

How to study Antarctic ice without blowing it up

不用炸药，怎样看清南极冰层？

The sound of giant tractors may replace dynamite

巨型履带车的声音或可代替炸药

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一辆红色履带车在积雪地面上作业，远处可见海面与雪山。

难度 58 / 100

建议60–80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

一辆承担运输任务的极地履带车，还能成为研究冰层的工具。文章先解释需要看清什么，再介绍传统方法的代价、替代声源的试验与比较。精读重点是沿着“问题—机制—限制—验证”读懂方法改进，同时保留研究结论的适用范围。

- 解释声音信号为何能够帮助重建冰雪内部结构
- 拆解倒装、长主语和多层宾语从句
- 辨认比较对象与替代词those的指代
- 用证据和限定语概括实验结果

Before you read 读前思考

Why might researchers replace a method that already works?

拓展例句与练习情境用于说明用法。

书末答案 (p.11)

Text 课文

[P01] THE PISTENBULLY 300 Polar Antarctic vehicle is a 8.5-tonne heavy-duty specialised monster built to withstand extreme polar conditions.^{V01V02} It features wide tracks, massive pulling strength, powerful cranes and multi-purpose tools designed for the toughest ice and snow operations.^{V03} No Antarctic base should be without one. Research led by Liu Guofeng at China University of Geosciences in Beijing, however, suggests the PistenBully may be capable of more than just fetching and carrying.^{V04V05} As Dr Liu writes in the Journal of Glaciology, it is also able to do actual science.



一辆红色履带车在积雪地面上作业，远处可见海面与雪山。

[P02] Antarctica's ice sheet is the largest reservoir of freshwater on Earth, but it is shrinking.^{V06} Just above the ice proper, but below the surface snow, is a transition zone 50-100 metres thick called the firn layer.^{V07V08V09K01} This is where snow is compressed into ice.^{V10} It is also where meltwater from above is captured in pores and refrozen.^{V11} Knowing the firn layer's exact thickness and understanding how it behaves is crucial to predicting what will happen, over the long term, to the ice sheet and thus to the world's sea levels.^{V12K02} Visualising this subsurface melange is difficult, though.^{V13}

15 [P03] Current practice, borrowed from oil- and gas-prospecting, is to use an "active source".^{V14} This is geologist-speak for dropping a stick of dynamite down a drill hole and listening to the explosion's sound, propagated through the rock—or, in this case, ice.^{V15} The listening is done by sensors called geophones.^{V16} Since sound travels at different speeds through water, ice and snow, a computer analysis of when and how powerfully the echoes arrive at different geophones permits construction of a high-resolution image of the firn layer.^{V17K03}

[P04] This works, but is not ideal. First, someone has to drill the hole down which to drop the dynamite.^{K04} That is not always possible in polar conditions. Then, the explosive must be purchased, brought to Antarctica and the actual dropping carried out. Moreover, detonating dynamite in sensitive environments is not to be done lightly.^{V18V19} An alternative source of

25 sound would thus be good. And, after hearing the din created by a convoy of PistenBullys, Dr Liu thought they might be the very thing.^{V20V21V22}

[P05] To this end, he and his colleagues experimented with geophones already in place in the Larsemann Hills of East Antarctica.^{V23} They commandeered some PistenBullys and arranged for them to be driven around the hills.^{V24K05} They found that if the vehicles were sent along both
30 sides of a line of geophones, parallel with the sensors, they got the effect they were after.^{V25}

[P06] Since the Larsemann Hills' firn had already been mapped the old-fashioned way, Dr Liu was able to compare his machine-created images with those obtained using dynamite.^{K06} They were pretty much identical.^{V26} He thus seems to have devised a way of mapping the firn's structure that is simpler than blowing it up, but equally good.^{V27}

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 heavy-duty

/ˈhevi 'dju:ti/ adj. 重型的；耐高强度使用的
修饰专用车辆，说明设计用途和承载条件，不是说它承担繁重的道德义务。

V02 · P01 withstand*

/wɪð'stænd/ v. 经受住；抵抗
直接接环境、压力等宾语，不加介词；过去式与过去分词均为 withstood。

The shelter withstood the storm.

