

爱上科学

Science

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# 爱上科学

INTRODUCING · 生物系列  
BIOLOGY

## 生命的进化

EVOLUTION 双语版

[英] Sarah Eason 编  
王玉娟 译  
王宜欣 审



人民邮电出版社  
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## 内容提要

《爱上科学》系列科普丛书为读者全面地讲述了科学知识和原理，以通俗的文字、生动的图表为特色，每本书介绍一个或几个主题。从日常生活中有趣的现象出发，引导和培养读者学习的兴趣，扩宽读者的视野，同时还可以帮助读者学习英语词汇、练习英语阅读。丛书涵盖物理、化学、生物、科技与发明这4个系列。适合对科学知识感兴趣的广大科普爱好者阅读。

本书是生物系列中的一本。生物系列主要阐释生命科学的基本概念，并探讨有关生物学的现代思想的各个方面，包括植物学、微生物学、动物与人类、遗传学、细胞生物学以及生命形式等。

你正在好奇生物如何改变自身以应对生存环境吗？我们人类与其他动物有何不同？这本书将介绍究竟什么是进化，包括进化模式、自然选择学说、基因组和人类的进化等，让读者全方位了解生命的进化历程。书中含有“科学词汇”栏目，提取每章重点知识词汇。同时还有“试一试”栏目，包含丰富有趣的家庭小实验，有助于提高大家的动手能力。



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## 丛书序

这是一个科技新时代，我们曾经认为遥不可及的科学，时刻围绕在我们身边。你是否曾经怀疑过所谓的“2012，世界末日”，或者好奇过在地下高速飞驰的地铁，抑或每天都在关注着PM2.5……这说明科学已然走进了你的生活。学习科学，分享科学，爱上科学，让我们共同聆听来自科学的声音。

《爱上科学》系列科普丛书是一套引进版系列科普丛书，译自英国大型出版商棕熊图书（BROWN BEAR BOOKS）有限公司出版的著名系列科普图书《Facts At Your Fingertips》，其独特的科学解读视角、生动的科普画面、优美的图文设计，得到了欧洲读者的青睐，尤其是得到了欧洲青少年的极大欢迎。本丛书为读者全面地讲述了各个领域的基础科学知识和基本事实，以精彩的主题、通俗的文字、生动的画面为特色，从我们身边的素材和现象出发，激发和培养读者学习的兴趣。

丛书涵盖物理、化学、生物、科技与发明四大系列。物理系列阐释和说明了物理学知识及其发展史，包含对物理学发展史许多重大的物理发现以及著名的物理学家的介绍。化学系列主要阐释现代化学的基本概念，涵盖化学反应、有机化学、生物化学、金属、非金属、分子、原子、物态等多方面内容。生物系列主要阐释生命科学的基本概念，并探讨有关生物学的各个方面，包括植物学、微生物学、动物和人类、遗传学、细胞生物学以及生命形式等。科技与发明系列主要介绍各种科技成果以及相关发明，覆盖多个领域，包括建筑、交通、医学、军事、能源以及航空航天等，指导读者认知和学习各种科学技术，拓宽视野，引发思考，提升创新能力以及发明意识。

