

Rock-solid evidence for the origins of birds

胃里的石头，如何揭示鸟类起源？

Stones in dinosaur stomachs may help understanding of avian evolution

恐龙胃中的石头或可帮助理解鸟类演化

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影视画面中，一名男子在草地上奔跑，身后是一群奔跑的恐龙。

难度 69 / 100

建议70–95分钟；选做作文另计。

适用读者：能阅读一般英语新闻，希望读准长句、搭配与作者语气的学习者。

入门准备：能辨认基本主谓结构和常见从句，愿意结合语境查词。

About this lesson 本课导读

柔软的内脏难以保存，胃中的石头却能留下消化方式的线索。文章由现代动物的比较走向恐龙，再提出食物研磨位置与飞行之间的联系。精读时既要拆开嵌套长句，也要分清观察、类比和演化解释。

- 画出“石头形状—胃的作用—身体重心”的推理链
- 读懂夹有插入语的多层关系从句
- 区分圆润胃石所支持的推断与尚未证明的因果
- 解释标题和结尾围绕石头、胃展开的双关

Before you read 读前思考

What might teeth and stomach stones reveal about an animal?

拓展例句与练习情境用于说明用法。

书末答案 (p.12)

Text 课文

[P01] HOW DO YOU know what a dinosaur ate? Guts rot away after death, so the details of dinosaur digestion remain obscure.^{V01V02} The best indicators are teeth.^{V03} Sharp, pointed teeth probably ripped chunks of flesh off prey for swallowing whole.^{V04} Robust grinding surfaces suggest lots of chewing was involved.^{V05} Yet many dinosaurs belonging to a group called the theropods, which gave rise to birds, lost their teeth altogether and evolved beaks.^{V06V07V08} This has made it hard to work out what they ate and how they digested it.^{V09K01}



影视画面中，一名男子在草地上奔跑，身后是一群奔跑的恐龙。

[P02] There is, however, a second clue. Lots of dinosaurs had stones, known as gastroliths, in their stomachs.^{V10} These are assumed to have assisted with digestion, and thus have their own tales to tell.^{V11} And modern birds and crocodilians (which are both, like dinosaurs, members of a larger evolutionary group called the archosaurs) often have gastroliths, too.^{V12}

[P03] Takasaki Ryuji at Okayama University of Science, in Japan, decided to investigate. In a study published in Paleobiology, he and his colleagues examined the gastroliths of 46 modern archosaur species (42 birds and four crocodilians) and compared them with those from 16 species of dinosaur.

15 [P04] The birds included herbivores, omnivores and carnivores.^{V13V14V15} The crocodilians were all carnivorous. The shapes of the stones varied. As might be expected, if an animal had a highly muscular stomach (ducks and geese), its gastroliths tended to have been worn into the sorts of rounded shapes displayed by beach pebbles.^{V16V17K02} Weaker stomachs (seabirds and crocodiles) contained more angular stones.^{V18}

20 [P05] Looking at the dinosaurs, Dr Takasaki and his colleagues found that ornithischians (think Triceratops), a group which their teeth suggest were herbivores, retained angular gastroliths.^{V19K03} These creatures, this implies, relied mostly on their jaws to grind up their food, leaving their stomachs to apply merely the finishing touches.^{V20}

[P06] Long-necked sauropods (think Diplodocus) also had angular gastroliths.^{V21} That is more of
 25 a puzzle, for these animals had pencil-like teeth using which, it is assumed, they stripped the
 leaves off tree branches that less cervically elongated animals were unable to reach.^{V22V23K04}
 The explanation, Dr Takasaki suspects, is that like those of modern ungulates, sauropods' stom-
 achs depended mainly on fermentation to break food down.^{V24V25K05}

[P07] Stones in the guts of theropods tell yet another story. Tarbosaurus, a hypercarnivore sim-
 30 ilar to Tyrannosaurus, and similarly endowed with sharp, pointed teeth, had angular gas-
 troliths.^{V26} However, theropods with beaks (of which science recognises at least four groups)
 had rounded ones. Indeed, Dr Takasaki saw a clear relation between tooth loss and stone
 roundness, as the work of grinding up food was transferred from jaws to stomach.^{V27}

[P08] That shift may have helped make possible the evolutionary success of birds. Teeth are
 35 heavy, as are the jaw muscles those teeth require to do their job.^{K06} This puts a lot of weight
 near an animal's front. Shifting the job of grinding, and the muscles and hard surfaces in-
 volved, to the stomach centralises an animal's centre of gravity in a way that would make it
 easier for it to rise from the ground.^{V28K07}