避难棚经受住了风暴。

V03 · P01 track

/træk/ n. 履带
wide tracks 在履带车语境中不是铁轨。宽履带与强牵引力并列介绍装备。

V04 · P01 be capable of*

/bi 'keɪpəbəl əv/ phr. 能够；有能力做
of 为介词，后接名词或动名词；more than just 限定的不是能力上限，而是说能力超出搬运。

The software is capable of handling larger files.

这套软件能够处理更大的文件。

V05 · P01 fetch

/fetʃ/ v. 去取来
fetch 通常包含去某处拿来，carry 则强调搬运。二者并列把车辆日常支援任务说得轻松。

V06 · P02 reservoir

/ˈrezəvwa:/ n. 储库；蓄积体
这里写储存淡水的巨大冰体，不是特指人工水库。

V07 · P02 proper*

/ˈprɒpə/ adj. (后置) 严格意义上的；本身的
the ice proper 指真正的冰体，与上面的粒雪和表层积雪区分；不是道德意义上的正确。

V08 · P02 transition zone

/træn'ziʃən zəʊn/ n. phr. 过渡带
说明不同物质状态或层次之间的区域；本篇随即给出位置、厚度和名称。

V09 · P02 firn

/fɪən/ n. 粒雪
本文指积雪逐渐压实成冰过程中的材料。本课采用 Collins 的英式读音。

V10 · P02 compress

/kəm'pres/ v. 压缩；压实
is compressed into ice 为被动，into 写变化结果；文中讨论由雪到冰的过程。

V11 · P02 pore

/pɔ:/ n. 孔隙
融水可进入的微小空间。此处不是动词 pore over (仔细研读)。

V12 · P02 crucial to*

/ˈkru:ʃəl tu:/ adj. phr. 对...至关重要
to 为介词，后接 predicting。不要因为看到 to 就一律改用动词原形。

V13 · P02 melange

/meɪˈlɑ:nʒ/ n. 混合物
回指前文雪、冰、孔隙和融水构成的复杂层次；不是新增的一种物质。

V14 · P03 prospecting

/ˈprɒspektɪŋ/ n. 勘探
oil- and gas-prospecting 为石油和天然气勘探，和 prospect (前景) 相关但本课用专门义。

V15 · P03 propagate

/ˈprɒpəgeɪt/ v. 传播；传递

这里是声波在介质中传播；过去分词短语修饰 sound，不是指宣传某种观点。

V16 · P03 geophone

/ˈdʒiːəfəʊn/ n. 地震检波器

文中用 sensors 先给出上位概念；它记录振动信号，不是直接拍摄冰层的照相机。

V17 · P03 high-resolution

/ˈhaɪ rezəluːʃən/ adj. 高分辨率的

修饰由分析构建的图像；图像来自回声数据，不表示研究者已目视看到了冰层内部所有细节。

V18 · P04 detonate

/detəneɪt/ v. 引爆；爆炸

detonating dynamite 整体作主语，本篇在评价这种方法的环境和操作代价。

V19 · P04 lightly*

/ˈlaɪtli/ adv. 轻率地；不加慎重考虑地

not to be done lightly 不是说动作不能轻一点，而是说不应草率决定。

V20 · P04 din

/dɪn/ n. 喧闹声；嘈杂声

把令人烦扰的声音写成可能有科研用途的信号，为转折提供契机。

V21 · P04 convoy

/ˈkɒnvɔɪ/ n. 车队

本课是一起行驶的履带车队，不必添加军队护送等原文未给的情境。

V22 · P04 the very thing*

/ðə 'veri θɪŋ/ n. phr. 正是所需之物

very 在名词前强调“正是”，不是副词“非常”修饰 thing。

V23 · P05 to this end*

/tə ðɪs end/ phr. 为此；为达到这一目的

承接寻找替代声源这一目标，不是到达某条道路的尽头。

The team wanted cleaner data. To this end, it repeated the measurements.