本丛书还具有中英双语的独特设计，让读者在阅读中文时，能对照性地阅读英语原文，为他们提高科学领域的英文阅读能力以及扩展科学类英语词汇量提供了很好的帮助。

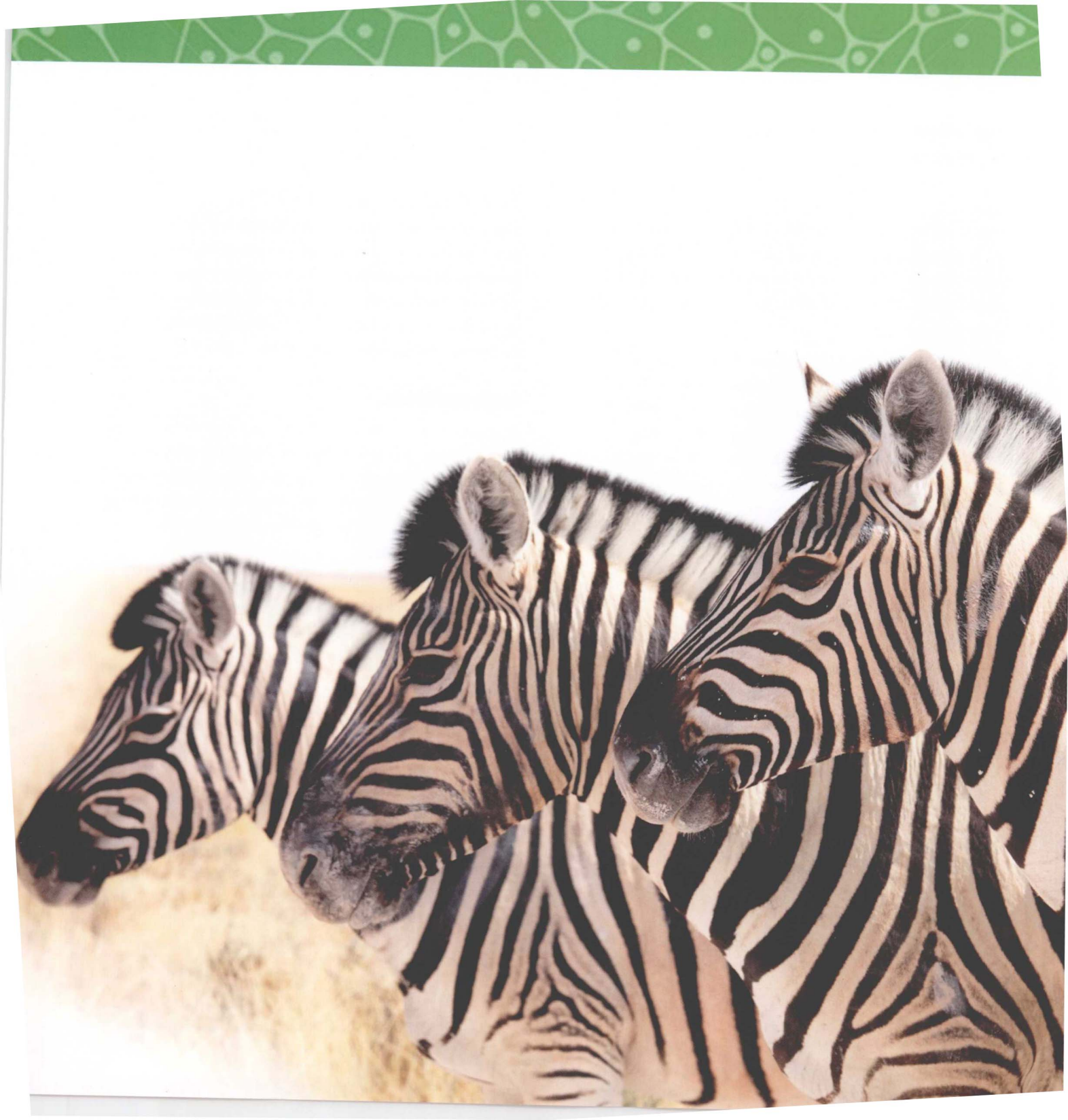
丛书中还有“试一试”栏目，该栏目包含了丰富有趣的家庭小实验，为大家在生活实践中验证科学知识提供了更多的选择。

学无止境，让我们一起爱上科学！

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# WHAT IS EVOLUTION?

**Evolution** is the process of change in groups of creatures over time.

**Species** (types) of living things change over long periods of time to adapt to their environment. Biologists call this process evolution. Although it is a pillar of biological thinking today, and widely accepted, the theory of evolution was shocking when it was first proposed since it challenged religious views of how life on Earth began.

In 1859, the publication of a book entitled *On the Origin of Species* by English naturalist Charles Darwin (1809–1882) changed biological thinking completely and had a profound influence in many other fields as well. Darwin suggested that a process called **natural selection** could explain the variety of life. In nature more individuals are born than survive to adulthood. Certain individuals survive because they have some advantage over the others. These individuals are more successful in breeding and passing on the advantage to their young. This process is the driving force behind evolution.

Evidence that Darwin was right is abundant. There are fossils that show the course of evolution over time in certain groups of organisms, such as horses. Evolution is also supported by

studies of **deoxyribonucleic acid (DNA)** that shed light on the common ancestry of different organisms.

## Spontaneous generation

Many people attempted to explain diversity in the natural world before Darwin. A widespread belief was the theory of **spontaneous generation**—that species arose from matter such as decaying organic material. The appearance of maggots and mice in conditions that seemed lifeless suggested that organisms could originate from nothing.

## Lamarckism

At the beginning of the 19th century, French naturalist Jean Baptiste Lamarck (1744–1829) developed a theory that suggested that different species arose by changing from already existing ones. He thought that favorable features gained during a parent's lifetime would be passed on to offspring—an idea known as **Lamarckism**.