[P09] Curiously, it is clear from the fossil record that the very earliest birds of all did not have
 40 beaks.^{V29} But the fact that so many of their theropod relatives did, and that birds themselves
 evolved them at least twice, suggests the transition was easy.^{K08} It may thus be that part of the
 secret to taking successfully to the skies was, quite literally, having the stomach for it.^{V30}

New words and expressions 生词和短语

按原文出现顺序排列；★为优先练习表达。

V01 · P01 rot away

/rɒt ə'weɪ/ phr. v. 腐烂消失

away 强调腐烂到消失，解释为何难以直接从内脏取得证据。

V02 · P01 obscure★

/əb'skjuə/ adj. 不清楚的；难以了解的

remain obscure 是仍不明晰，不是故意把细节藏起来。

V03 · P01 indicator

/ˈɪndɪkətə/ n. 指示物；线索

牙齿可反映食物处理方式；indicator 本身不表示百分之百确定的证明。

V04 · P01 prey

/preɪ/ n. 猎物

这里为被捕食的动物；不要与祈祷 pray 混淆。

V05 · P01 grind★

/ɡraɪnd/ v. 磨碎；研磨

牙齿研磨食物，也可描述胃石参与的机械加工；过去式、过去分词为 ground。

V06 · P01 theropod

/θɪərəpɒd/ n. 兽脚类恐龙

文中包括有尖齿者和有喙者；不能因名称含脚就把它理解成某种鸟足结构。

V07 · P01 give rise to★

/ɡɪv raɪz tuː/ phr. 产生；使...出现

本篇写演化来源，不是个体恐龙在一生中变成鸟。

V08 · P01 beak

/biːk/ n. 喙

与 teeth 形成贯穿全文的对照，后文讨论它们和消化分工的关系。

V09 · P01 work out★

/wɜːk aʊt/ phr. v. 弄清；推算出

后接 what/how 从句表示弄清信息，不取锻炼身体之义。

The team worked out how the parts fitted together.

团队弄清了这些部件如何装配。

V10 · P02 gastrolith

/ˈɡæstrəlɪθ/ n. 胃石

胃中石头的专门名称。词义不等于胆结石或病理结石，本文讨论其消化用途。

V11 · P02 assume*

/ə'sju:m/ v. 推测；假定

are assumed to have ... 标记解释的认识状态，不应译成已被直接观察证实。

V12 · P02 archosaur

/ɑ:kəsɔ:/ n. 主龙类动物

按本文，是涵盖鸟类、鳄类和恐龙的较大演化类群；不是胃石的类别。

V13 · P04 herbivore

/hɜ:bɪvɔ:/ n. 植食动物

与 omnivore、carnivore 并列按食性分组，并非按牙齿数量分组。

V14 · P04 omnivore

/ɒmnɪvɔ:/ n. 杂食动物

同时利用植物和动物性食物；文中只说鸟类样本包括这种食性。

V15 · P04 carnivore

/kɑ:nɪvɔ:/ n. 肉食动物

形容词 carnivorous；注意原文说鳄类样本全为肉食性，而非全部样本都是。

V16 · P04 muscular

/mʌskjələ/ adj. 肌肉发达的

highly muscular stomach 是胃部肌肉强健，和后面的 weaker stomachs 对照。

V17 · P04 wear into

/weər 'ɪntu:/ v. phr. 磨成某种形状

have been worn into ... 为完成式被动，石头承受磨损；不是穿上衣服。

V18 · P04 angular*

/æŋgjələ/ adj. 有棱角的

贯穿不同类群的比较，与 rounded 对照；不表示石头旋转的角速度。

V19 · P05 retain*

/rɪ'teɪn/ v. 保留

保留棱角分明的胃石，不能由此单独推断完全不使用胃。

V20 · P05 finishing touches*

/fɪnɪʃɪŋ ˌtʌtʃɪz/ n. phr. 最后的加工；收尾步骤

比喻胃只承担加工末端较小的部分；不是用手摸食物。

The painter returned to add the finishing touches.