团队希望获得更干净的数据，为此重复了测量。

V24 · P05 commandeer

/kəməneɪ'diə/ v. 调来使用；征用

本文写调来车辆做试验；没有交代法律征用程序，不应补成武力夺取。

V25 · P05 be after*

/bi 'ɑːftə/ phr. 想要；寻求

the effect they were after 即他们寻求的效果；after 不是时间上的“之后”。

V26 · P06 pretty much*

/ˈprɪti mʌtʃ/ phr. (非正式) 几乎；差不多

限定 identical，保留细微差别的余地；pretty 在这里不表示漂亮。

V27 · P06 devise

/dɪ'vaɪz/ v. 设计出；想出

常接 method、plan、system。不要与名词 device (装置) 混淆。

Notes on the text 课文注释**1 monster 与 actual science：从运输角色转向测量角色****[P01]**

monster 形容机器庞大、强劲，随后由履带、牵引力、起重装置和工具具体展开。No Antarctic base should be without one 带有赞叹和推荐语气，并不是关于所有科考站装备的调查。

however 才引出真正的新闻：车辆发出的声音可能参与测量。more than just fetching and carrying 不是否定运输价值，而是拓宽用途；actual science 与搬运形成角色上的对比，不表示后勤工作“没有价值”。

2 为什么先花一段解释粒雪层？**[P02]**

第二段先交代研究对象的层次：表面是雪，下方是雪逐渐压实成冰的过渡带，再往下是严格意义上的冰体。粒雪层孔隙能容纳并重新冻结融水，因此理解它的厚度与变化，是预测冰盖行为的一部分。

这段的因果链是“粒雪层结构与行为—冰盖未来变化—海平面”。is crucial to 说明信息很关键，没有说只知道粒雪层厚度就能单独预测全球海平面；over the long term 限定讨论的时间尺度。

3 声音怎样变成结构图像？

[P03]

主动声源的方法，是先产生信号，再让检波器记录它穿过或受到冰雪内部结构影响后的响应。文中关键不是“听到很响的一声”，而是比较不同传感器收到回声的时间和强度，再借计算机分析构建图像。

可以把它想成对看不见的结构进行间接测量：不同材料中的传播速度不同，信号到达的差别就带有路径和材料的信息。原文没有给出具体速度或反演公式，因此不需要编造数字来解释。geophones 是记录者，computer analysis 才负责把记录组织成图像。

4 This works, but is not ideal：有效仍可能值得改进

[P04]

works 承认方法能完成任务；not ideal 随后从钻孔、运输、投放和环境影响四个方面讨论代价。不是“测不准，所以放弃”，而是问能否在保留效果的同时，让操作更简单。

is not to be done lightly 带有慎重行事的规范语气；这里的 sensitive environments 指容易受干扰的环境。听到车队的 din 后，研究者把通常被视为背景噪声的东西重新看作可利用声源，这才连接到下一段的试验。

5 测试车辆，并不是在任何地点随便开一圈

[P05]

To this end 把试验与前面的目标接上。文中交代了现有检波器、车辆行驶区域以及相对传感器的方向。both sides 和 parallel 是布置条件；删掉这些信息，只说“车辆能测冰层”，会过度泛化试验结果。they got the effect they were after 的第二个 they were after 修饰 effect，相当于 the effect that they wanted。这里先报告得到了所需信号效果，下一段再通过与传统图像比较来判断新办法是否可靠。

6 “几乎相同”支持什么，又没有证明什么？

[P06]

传统方法此前已为同一地区绘图，提供了比较基准。those obtained using dynamite 指旧方法取得的图像，所以比较双方是“新图像与旧图像”，不是车辆与炸药的外形。

pretty much identical 表示几乎一致；seems to have devised 保留结论的审慎程度。这些结果支持新方法在这次研究中的可行性，不直接证明它已在南极所有地形、所有深度或所有天气下胜过旧方法。

Special difficulties 难点辨析

1 a 8.5-tonne：原文中的冠词不宜照搬

[P01]

所给材料第一句写 a 8.5-tonne。8.5 读作 eight point five，以元音音素开头；规范搭配应使用 an 8.5-tonne vehicle。本课保留所给正文，在写作和练习中使用 an。

冠词看读音，不是看字形。an eight-year-old child 与 a one-year-old child 不同，因为 one 以辅音音素 /w/ 开头。这里的更正针对英语用法，不改动车重信息。

2 两个 to：不定式标记与介词

[P01 / P02]

able to do 中 to 后接动词原形；capable of doing 与 crucial to predicting 中 of、to 都是介词，后接动名词。不要把中文“能够”和“对...关键”的相近表达误当成同一种搭配。

The device is able to record sound; accurate timing is crucial to interpreting the results.