Lamarck suggested that changes in an organism's needs due to environmental changes could make body structures increase or decrease in size based on how much they were used. Lamarck's ideas were attacked during his lifetime and later proven to be false.

*Evolutionary biologists study fossil evidence, such as this ancient fish, to figure out how living organisms have evolved over millions of years.*



## SHEEP SELECTION

To get an idea of how selection works, imagine a farmer has some sheep, half of which are white and the rest black. Needing white rather than black wool, the farmer selects the white sheep for mating. Because the colors are inherited, he soon has a flock of mostly white sheep.

Years earlier some of the flock escaped into a local forest. Their only **predators**, wolves, hunted at night and often caught the conspicuous white sheep. Soon the sheep of the forest became mostly black—because of natural selection rather than selection by the farmer.



Today, Lamarck is remembered only for his discredited theory, and Lamarckism remains a byword for poor biology. However, modern biologists who criticize Lamarck have the benefit of hindsight. Lamarck was actually a very talented naturalist who made a number of important zoological discoveries.

### Religion and evolution

Darwin's theories were at odds with the teachings of the Bible, which asserted that God created Earth and all the organisms on it. The argument continues to this day. People who believe that all life on Earth is the work of an all-powerful being rather than part of an evolutionary process are called creationists. They do not accept evolutionary theory as fact.

### Studying evolution

Today, biologists study the process of evolution in a number of different ways. Population geneticists look at the different factors that affect inheritance. **Paleontologists** focus on **fossils** and other evidence to study how organisms evolved

long ago in the past. Ecologists examine how relationships between organisms and the environment they live in can affect the process of evolution. Studies like these provide crucial information for biologists. They interpret the evidence to figure out evolutionary relationships that may link different species.

### SCIENCE WORDS

- ❏
**deoxyribonucleic acid (DNA)** Molecule that contains the genetic code for all cellular (nonvirus) organisms.
- ❏
**evolution** Process of change in groups of organisms over long periods of time.
- ❏
**Lamarckism** Outdated evolutionary theory that suggested that a parent's features changed according to use during its lifetime before being inherited by young.
- ❏
**spontaneous generation** Ancient belief that organisms could arise directly from nonliving matter.



# 什么是进化？

进化是随着时间的推移生物群体的变化过程。

生物的**物种**（类型）在漫长的时间中不断地改变自身以适应环境。生物学家称这个过程为进化。

虽然进化论现已成为生物学的核心思想之一，并被人们广泛地接受，但是在它刚刚出现的时候带来了巨大的震撼，因为它对宗教所宣扬的地球生命出现的方式是一种挑战。

1859年，英国自然学家查理斯·达尔文（1809—1882）出版了一本名为《物种起源》的书，这不但完全改变了生物学的思维方式，而且对其他许多领域产生了深远的影响。达尔文提出了一个叫作**自然选择**的概念，可以解释物种的多样性。在自然界中，出生的个体远多于后来存活的个体。一部分个体可以成活是因为它们具有其他个体所没有的某些优点，这些个体就在繁殖上更具有优势，并能将自己的这些特点传递给后代。这个过程就是进化背后的驱动力。

有丰富的证据证明达尔文是对的。化石展示了特定的动物随着时间的推移而进化的过程，例如马

进化生物学家通过对化石的研究，来搞清楚生物是如何在亿万年的过程中进化的，例如这个远古鱼类化石。

的化石。对**脱氧核糖核酸（DNA）**的研究也支持了进化论，它清楚地证明了不同的物种起源于共同的祖先。

## 自然发生

在达尔文之前，许多人也试图解释自然界中何以有着如此众多的生命形式。一个广为人知的理论就是**自然发生**理论。该理论认为，物种产生于诸如正在腐烂的有机材料这样的物质。在看起来不会有生命存在的条件下，蛆虫和老鼠的存在证明了物种可以凭空而生。

## 拉马克理论

19世纪初期，法国的自然学家让·巴蒂斯特·拉马克（1744—1829）提出了一个理论，认为不同的物种是由以前已经存在的物种变化而来的。他认为父母一生中获得的有利的特性会传递给后代，这个观点就是**拉马克理论**。

拉马克认为一个生物体结构的大小变化是源于对环境的适应，使用得越多就相对发达，而使用得越少就会退化。拉马克理论在他的一生中饱受抨





## 绵羊选择

为了理解选择的过程,想象一位农场主有一群绵羊,一半是白色的,另一半是黑色的。由于只需要白色的羊毛而不需要黑色的羊毛,农场主就会选择白色的绵羊让它们交配产生后代。因为羊毛的颜色是可以遗传给后代的,这样,用不了多久他就能拥有一群几乎都是白色的羊了。