画家回来完成最后的修饰。

V21 · P06 sauropod

/sɔ:rəpɒd/ n. 蜥脚类恐龙

文章以梁龙为例；其牙齿和胃石的组合引出不同于颌部研磨的解释。

V22 · P06 strip A off B*

/stri:p/ v. phr. 把A从B上剥下或捋下

leaves 是被取下的叶子，tree branches 是叶子原来所在位置，不可颠倒宾语关系。

V23 · P06 elongated

/i:lɒŋɡeɪtɪd/ adj. 延长的；细长的

cervically elongated 用正式解剖词语写颈长；less ... 委婉地说颈部较短。

V24 · P06 ungulate

/ʌŋɡjʊlət/ n. 有蹄类动物

以现代动物作消化方式的类比；those 指其胃，不是其蹄。

V25 · P06 fermentation

/fɜ:men'teɪʃən/ n. 发酵

本文用于解释食物如何分解，和机械研磨形成不同路径。

V26 · P07 be endowed with*

/bi m'daʊd wɪð/ phr. 具有；天生具备

这里说牙齿这一身体特征，不是给恐龙捐赠资金。

V27 · P07 transfer*

/træns'fɜ:/ v. 转移

was transferred from jaws to stomach 指研磨任务的演化转移，不是一次进食中的吞咽过程。

The work was transferred from the main office to a local team.

这项工作从总部转交给了当地团队。

V28 · P08 centre of gravity

/sentər əv 'grævəti/ n. phr. 重心

centralises 强调重量分布更居中；不是说胃石不再有重量。

V29 · P09 fossil record

/'fɒsəl rekɔ:d/ n. phr. 化石记录

指保存的化石证据及其显示的历史信息，不是一本专门名为该词的记录册。

V30 · P09 have the stomach for*

/hæv ðə 'stʌmək fə/ phr. 有勇气或承受力去做

通常为习语；本篇又按字面回到能研磨食物的胃，因此结尾同时照应语言与生物机制。

Notes on the text 课文注释

1 从缺失的证据，转向能够保存的线索

[P01 / P02]

开头的问题不是恐龙是否吃东西，而是怎样知道它们吃什么。内脏会腐烂，牙齿于是成为可观察线索；但失去牙齿的类群让这条途径遇到困难。这才需要第二段的胃石。

probably、suggest、are assumed to 接连出现，提醒读者这是借形态推断功能。石头 have their own tales to tell 是拟人：其形状保留了可能的使用痕迹，并非化石能直接提供一份食谱。标题 rock-solid 既可指可靠坚实，也呼应石头本身。

2 先认识现代动物，再解释恐龙胃石

[P03 / P04]

研究先比较46种现代主龙类动物的胃石，再与16种恐龙比较。现代样本中的肌肉胃和圆润石头相联系，力量较弱的胃中则有更多棱角石头，这为解释化石提供参照。

46与16都是物种数，不是石头总数；42种鸟加4种鳄类构成46。食性列举说明样本多样，而真正推进下一段的是“胃部力量—磨损程度—石头形状”这一关系，不能把植食性直接等同于圆胃石。

3 同为棱角石头，为何能有不同解释？

[P05 / P06]

结合表明植食性的牙齿和棱角胃石，作者解释鸟臀类的消化分工：主要研磨在颌部完成，胃只作收尾。蜥脚类却有不擅长同样研磨的铅笔状牙齿，棱角胃石因而变成新的疑问。

第六段提出依靠发酵分解食物的解释，并用 Dr Takasaki suspects 标明是谁的推测。相同形状不保证相同机制；必须把石头、牙齿和类群放在一起读。文章没有给每块胃石的磨损历史，不能把推测扩大成逐个个体的确定事实。

4 从有喙与圆胃石，走向研磨任务转移

[P07]

兽脚类内部有对照：特暴龙有尖齿和棱角胃石，有喙类群则出现圆胃石。作者随后把牙齿丧失和胃石变圆连接到研磨工作由颌转胃。ones 只替代 gastroliths，不是胃或牙齿。

as the work ... was transferred 写这一转移过程，使形态对照获得功能解释。这是演化尺度的分工变化；不能理解成每只动物吃饭时牙齿先掉下来，再把磨碎的任务临时交给胃。

5 重量改变位置，而非凭空消失

[P08]

第八段的重点是身体前端承载的牙齿和颌部肌肉。如果研磨结构更靠近胃，重量分布可能更居中，进而有利于离地。文章写 centralises，不是说胃石比所有牙齿都轻。

may have helped make possible 连用可能、帮助、使成为可能，避免把单一变化写成飞行的充分原因。would make it easier 也是机制上的推演。读摘要时保留“可能有助于”，比把它改成“石头让恐龙飞起来”准确得多。