设备能够记录声音；准确计时对解读结果至关重要。

Background 背景与延伸

1 噪声与信号，是相对于研究目的而言

[P03 / P04 / P05]

对想安静交谈的人，车队轰鸣是噪声；对需要让振动穿过冰层并被检波器记录的研究者，它可能是有用输入。改变的首先是用处，而非声音突然拥有了全新的物理性质。

但“已有声音”并不自动等于“足够好的测量”。第五段说明研究者仍需安排车辆路线，第六段说明仍需比较图像。这使文章的创新既容易理解，又不被简化成偶然听见噪声就完成研究。

Key structures 关键句型

K01 · P02 地点短语前置后的完全倒装

Just above the ice proper, but below the surface snow, is a transition zone 50-100 metres thick called the firn layer.

在真正的冰体上方、表层积雪下方，有一个厚50至100米的过渡带，称为粒雪层。

常规次序是 A transition zone ... is just above the ice proper, but below the surface snow。原句把位置放在开头，再用 is 引出新对象，是地点说明中的完全倒装，不是疑问句。

50-100 metres thick 是后置的厚度描述；called the firn layer 是过去分词短语，补充名称。先抓“某处有一个过渡带”，再接尺寸和名称，就能读清这一长主语。

Below the main hall is a small room used for storage.

大厅下方有一间用作储藏室的小房间。

K02 · P02 长主语与宾语从句：先定位 is crucial

Knowing the firn layer's exact thickness and understanding how it behaves is crucial to predicting what will happen, over the long term, to the ice sheet and thus to the world's sea levels.

要预测从长远看冰盖、进而全球海平面将如何变化，了解粒雪层的确切厚度及其行为至关重要。

主语由 Knowing ... and understanding ... 两个动名词部分组成，本文把“了解厚度与行为”作为一个整体认识任务，用 is。understanding 的宾语是 how it behaves，it 指粒雪层。

谓语之后 crucial to 接 predicting；predicting 的宾语又是 what will happen ... to the ice sheet。over the long term 插在 happen 与 to 之间，thus 再把影响推进到海平面。不要把主语里的 understanding 误当成主句谓语。

Knowing the route and understanding how the bus system works is essential to planning a short visit.

了解路线并弄清公交系统如何运作，对规划一次短途游览至关重要。

K03 · P03 of 后的并列疑问信息：何时、以多强的程度

Since sound travels at different speeds through water, ice and snow, a computer analysis of when and how powerfully the echoes arrive at different geophones permits construction of a high-resolution image of the firn layer.

由于声音在水、冰和雪中的传播速度不同，计算机分析回声何时、以多大强度到达不同检波器，便能据此构建粒雪层的高分辨率图像。

Since 引导原因：声音在不同介质中速度不同。主句主语是 a computer analysis，核心谓语是 permits，construction 是允许实现的结果。

of when and how powerfully the echoes arrive ... 说明分析的内容。when 问到达时间，how powerfully 问强度；两者共享 the echoes arrive。嵌入句中用陈述语序，不写 when do the echoes arrive。

An analysis of when and how often customers return helps the shop assess demand.

分析顾客何时、多频繁地再次光顾，有助于商店判断需求。

K04 · P04 介词 + which + 不定式：供...使用的孔

First, someone has to drill the hole down which to drop the dynamite.

首先，得有人钻出一个可向下放入炸药的孔。

the hole down which to drop the dynamite 是压缩的关系结构，可展开为 the hole down which someone can drop the dynamite。down which 交代向孔内下方投放的方向；which 不能换成 that 放在 down 后。

主句先说 someone has to drill the hole，因此不定式里没有再写动作执行者。理解时补出可行的动作关系即可，不要误认为 hole 自己投放炸药。

They need a container in which to store the samples.

他们需要一个可用来存放样品的容器。

K05 · P05 arrange for somebody/something to be done

They commandeered some PistenBullys and arranged for them to be driven around the hills.

他们调来了一些PistenBully车辆，并安排车辆绕着丘陵行驶。

arranged for them to be driven 是安排车辆被驾驶。them 回指 PistenBullys；to be driven 为被动不定式，因为车辆承受驾驶这一动作。

与 arrange to drive the vehicles 相比，原句不说明安排者本人开车。for 在这里引出不定式的逻辑主语，不是泛泛的“为了它们”。

The team arranged for the equipment to be delivered before the test.