而几年前,羊群中的一些羊逃进了当地的树林中。那里只有狼这样的**捕食者**,由于它们只在夜间捕猎,所以捕到更多的是显眼的白绵羊。很快树林中的羊就几乎都是黑色的了,这就不是农场主的选择,而是由于自然选择的结果了。



击,最终被认为是错误的。如今,拉马克只是因为他的怀疑理论而被记住,但他仍然是生物学上的一个笑柄。尽管如此,现在批评拉马克的生物学家也都是事后诸葛亮。拉马克实际上是一个很有天赋的自然学家,在动物学方面贡献了许多重要的发现。

## 宗教和进化论

达尔文的理论和《圣经》中所宣称的地球和所有生物都是上帝所创造的理论是相左的。这之间的争论一直持续到了现在。相信地球上所有生物都是一个全能上帝的杰作的人被称为创世论者。他们不接受进化论这个事实。

## 研究进化论

如今,生物学家通过多种不同的方法来研究进化论。人口遗传学家关注影响遗传的不同因素。**古生物学者**则把注意力放在**化石**以及其他证据上,来

研究很久以前的生物是如何进化的。生态学家研究生物体和它们所生活的环境之间的关系,看环境是如何影响生物的进化的。这些研究为生物学家们提供了重要的信息。他们通过解读这些证据,来揭示不同物种之间可能的进化关系。

## 科学词汇

- ❖ **脱氧核糖核酸(DNA)**: 携带所有细胞生物(非病毒的)遗传密码的分子。
- ❖ **进化**: 在长时间范围内生物群体的变化过程。
- ❖ **拉马克理论**: 过时的进化理论,认为父母在一生中身体结构产生的用进废退变化会遗传给后代。
- ❖ **自然发生**: 古时候人们认为生物可以从毫无生命的物质中自发产生出来。

# EVIDENCE FOR EVOLUTION

Every feature of every organism on Earth provides evidence that evolution has taken place.

Charles Darwin's theory of evolution by natural selection is relatively simple, yet scientific evidence for it (especially in the light of recent genetic advances) is so powerful that biologists accept it almost universally. The world is full of evidence that supports evolutionary theory. This evidence ranges from the fossils of creatures that lived many millions of years ago to the rapid changes that are now taking place in bacteria that cause diseases.

## The evidence of fossils

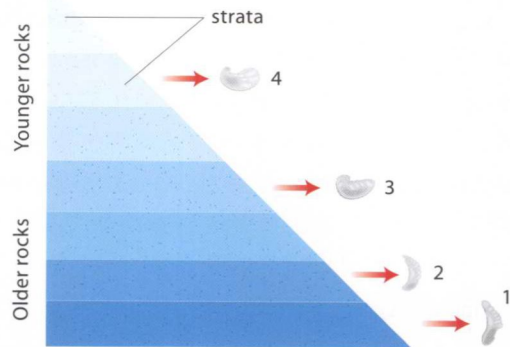
Fossils are the remains or traces of long-dead organisms preserved in rock. They have been collected and puzzled over for hundreds of years.

Before the 19th century, fossils were explained as leftovers from the biblical flood or as parts of creatures such as unicorns or giants. By the early 1800s biologists had begun to realize that many fossilized creatures no longer existed on Earth. They also noticed that some fossils were similar to, but not the same as, living creatures. This evidence suggested that they were distant ancestors of living animals. Geologists (people who study

*This is a reconstruction of a Tyrannosaurus rex skeleton. These fearsome predators roamed the land in the Cretaceous period, around 65 million years ago.*

## EVIDENCE IN THE ROCKS

Sedimentary rocks such as limestone are formed by layers of sediment called strata. **Geologists** showed that younger strata always lay above older strata, except when they have been buckled and folded later. This discovery allowed biologists to follow changes in fossil groups over time. *Gryphaea* were a group of mollusks that lived on shallow seafloors between 190 and 75 million years ago. Early *Gryphaea* shells (1) were flat, but with an increase of silt in the water *Gryphaea* evolved to lift themselves off the bottom. Via several intermediate stages (2, 3) the flat *Gryphaea* evolved curled shells that are often called "Devil's toenails".