6 最早鸟类无喙，为何不直接推翻前文？

[P09]

最后一段承认化石记录中的复杂性：最早的鸟没有喙。作者的论点因此不能是“有喙先出现，所以鸟才能首次出现”，而是讨论某种消化安排可能如何帮助后续的演化成功。

许多亲缘类群有喙，鸟类又至少两次演化出喙，作者据此认为转变容易发生。结尾用 part of the secret 限定为部分原因，同时用 quite literally 让 have the stomach for it 的习语落回真实的胃。

Special difficulties 难点辨析

1 鸟臀类与鸟的起源：名称不能代替谱系

[P01 / P05 / P07]

ornithischians 的中文名是鸟臀类，但本文明确说鸟来自 theropods (兽脚类)。不要仅凭中文名称中的“鸟”推定祖先关系。阅读时沿着文章给出的 gave rise to 和 group 关系整理类群，物种例子只用于帮助辨认。

2 三个 as 的功能不同

[P04 / P07 / P08]

As might be expected 是“正如可能预料的”，对后面的观察作评注；P7的 as 引出研磨任务转移的过程；P8的 as are 则表示另一事物同样具备前述性质。只把 as 背成“因为”，会破坏三个句子的不同关系。

Background 背景与延伸

1 读间接证据时，把观察和解释分开

[P04 / P05 / P06 / P08]

本课可分成三层：观察到石头圆或有棱角；据现代动物比较，推断机械研磨可能强或弱；再联系牙齿与身体结构，提出演化意义。越往后，跨越的信息越多，限定语也越值得注意。

同样的读法可用于器物考古：一件工具有磨痕，是观察；它可能被用于某类加工，是解释。恰当的类比可以帮助解释，但仍要对照其他线索，而不是把一个相似外观当成整个历史过程的证明。

Key structures 关键句型

K01 · P01 make it + 形容词 + 不定式；并列间接问句

This has made it hard to work out what they ate and how they digested it.

这让人很难弄清它们吃什么，以及如何消化食物。

it 为形式宾语，真正造成困难的内容是 to work out ...。what they ate 和 how they digested it 并列作 work out 的宾语，都用陈述语序。

句末 it 指食物，句首 This 回指失去牙齿并演化出喙造成的线索变化。不要把两个 it 认为同一个对象。

The missing notes made it hard to work out what they tested and how they measured it.

缺失的笔记让人难以弄清他们测试了什么，以及如何测量它。

K02 · P04 完成式被动：tended to have been worn

As might be expected, if an animal had a highly muscular stomach (ducks and geese), its gastroliths tended to have been worn into the sorts of rounded shapes displayed by beach pebbles.

正如人们或许会预料的，如果一种动物的胃部肌肉很发达，例如鸭和鹅，其胃石往往已被磨成类似海滩卵石的圆润形状。

主句从 its gastroliths tended ... 开始。to have been worn 是完成式被动不定式，表示观察到的石头已承受了磨损；into 后接结果形状。

As might be expected 是开头的评注，if 引出动物胃部条件，displayed by beach pebbles 修饰 rounded shapes。先抓石头“倾向于已经被磨圆”，再把条件和比较对象放回去。

The old steps tended to have been worn smooth by years of use.

这些旧台阶往往已经被多年使用磨得光滑。

K03 · P05 关系从句里嵌入 suggest

Looking at the dinosaurs, Dr Takasaki and his colleagues found that ornithischians (think Triceratops), a group which their teeth suggest were herbivores, retained angular gastroliths.

再看恐龙，Takasaki博士和同事发现，鸟臀类——可以想想三角龙——保留着棱角分明的胃石；牙齿表明，这个类群的动物是植食性的。

主干是 Dr Takasaki and his colleagues found that ornithischians retained angular gastroliths. Looking at ... 的逻辑主语是研究者，不是恐龙。

a group which their teeth suggest were herbivores 中，their teeth suggest 是嵌在关系结构中的判断来源；含义相当于 their teeth suggest that these animals were herbivores. which 对应被判断为植食性的动物类群，不是 suggest 的直接宾语“建议某个组”。复数 were 按群体成员理解。

They identified animals which the footprints suggest were very large.

