting<sup>4</sup> experiments and sorting through data<sup>5</sup> in an organized way. Reasoning and logical thinking also help scientists predict<sup>6</sup> and interpret<sup>7</sup> their results. In fact, there are scientists e-mailing from the field right now. Look and see if you can follow the logic behind their labors<sup>8</sup>.

- |              |             |                            |
|--------------|-------------|----------------------------|
| 1. logical   | <i>adj.</i> | 符合逻辑的                      |
| 2. sink      | <i>n.</i>   | 洗澡槽                        |
| 3. route     | <i>n.</i>   | 路线                         |
| 4. conduct   | <i>v.</i>   | 进行                         |
| 5. datum     | <i>n.</i>   | ( <i>pl. data</i> ) 资料; 数据 |
| 6. predict   | <i>v.</i>   | 预料; 预计                     |
| 7. interpret | <i>v.</i>   | 解释                         |
| 8. labor     | <i>n.</i>   | 工作                         |





**Subject: Trailmaster**

**From:** joel@apptrail.org

**To:** marissa@syu.edu, eric@museum.org

Hi Marissa and Eric,

I just got back from a five-mile hike down the Appalachian Trail<sup>1</sup>. Today I was lucky enough to spot a couple of broad-winged hawks<sup>2</sup>. These hawks breed<sup>3</sup> here in the Appalachian Mountains<sup>4</sup> during spring and summer, but they fly south for the winter. Our data tell us that these birds venture<sup>5</sup> south to Florida<sup>6</sup>. But some hawks have been known to fly all the way to Peru<sup>7</sup>. Talk about a long hike. These birds take the prize! Let me know when you're ready to hit the trail<sup>8</sup>.

Joel



- |                          |         |
|--------------------------|---------|
| 1. Appalachian Trail     | 阿巴拉契亚山径 |
| 2. broad-winged hawk     | 巨翅鸢     |
| 3. breed                 | 繁殖      |
| 4. Appalachian Mountains | 阿巴拉契亚山脉 |
| 5. venture               | 冒险前进    |
| 6. Florida               | 佛罗里达州   |
| 7. Peru                  | 秘鲁      |
| 8. hit the trail         | 出发      |



# Tracking the Trail

## 沿着山径探索

Joel is an ecologist<sup>1</sup>, a scientist who studies living things in their natural surroundings<sup>2</sup>. He works on one of the most beautiful nature trails in the world—the Appalachian Trail.

The Appalachian Trail is a marked trail that stretches<sup>3</sup> along the East Coast of the United States. It runs through the Appalachian Mountains from Katahdin, Maine<sup>4</sup>, to Springer Mountain<sup>5</sup>, Georgia<sup>6</sup>—a distance of more than 3,300 kilometers (about 2,051 miles).

Joel lives near the southern end of the trail and studies plants and animals. He gathers data about species<sup>7</sup> and their habitats<sup>8</sup>. With so much information, Joel has to think about organizing his data in logical ways.

- |                      |           |         |
|----------------------|-----------|---------|
| 1. ecologist         | <i>n.</i> | 生态学家    |
| 2. surrounding       | <i>n.</i> | [~s] 环境 |
| 3. stretch           | <i>v.</i> | 延伸      |
| 4. Maine             |           | 缅因州     |
| 5. Springer Mountain |           | 斯普林格山   |
| 6. Georgia           |           | 佐治亚州    |
| 7. species           | <i>n.</i> | 物种      |
| 8. habitat           | <i>n.</i> | 栖息地     |



## A Logical Sort

Scientists often use charts<sup>1</sup>, graphs<sup>2</sup>, and diagrams that show several layers<sup>3</sup> of information at once. Joel likes to use Venn diagrams for this purpose. Venn diagrams provide a logical way of sorting and classifying data.

The drawing on the next page shows one way that Joel uses a Venn diagram in his notes. The diagram shows all of the animals that Joel spotted on one of his hikes. It also shows how Joel sorted the animals according to a certain trait<sup>4</sup>. The trait he used was what the animals eat.

Let's examine the Venn diagram more closely. The circle on the left includes the herbivores<sup>5</sup> that Joel identified<sup>6</sup> one day. Herbivores are animals that eat only plants. Notice that the white-tailed deer<sup>7</sup> and the woodchuck<sup>8</sup> are listed as herbivores.