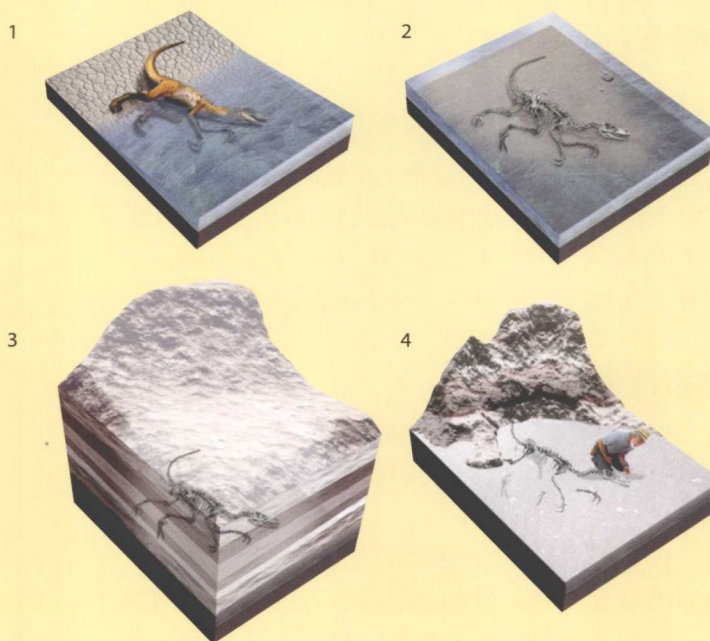




## HOW DO FOSSILS FORM?

Fossils are the preserved remains or traces, such as footprints, of living organisms that died millions of years ago. Fossilization (fossil formation) occurs in a number of steps. Bones and other hard parts of a dead organism are gradually replaced by minerals.

1. A dinosaur dies on the shore of a large river.
2. The dinosaur is quickly covered by particles of mud and sand.
3. The sediment is slowly compressed (squeezed), forming rock. Minerals seep through the rocks and replace the dinosaur's bones and teeth.
4. Millions of years later paleontologists carefully pick away the rock to reveal the fossilized dinosaur.



rocks) realized that the rocks in which fossils were found were sometimes millions of years old. These lines of evidence were in complete opposition to the teachings of the Bible, which held great sway over much of the scientific thinking at this time.

Paleontologists (scientists who study fossils) can follow how one form of organism evolved into another over millions of years. For example, around 55 million years ago *Hyracotherium*, the earliest known ancestor of the modern horse, lived in forests in North America. It was a small, dog-sized animal with five toes on each foot. Over many millions of years animals like *Hyracotherium* evolved to become larger and lost four of the five toes. That helped them run faster. Horse evolution did not move in a straight line but more by way of a "sprawling bush". Modern horses and their relatives form the last "branch" of this bush.

Signs in the rocks also tell scientists what the environment was like—for example, whether it was hot or cold, wet or

## THE SPEED OF EVOLUTION

Scientists argue about the speed at which evolution takes place. Some scientists have looked at fossils and decided there is a regular rate of change, or evolution. Others believe a theory called "**punctuated equilibrium**" is correct. It suggests that there are long periods with no change, followed by shorter periods with very rapid change. The truth may lie somewhere between these two viewpoints.

dry. So, they can see from the fossils how living organisms have changed over time in response to major changes in the environment.

## Isolation and evolution

In different parts of the world there are animals that are similar

# 进化的证据

地球上所有生物的所有特征都证明了进化的存在。

虽然查理斯·达尔文关于自然选择的进化论相对简单，但是它的科学证据（尤其最近的遗传学证据）如此有力，以至于生物学家都普遍接受它。从生活在数百万年前的生物化石，到如今正在发生的致病性细菌的快速变异，世界上到处都是进化论的证据。

## 化石证据

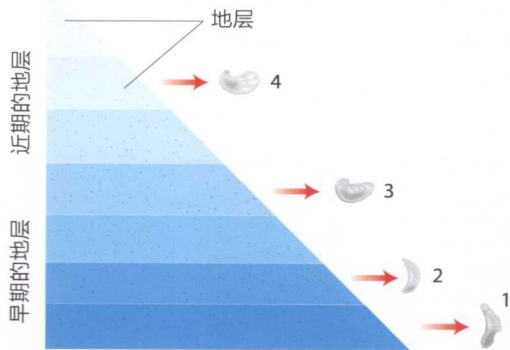
化石是被保存在岩石中的已经死去很久的生物体的残骸或遗迹。几百年来化石都被人们收集并困惑着。