他们识别出一些动物，脚印表明这些动物体型很大。

K04 · P06 using which 加插入语，再接第二层关系从句

That is more of a puzzle, for these animals had pencil-like teeth using which, it is assumed, they stripped the leaves off tree branches that less cervically elongated animals were unable to reach.

这就更令人费解了，因为这些动物的牙齿像铅笔一样；据推测，它们用这种牙齿从那些颈部较短的动物够不到的树枝上捋下叶子。

先抽出原因分句的主干 these animals had pencil-like teeth. using which 修饰 teeth，相当于 using these teeth；it is assumed 插入标记推测。

they stripped the leaves off tree branches 的宾语是 leaves. that ... were unable to reach 修饰 branches，较短颈的动物够不到的是树枝。按“牙齿作工具—捋叶子—树枝的高度限制”分层，就不会把 which 错指为树枝。

They had a small tool using which, the guide explained, they could reach parts that larger tools could not access.

他们有一件小工具，导游解释说，用它能触及大工具到不了的部位。

K05 · P06 those of：比较的是两类动物的胃

The explanation, Dr Takasaki suspects, is that like those of modern ungulates, sauropods' stomachs depended mainly on fermentation to break food down.

Takasaki博士推测，解释可能在于：蜥脚类的胃像现代有蹄类动物的胃一样，主要依赖发酵来分解食物。

The explanation is that ... 是主干；Dr Takasaki suspects 为插入语，说明解释的归属和把握程度。like those of modern ungulates 中 those 代替 stomachs，先提出比较项，再出现主语 sauropods' stomachs. depend on fermentation to break food down 是依赖发酵来分解食物；like 不把两类动物写成同一类。

The roots, like those of the nearby trees, spread close to the surface.

这些根和附近树木的根一样，贴近地表延伸。

K06 · P08 as are 倒装与省略的关系词

Teeth are heavy, as are the jaw muscles those teeth require to do their job.

牙齿很重，让牙齿发挥作用所需要的颌部肌肉也很重。

as are the jaw muscles 相当于 the jaw muscles are heavy too。倒装保留系动词 are，把重复的 heavy 省去。

those teeth require to do their job 是修饰 muscles 的关系从句，可补出 that/which。those teeth 为 require 的主语，muscles 是被需要的对象；不是肌肉需要牙齿去工作。

The box is heavy, as are the tools the workers need to repair it.

箱子很重，工人修理它所需的工具也很重。

K07 · P08 长动名词主语与两个 it

Shifting the job of grinding, and the muscles and hard surfaces involved, to the stomach centralises an animal's centre of gravity in a way that would make it easier for it to rise from the ground.

把研磨工作以及相关肌肉和坚硬表面移到胃部，会让动物的重心更集中于身体中部，从而更容易离地飞起。

Shifting ... to the stomach 是完整主语，the job of grinding 与 the muscles and hard surfaces involved 是被转移的并列内容。主句谓语为 centralises，宾语为 centre of gravity。

in a way that would make it easier for it to rise ... 修饰作用方式。make 后第一个 it 为形式宾语；for 后第二个 it 指 animal，是 rise 的逻辑主语。to rise from the ground 才是变得容易的事情。

Moving the controls closer to the driver makes it easier for her to reach them.

把控制装置移近驾驶员，能让她更容易够到它们。

K08 · P09 the fact that ... and that ... : 事实内容并列

But the fact that so many of their theropod relatives did, and that birds themselves evolved them at least twice, suggests the transition was easy.

但鸟类的许多兽脚类亲缘动物有喙，而且鸟类自身至少两次演化出了喙；这些事实表明，这种转变并不难。

主语核心为 the fact，两个 that 从句说明这个事实的内容：亲缘类群有喙；鸟自己至少两次演化出喙。

主句谓语所以是 suggests。

did 代替 had beaks；them 指 beaks。suggests 后的 the transition was easy 是推论，不是与前两个 that 从句平行的第三项已知事实。

The fact that the route is short and that buses run often suggests the journey will be manageable.

路程短且公交频繁这一事实表明，这趟出行应当不难安排。

Exercises 练习与写作

Listening 听力（选做）

选做：听录音，记录比较中的两种石头形状。

02 What two contrasting stone shapes recur in the article?

Comprehension 理解

回答时指出观察如何支持解释。

- 03 Why did toothless dinosaurs create a problem for researchers?
- 04 What do the numbers 46 and 16 refer to?
- 05 Why are angular stones in sauropods described as a puzzle?
- 06 How might moving grinding structures to the stomach help flight?
- 07 Why would “All early birds had beaks, which caused flight” misrepresent the article?