团队安排在测试之前把设备送达。

K06 · P06 those 替代复数名词，保留比较口径

Since the Larsemann Hills' firm had already been mapped the old-fashioned way, Dr Liu was able to compare his machine-created images with those obtained using dynamite.

由于拉斯曼丘陵的粒雪层此前已用传统方法绘制成图，Liu博士能够把车辆声源生成的图像与用炸药取得的图像作比较。

Since 在这里引出原因：同一区域先前已经用旧方法制图。had already been mapped 为过去完成时被动，把既有测绘放在此次比较之前。

compare his machine-created images with those obtained using dynamite 中 those 代替 images，obtained ... 修饰 those。using dynamite 说明获取方式。若把 those 理解成炸药，就把比较对象错换了。

The team compared the new measurements with those recorded last winter.

团队将新测量结果与去年冬天记录的结果作比较。

Exercises 练习与写作

Listening 听力（选做）

选做：听配套录音，按出现顺序记录研究对象、旧声源与新声源。

02 Name the layer studied and the two sources of sound compared.

Comprehension 理解

用文章中的机制和证据回答，避免把推测升级成保证。

03 Why do the timing and strength of echoes matter?

04 What is the main criticism of the dynamite method?

- A. It never produces useful images.
- B. It works, but drilling, transport and environmental concerns make it inconvenient.
- C. It cannot be used anywhere in Antarctica.

05 What made a direct comparison of the two imaging methods possible?

06 Does the article prove that vehicle sound will work equally well everywhere?

Words in use 词汇

选择表达填空，每项用一次，必要时变形。

词库：withstand / to this end / the very thing / pretty much

07 The new roof must ____ strong winds.

08 The team wanted to reduce waiting times. ____, it opened another entrance.

09 We needed a quiet room, and the empty office was ____.

10 The two designs are ____ identical, apart from the colour.

Key structures 句型

保持原意；先读清结构，再尝试改写。

11 Rewrite in ordinary subject-first order: “Under the stairs is a cupboard used to store cleaning equipment.”

12 In P2’s sentence beginning “Knowing...”, what is the main predicate?

13 Correct: “The analysis shows when do the signals arrive.”

- 14 Rewrite using in which to: “We need a place where we can keep the equipment.”
- 15 Complete in the passive: “They arranged for the samples ____ (collect) on Friday.”
- 16 What does those replace in “Compare these images with those obtained last year”?
- 17 Choose a or an: “____ 8.5-tonne vehicle”.

Summary writing 摘要

用70–90词说明研究对象、方法替换、验证与结论范围。

- 18 Write a 70–90-word summary.

Composition 作文 (选做)

选做：用100–120词介绍一个用现有工具解决新问题的设想，写出比较办法与一项限制。

- 19 Propose a new use for an existing tool in 100–120 words.

Reference translation 参考译文

P01 PistenBully 300 Polar南极作业车是一台重8.5吨的重型专用“巨兽”，为承受极端极地条件而造。它配有宽阔的履带、强大的牵引力、有力的起重装置，以及为最艰苦冰雪作业设计的多用途工具。任何南极科考站都不应缺少这样一辆车。不过，北京的中国地质大学由Liu Guofeng带领开展的研究表明，PistenBully的本领可能不只限于取东西和搬运。正如Liu博士在《冰川学杂志》中所写，它还能真正参与科学研究。

P02 南极冰盖是地球上最大的淡水储库，但它正在缩小。在真正的冰体上方、表层积雪下方，有一个厚50至100米的过渡带，称为粒雪层。积雪在这里被压实成冰。上方流下的融水也会在这里被困在孔隙中，重新冻结。要预测从长远看冰盖、进而全球海平面将如何变化，了解粒雪层的确切厚度及其行为至关重要。不过，要让这层表层以下混合物的结构显现出来并不容易。

P03 目前采用的方法借鉴自油气勘探，是使用一种“主动声源”。地质学家的这套说法，指的是把一根条状炸药放入钻孔，监听爆炸产生的声音在岩石——在这里则是冰——中传播的情况。承担监听任务的是称为地震检波器的传感器。由于声音在水、冰和雪中的传播速度不同，计算机分析回声何时、以多大强度到达不同检波器，便能据此构建粒雪层的高分辨率图像。