19世纪之前，化石通常被理解为圣经中大洪水留下的遗迹或者是独角兽或者巨人这类生物的残骸。直到19世纪初期，生物学家才开始认识到许多化石中的生物已经不存在于世界上了。同时他们还发现一些化石和现在活着的生物非常相似，但是又不完全相同。这些证据说明化石是现代生物们遥远的

这是一个重新组合起来的雷克斯霸王龙的骨架。大约6 500万年，这些可怕的捕食者在白垩纪时期的陆地上横行。

## 岩石中的证据

沉积岩，例如石灰岩，是由一层叫作地层的沉积物构成的。**地质学家**指出除非当它们被弯曲折叠，否则新地层通常在老地层上方。这个发现让生物学家得以研究化石是如何随着时间变化的。螺蛳属的动物是一群生活在1.9亿年到7 500万年前浅海底的软体动物。早期的螺蛳贝（1）是平的，但是随着水中淤泥层的生长，螺蛳进化使自己从底部抬高。通过一些中间的阶段（2和3），平螺蛳那被称为“恶魔的脚趾甲”的甲壳得到了进化。





## 化石是如何形成的?

化石是被保存在岩石中的动植物残骸或遗迹，如在几百万年前死去了的动物的足印。石化（化石形成）需要多个步骤。动物遗骸和其他坚硬部分逐渐被矿物质取代。

1. 一只恐龙死在一条大河的河滩上。
2. 然后恐龙的遗骸被泥沙快速地掩埋住。
3. 地层被缓慢地压缩（挤压），形成岩石。矿物质渗入岩石，取代恐龙的骨架和牙齿。
4. 几百万年后，古生物学家仔细地清理岩石，挖出石化了的恐龙骨架。



祖先。地质学家（研究岩石的人）们发现有些含有化石的岩石都已经数百万年之久了。这些证据和以前在科学界中根深蒂固的圣经的教义是完全相反的。

古生物学家（研究化石的科学家）能够探究在百万年过程中，物种是如何从一种形式进化成另一种形式的。例如，大约5 500万年前，在北美丛林中生存的始祖马是最早已知的现代马匹的祖先。那是一种如狗般大小的动物，每个脚有五个脚趾。在几百万年的进化过程中，始祖马变得越来越大，而且慢慢地，五个脚趾的四个消失了，这使得它们跑得更快。马的进化过程不是直线的，而是像一个枝蔓丛生的“灌木”一样。现代马匹以及它们的近亲组成了这个“灌木”的最后一支。

岩石中的特征也告诉科学家们当时的环境是如何的，例如是冷是热，是干燥还是潮湿。所以，他

## 进化的速度

科学家们一直在争论进化发生的速度。有些科学家通过观察化石得出结论，进化的速率是有规律的。其他人则认为一种叫作“**间断平衡**”的理论才是正确的。这个理论认为进化的过程是：在很长的时间都不改变，然后在一个很短的时间内突然改变。而真实的情况可能是介于这两种理论之间。

们可以从化石中读出生物在环境的变迁过程中是如何进化的。

## 隔离和进化

世界上的不同地方都有着相似但是并不完全



# EVIDENCE FOR EVOLUTION

*Modern-day horses have evolved over millions of years from small forest dwellers into large, fast-running animals adapted for life on grasslands.*

## RELIGIOUS BELIEFS

Before Darwin's work, biology in Christian countries was underpinned by a literal belief in the Bible. People thought that the Earth was created in seven days in 4004 B.C.E., and God also created animals and plants. Evolution did not take place because God had created perfect organisms. Fossils were explained away as creatures that failed to make it onto Noah's Ark and died in the flood.

Many Christians today, as well as people of other faiths, think Darwin was wrong and evolution does not exist, but instead, God created all creatures. This idea is called **creationism**, and it has some powerful advocates. Some schools, for example, are not allowed to teach evolutionary theory. However, creationism has been completely disproved by more than a century of experimental evidence.

to each other but are not identical. For example, jaguars live in South America, lions in Africa, and tigers in Asia. All are big cats, but each has a different coat and forms a separate species. Evolving from a common ancestor, each big cat adapted to its environment over millions of years.

A similar pattern is found in many other creatures. For example, there are similar large, flightless birds in different parts of the world, such as the rhea in South America, the ostrich in Africa, and the emu in Australia. However, some creatures that look similar do not share a common ancestor and have evolved from completely different organisms. This is called **convergent evolution**. For example, both whales and fish have streamlined bodies and powerful tails to drive them through water. Despite these similarities, whales are only very distantly related to fish. Each group has adapted in similar ways to the challenge of movement in water.