Words in use 词汇

每项用一次，必要时变形。

词库：work out / retain / give rise to / finishing touches

- 08 We need to ____ why the machine stopped.
- 09 The old house still ____ many original features.
- 10 A small misunderstanding can ____ a long argument.
- 11 Only the ____ remain before the room is ready.

Key structures 句型

保留指代与逻辑关系，完成改写。

- 12 Correct: “The missing page made difficult to understand the story.”
- 13 In P5, does which mean the researchers suggested a group, or that the animals were probably herbivores?

- 14 What does those replace in “Their stomachs, like those of other animals, were examined”?
- 15 Expand the second clause: “The teeth are heavy, as are the muscles.”
- 16 Identify the two instances of it: “The new handle makes it easier for it to be carried”, where the second it refers to a suitcase.
- 17 Use the present simple: “The fact that the streets are narrow and that buses are large ____ (suggest) a possible problem.”
- 18 In “the stones tended to have been worn smooth”, had the wear occurred before observation, and did the stones perform or receive the action?
- 19 In P6, replace using which with an ordinary phrase, and identify what the later that-clause describes.

Summary writing 摘要

用75–95词概括比较、消理解释和演化意义。

- 20 Write a 75–95-word summary.

Composition 作文 (选做)

选做：用100–120词解释为什么外观相似的物品未必有相同用途，给出一项比较办法。

- 21 Explain how you would investigate the use of an unfamiliar old object in 100–120 words.

Reference translation 参考译文

P01 怎样知道一只恐龙吃过什么？内脏在死亡后腐烂消失，因此恐龙消化过程的细节仍不清楚。最好的线索是牙齿。尖锐的牙齿很可能把肉块从猎物身上撕下来，整块吞下。坚固的研磨面表明，进食时涉及大量咀嚼。然而，许多属于兽脚类这一类群的恐龙完全失去了牙齿，演化出了喙；鸟类正是由兽脚类演化而来。这让人很难弄清它们吃什么，以及如何消化食物。

P02 不过，还有第二条线索。许多恐龙胃里有被称作胃石的石头。人们推测这些石头曾辅助消化，因此它们也有自己的故事可讲。现代鸟类和鳄类也常有胃石；它们与恐龙一样，都属于更大的演化类群——主龙类。

P03 日本冈山理科大学的Takasaki Ryuji决定展开调查。在发表于《古生物学》的一项研究中，他和同事检查了46种现代主龙类动物——42种鸟类和4种鳄类——的胃石，并将它们与16种恐龙的胃石比较。

P04 研究中的鸟类包括植食、杂食和肉食动物。鳄类则全是肉食动物。石头形状各不相同。正如人们或许会预料的，如果一种动物的胃部肌肉很发达，例如鸭和鹅，其胃石往往已被磨成类似海滩卵石的圆润形状。力量较弱的胃，例如海鸟和鳄的胃，则含有棱角更多的石头。

P05 再看恐龙，Takasaki博士和同事发现，鸟臀类——可以想想三角龙——保留着棱角分明的胃石；牙齿表明，这个类群的动物是植食性的。这意味着，这些动物主要依靠颌部磨碎食物，只让胃完成最后一点加工。

P06 长颈的蜥脚类——可以想想梁龙——也有棱角分明的胃石。这就更令人费解了，因为这些动物的牙齿像铅笔一样；据推测，它们用这种牙齿从那些颈部较短的动物够不到的树枝上捋下叶子。Takasaki博士推测，解释可能在于：蜥脚类的胃像现代有蹄类动物的胃一样，主要依赖发酵来分解食物。

P07 兽脚类肚子石头又讲述了另一番故事。特暴龙是一种与暴龙相似的高度肉食性动物，同样长着尖利的牙齿，其胃石也有明显棱角。然而，有喙的兽脚类——科学界至少识别出四个这样的类群——却有圆润的胃石。事实上，Takasaki博士观察到牙齿丧失与石头圆润程度之间存在清晰联系：研磨食物的工作从颌部转移到了胃中。

P08 这种转移可能帮助促成了鸟类在演化上的成功。牙齿很重，让牙齿发挥作用所需要的颌部肌肉也很重。这让动物身体前端承受了很大重量。把研磨工作以及相关肌肉和坚硬表面移到胃部，会让动物的重心更集中于身体中部，从而更容易离地飞起。