1. chart	n.	图表; 曲线(标绘)图
2. graph	n.	图表; 图解; 曲线图
3. layer	n.	层; 层次
4. trait	n.	特征
5. herbivore	n.	食草动物
6. identify	v.	识别; 认出
7. white-tailed deer		弗吉尼亚鹿
8. woodchuck	n.	美洲旱獭
9. raccoon	n.	浣熊
10. opossum	n.	负鼠

White-tailed deer



Raccoon<sup>9</sup>



Woodchuck



Opossum<sup>10</sup>





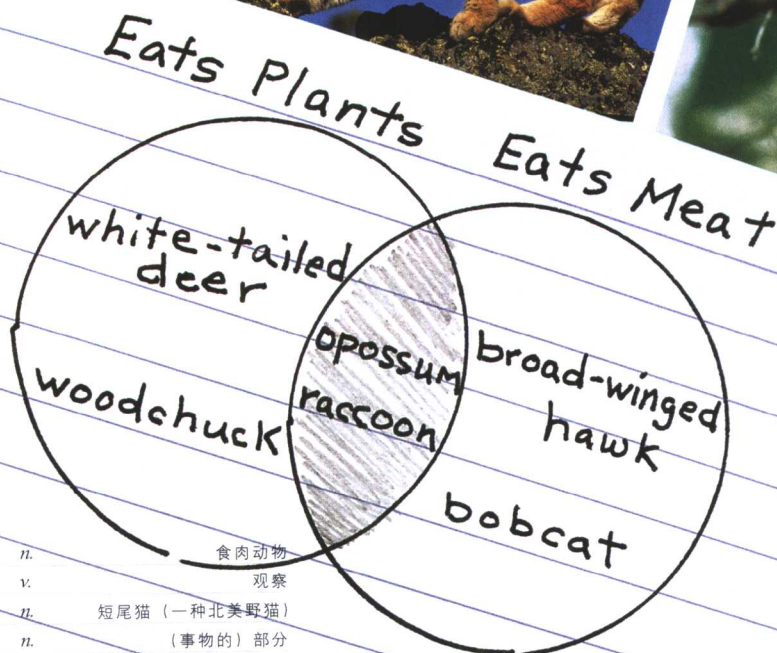
The circle on the right shows the carnivores<sup>1</sup> that Joel observed<sup>2</sup>. Carnivores, such as broad-winged hawks and bobcats<sup>3</sup>, are animals that eat only meat.

Notice the shaded section<sup>4</sup> in the middle. This area represents<sup>5</sup> the omnivores<sup>6</sup>, or animals that eat both plants and animals. Both the opossum and raccoon fall into this category<sup>7</sup>.

When Joel and other ecologists look at a Venn diagram, they see a logical presentation of data. In this case they can see at a glance what kind of herbivores, carnivores, and omnivores Joel spotted. Data like this help ecologists keep track of different populations<sup>8</sup> to make sure they are staying in balance.

**Broad-winged hawk**

**Bobcat**



- |               |    |              |
|---------------|----|--------------|
| 1. carnivore  | n. | 食肉动物         |
| 2. observe    | v. | 观察           |
| 3. bobcat     | n. | 短尾猫 (一种北美野猫) |
| 4. section    | n. | (事物的) 部分     |
| 5. represent  | v. | 代表           |
| 6. omnivore   | n. | 杂食动物         |
| 7. category   | n. | 类: 类别        |
| 8. population | n. | 种群           |





### E-mail from the Field

**Subject:** Buried Treasure

**From:** [eric@museum.org](mailto:eric@museum.org)

**To:** [joel@apptail.org](mailto:joel@apptail.org), [marissa@syu.edu](mailto:marissa@syu.edu)

Hey Guys!

Wow! Those hawks are impressive<sup>1</sup> travelers, Joel. Speaking of impressive, I'm out in Colorado<sup>2</sup> digging up real treasure. Actually the treasure is bits of broken pottery<sup>3</sup> from a culture that is long gone. That may not seem very valuable to most people, but to me, it's a gold mine of information from the past.

Now if I can only figure out what it all means!

Eric

1. impressive     *adj.*     给人以深刻印象的

2. Colorado     科罗拉多州

3. pottery     *n.*     陶器



# Nuggets of Knowledge

## 宝贵的点滴信息

**E**ric is an archaeologist<sup>1</sup>. He studies the physical remains of human cultures that no longer exist<sup>2</sup>. Artifacts<sup>3</sup>—objects made by humans in the past—give Eric clues. Putting all the clues together helps Eric reconstruct<sup>4</sup> a picture of how people lived.

Eric has a special interest in the Native American<sup>5</sup> cultures of the western United States. He spends many months in the field working on archaeological digs. Then he returns to his museum lab to study the artifacts he found. It may take him years of work to make sense of the findings from just one successful dig. But careful reasoning and logic help him slowly build a picture of the past.