P04 这个办法有效，却并不理想。首先，得有人钻出一个可向下放入炸药的孔。极地条件下，这并不总能做到。接着，必须采购炸药、将其运到南极，并实际完成投放。此外，在脆弱环境中引爆炸药，也不能轻率为之。因此，如果能有另一种声源就好了。听到一队PistenBully车辆发出的喧闹声后，Liu博士觉得它们或许正是所需的東西。

P05 为此，他和同事利用已经布设在东南极拉斯曼丘陵的检波器展开试验。他们调来了一些PistenBully车辆，并安排车辆绕着丘陵行驶。他们发现，让车辆沿一系列检波器的两侧、平行于传感器排列方向行驶，就能得到他们想要的效果。

P06 由于拉斯曼丘陵的粒雪层此前已用传统方法绘制成图，Liu博士能够把车辆声源生成的图像与用炸药取得的图像作比较。两者几乎完全一样。因此，他似乎设计出了一种描绘粒雪层结构的方法，比用炸药更简单，却同样有效。

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

A replacement may be easier to use, cost less or disturb the environment less while giving comparable results.

至少区分效果与实施代价。读后检查本文具体提出的是钻孔、运输、环境还是精度问题。

Listening 听力

02

The firn layer; dynamite explosions and the sound of PistonBully vehicles.

冰盖是更大的研究背景；本次具体成像对象是粒雪层。

Comprehension 理解

03

Sound travels at different speeds through water, ice and snow. The echo data can therefore be analysed to construct an image of the firn layer.

检波器记录信号，计算机分析重建图像；并非直接拍摄冰层内部照片。

04

B. It works, but drilling, transport and environmental concerns make it inconvenient.

原文先承认 This works。没有说所有图像错误，也没有说南极不可能钻孔。

05

The firn in the same area had already been mapped using the traditional method.

同一区域的已有结果提供比较基准；不是仅因为两种设备同时存在。

06

No. It describes a particular trial whose images were nearly identical to those from the older method.

pretty much 与 seems 保留范围和谨慎程度。回答应点出试验条件，而不是空泛说科学永远不确定。

Words in use 词汇

07

withstand

must 后接原形，withstand 直接带宾语。

08

To this end

承接目标，引出为实现目标采取的行动。

09

the very thing

意思是正合所需，不是非常的东西。

10

pretty much

保留近似程度，apart from 说明仍有差别。

Key structures 句型**11**

A cupboard used to store cleaning equipment is under the stairs.

used to store ... 仍修饰 cupboard；不要把地点倒装误改成疑问句。

12

is crucial to predicting what will happen to the ice sheet and thus to sea levels

主句系动词为 is；understanding 和 predicting 不是独立的限定动词。

13

The analysis shows when the signals arrive.

嵌入的间接疑问从句用陈述语序，删去 do。

14

We need a place in which to keep the equipment.

in which 指地点关系，不可以写 in that to。

15

to be collected

samples 是被收集的对象，arrange for 后用带逻辑主语的被动不定式。

16

images

用同类对象进行比较；obtained last year 后置修饰。

17

an

eight 以元音音素开头；所给文章第一句的 a 不宜照搬。

Summary writing 摘要**18**

Researchers need images of Antarctica's firn layer to understand the ice sheet's behaviour. The traditional method uses dynamite, but drilling, transport and environmental concerns make it inconvenient. Liu's team tested sounds from PistenBully vehicles instead, arranging them to travel alongside existing sensors. The resulting images were nearly identical to earlier ones made with dynamite. The trial suggests that vehicle sound can offer a simpler way to map the layer, though the article does not establish that it works everywhere.

应说明比较基准和 nearly identical，避免只罗列车辆零件。把 has replaced dynamite everywhere 改成 the trial suggests a simpler alternative，才能恢复证据范围。

Composition 作文**19**

A school could use ordinary smartphones to investigate noise around its buildings. Students would record short samples at the same locations and times on several days. To make the comparison fair, they would use the same phone settings and keep the distance from the road constant. The recordings might identify places where lessons are often disturbed. However, phone microphones would not automatically provide precise professional measurements. The team would therefore compare a small set of results with those obtained from a proper sound meter. If the patterns were similar, the phones could offer a simple first survey, while important decisions would still require better evidence.

方案应包含工具、新用途、比较条件与限制。不能仅说 everyone has a phone, so the data must be correct ; 设备常见与测量有效是两件事。设想不应写成已完成的真实调查。