P09 有趣的是，化石记录清楚表明，最早的鸟类并没有喙。但鸟类的许多兽脚类亲缘动物有喙，而且鸟类自身至少两次演化出了喙；这些事实表明，这种转变并不难。因此，成功飞上天空的部分秘诀，可能真的就在于拥有能胜任这份工作的胃。

Reference answers 参考答案与解析

开放题不要求与参考答案逐字一致；先检查信息和意思，再修改表达。

Before you read 读前思考

01 读前思考

Teeth may indicate how food was taken or chewed, while worn stones may offer clues about processing inside the stomach.

提出可能线索即可；不要把所有胃石都认定为同一种用途。

Listening 听力

02

Rounded and angular.

抓住贯穿不同类群的比较，不要求默写专有动物名称。

Comprehension 理解

03

Teeth are useful indicators of diet and digestion, so their absence removes an important source of evidence.

内脏难保存，使牙齿缺失尤其重要。

04

Forty-six modern archosaur species and sixteen dinosaur species whose gastroliths were compared.

不是个体数，也不是胃石颗数。

05

Their pencil-like teeth were not the same grinding tools described earlier, yet their stomach stones were angular too. Fermentation is proposed as an explanation.

连接牙齿、石头形状与另一种分解方式。

06

It could move weight away from the front and concentrate it nearer the centre of the body, making rising from the ground easier.

说的是分布，不是石头没有重量。

07

The earliest birds lacked beaks, and the proposed digestive shift is presented as a possible contributing factor, not the sole cause of flight.

同时纠正历史信息 and 因果强度。

Words in use 词汇

08

work out

to 后用原形，表示弄清原因。

09

retains

可接受表达：

- retained

通常按现在情景用 retains，与单数 house 一致；若采用过去叙事，retained 也成立。still 强调仍保留。

10

give rise to

can 后接原形；to 为介词。

11

finishing touches

复数 touches 对应 remain；主要工作已完成。

Key structures 句型**12**

The missing page made it difficult to understand the story.

可接受表达：

- The missing page made understanding the story difficult.

补形式宾语 it；也可用 made understanding the story difficult.

13

It introduces the animals that the teeth suggest were herbivores.

their teeth 是 suggest 的主语；不要按汉语词序把 group 当作建议的内容。

14

stomachs

比较项必须是胃与胃。

15

The teeth are heavy, and the muscles are heavy too.

可接受表达：

- The teeth are heavy, and the muscles are also heavy.
- The muscles are heavy too.
- The muscles are also heavy.

as are 表同样如此，不是因为肌肉。

16

The first it is a formal object; the second refers to the suitcase, the thing being carried.

to be carried 是真正变容易的事；第二个 it 是被动不定式的逻辑主语。

17

suggests

主语中心词为单数 fact，而不是 streets 或 buses。

18

The wear had already occurred; the stones received the action.

have been worn 是完成式被动不定式，不能把石头理解为磨其他物体的主动主语。

19

using these teeth; the later that-clause describes tree branches.

第一层关系回到 teeth 这一工具；第二层关系限制动物够不到的 branches。

Summary writing 摘要

20

Researchers compared stomach stones from modern birds and crocodilians with those from dinosaurs. Rounded stones tended to occur in muscular stomachs, suggesting that their shapes reveal how food was processed. Beaked theropods had rounded stones, supporting a shift of grinding work from jaws to stomach. Moving the associated structures towards the body's centre may have helped birds fly successfully. However, the earliest birds lacked beaks, and the article presents the digestive change as a possible part of a complex evolutionary story.

保留比较对象与 may；不必罗列所有类群名称。将“有石头所以会飞”改成重量分布可能有助飞行。

Composition 作文

21

An old object can look like a familiar tool without having the same use. I would begin by describing its material, shape and signs of wear, keeping these observations separate from my first guess. I would then compare it with objects whose functions are known. Similar marks might suggest similar use, but the object's size or the place where it was found could support another explanation. Useful as a modern comparison is, it cannot supply the whole history. I would therefore look for several clues that fit together and state which parts of the explanation remain uncertain. A careful account should make the evidence clearer without pretending that every question has been answered.

要有观察、类比、交叉线索和不确定之处；避免仅写“看上去像，所以一定是”。