- |                    |    |       |
|--------------------|----|-------|
| 1. archaeologist   | n. | 考古学家  |
| 2. exist           | v. | 存在    |
| 3. artifact        | n. | 人工制品  |
| 4. reconstruct     | v. | 使再现   |
| 5. Native American |    | 印第安人的 |
| 6. Cliff Palace    |    | 悬崖宫殿  |

Cliff Palace<sup>6</sup> in Mesa Verde, Colorado



## Documenting<sup>1</sup> the Dig

Archaeologists dig in marked-off units called grids<sup>2</sup>. This is done so the exact<sup>3</sup> location of every artifact can be documented. Both horizontal<sup>4</sup> and vertical<sup>5</sup> positions of the artifacts are important to record. Why?

The horizontal position of the artifact describes where it is found in relation to the things around it. For example, a bowl may be next to another bowl and a plate.

The vertical position of the artifact, however, refers to<sup>6</sup> how deep the artifact is when it is discovered. Generally, if the site has not been disturbed, then

deeper artifacts are older artifacts.

Notice “if” and “then” in the previous<sup>7</sup> sentence. Believe it or not, these two little words represent an important part of logical thinking.

## Thinking About “If . . . then”

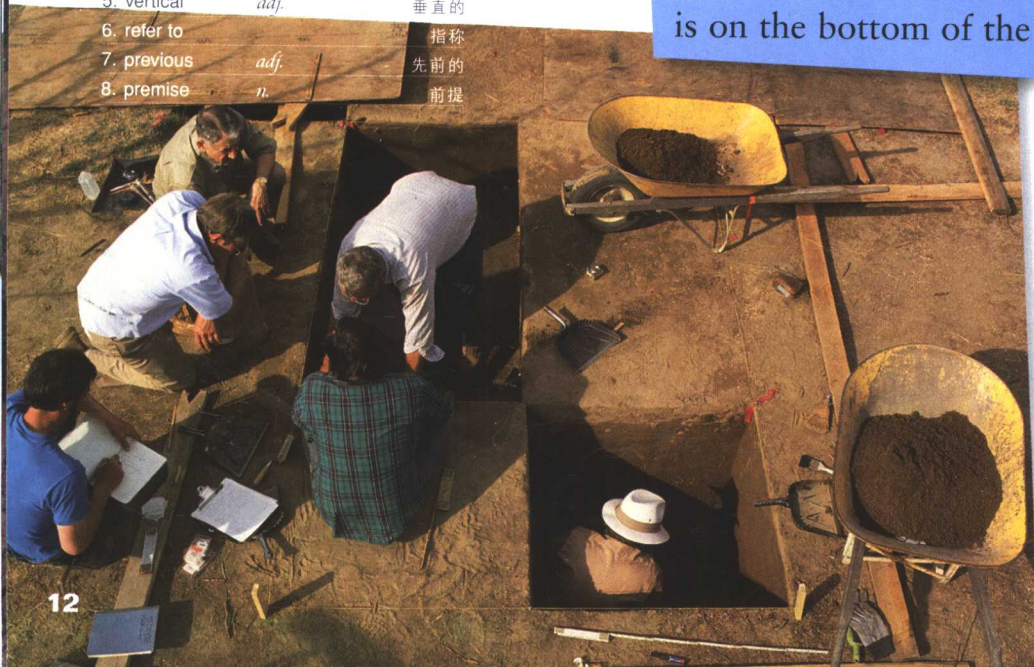
“If . . . then” reasoning is how scientists test different ideas. With this kind of reasoning, you start with certain information called a premise<sup>8</sup>. Then you come up with a conclusion based on that premise. Once you can prove that the premise is true, you also know that the conclusion is true.

Let’s look at this example:

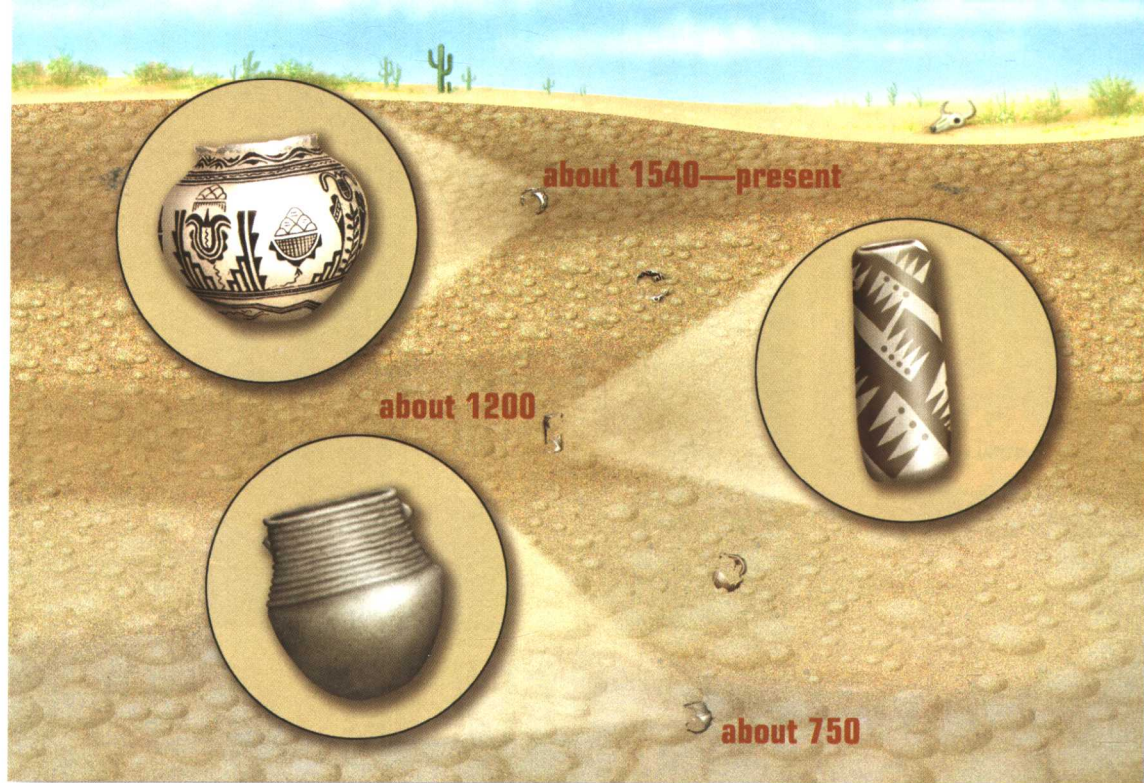
**Premise:** *If* the daily newspaper is placed on top of a pile every day,  
**Conclusion:** *then* the oldest newspaper is on the bottom of the pile.

Grids help archaeologists document their findings.

- |               |      |        |
|---------------|------|--------|
| 1. document   | v.   | 记实性地描述 |
| 2. grid       | n.   | 坐标方格   |
| 3. exact      | adj. | 准确的    |
| 4. horizontal | adj. | 水平的    |
| 5. vertical   | adj. | 垂直的    |
| 6. refer to   |      | 指称     |
| 7. previous   | adj. | 先前的    |
| 8. premise    | n.   | 前提     |







**If a site is undisturbed, then the deeper artifacts are probably older than those near the surface.**

Remember that the premise has to be true in order for the conclusion to be true. So if you place the daily newspaper on top of the pile each day, then the premise is true. This also means the conclusion is true. You know the oldest newspaper is on the bottom of the pile.

However, suppose you knock over the pile of newspapers. In your hurry to pick them up, you stack<sup>1</sup> the newspapers in any order. Now the premise is not true. The newspapers are not in order according to dates. Therefore, the conclusion is not true. The oldest newspaper could be in the middle of the

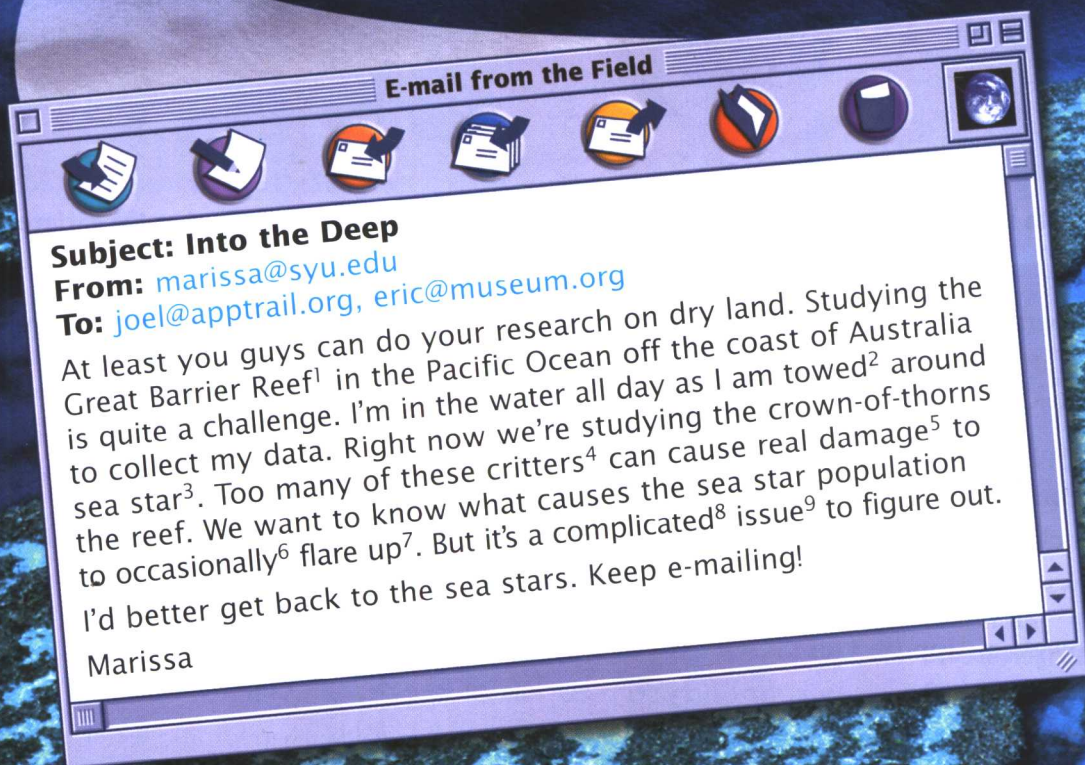
pile or the bottom. You can't be certain.

When Eric digs for artifacts, he may assume that a pot<sup>2</sup> found near the surface of the site is not as old as a jug<sup>3</sup> found deeper beneath the surface.

However, what if someone had already dug up the pot and moved it closer to the surface? The pot might still be just as old as the jug. That's why Eric has to be careful with his logic. He has to say "*If a site has not been disturbed, then it is likely that deeper artifacts are older artifacts.*"

- |          |    |            |
|----------|----|------------|
| 1. stack | v. | 把……叠成堆     |
| 2. pot   | n. | 罐          |
| 3. jug   | n. | (狭嘴带柄的) 大罐 |





- |                             |    |        |                 |      |        |
|-----------------------------|----|--------|-----------------|------|--------|
| 1. Great Barrier Reef       |    | 大堡礁    | 6. occasionally | adv. | 偶尔; 间或 |
| 2. tow                      | v. | 拖; 拖带  | 7. flare up     |      | 突然爆发   |
| 3. crown-of-thorns sea star |    | 长棘海星   | 8. complicated  | adj. | 复杂的    |
| 4. critter                  | n. | 生物     | 9. issue        | n.   | 问题     |
| 5. damage                   | n. | 毁坏; 破坏 |                 |      |        |



# Underwater Exploration

## 水下探索

Marissa is a marine biologist<sup>1</sup> studying the largest natural structure<sup>2</sup> in the world. The Great Barrier Reef stretches 2,000 kilometers (about 1,243 miles) along the northeastern coast of Australia. It is a large number of reefs, passages, and coral<sup>3</sup> strung<sup>4</sup> together.

Coral reefs are made of limestone<sup>5</sup> skeletons<sup>6</sup> of tiny animals called coral polyps<sup>7</sup>. When these corals die, new corals build on the remains of the dead ones. Over time, millions<sup>8</sup> and millions of limestone skeletons build up to form huge underwater reefs.

The living top layer of the reef is called the coral cover. It can be damaged by many things—including one of its own inhabitants<sup>9</sup>!

- |                     |                |        |
|---------------------|----------------|--------|
| 1. marine biologist |                | 海洋生物学家 |
| 2. structure        | <i>n.</i>      | 构造     |
| 3. coral            | <i>n.</i>      | 珊瑚     |
| 4. string           | <i>v.</i>      | 连成串    |
| 5. limestone        | <i>n.</i>      | 石灰岩    |
| 6. skeleton         | <i>n.</i>      | 骨骼     |
| 7. coral polyp      |                | 珊瑚虫    |
| 8. million          | <i>n.</i> [~s] | 许多; 无数 |
| 9. inhabitant       | <i>n.</i>      | 栖居的动物  |
| 10. aerial view     |                | 空中鸟瞰图  |
| 11. Queensland      |                | 昆士兰州   |

An aerial view<sup>10</sup> of the Great Barrier Reef, near Queensland<sup>11</sup>, Australia