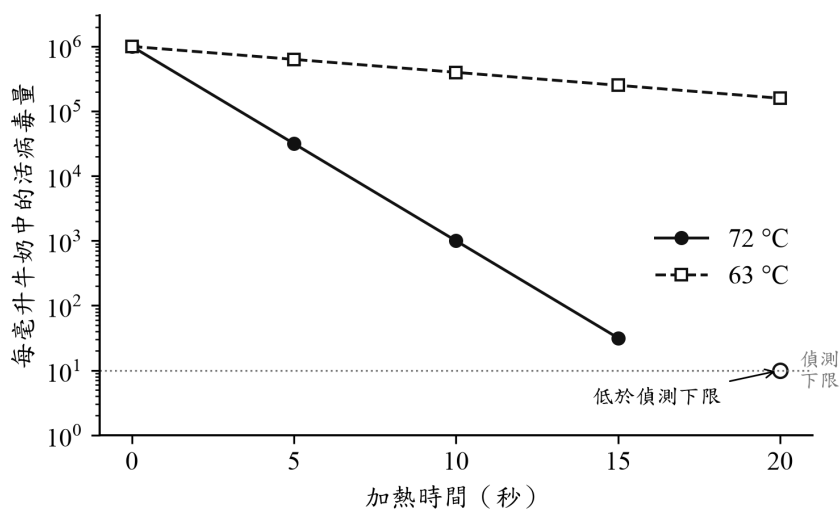


牛奶裡的禽流感病毒，殺得死嗎？

閱讀下列敘述後，回答 1~5 題。

2024 年，H5N1 禽流感病毒在美國多州的乳牛之間傳播。美國食品藥物管理局（FDA）抽驗市售的巴氏殺菌乳品，約五分之一的樣本驗出這種病毒的遺傳物質片段；但把陽性樣本接種到雞蛋胚胎中培養，並沒有培養出具感染力的活病毒。

為了解加熱對病毒的影響，某實驗室把含有活病毒的生乳分裝成多管，每管起始活病毒量都是每毫升 10^6 個感染單位，分別置於 63°C 與 72°C 的水浴中加熱不同秒數，取出後立刻冰浴，再以細胞培養計算殘存的活病毒量。這個方法能偵測的下限為每毫升 10 個感染單位，結果如圖(一)（情境數據）。



圖(一) 縱軸為對數刻度

微生物學常用「D 值」描述加熱殺滅的速度：在某一溫度下，使活微生物數量減少為原本十分之一所需的時間。

- () 1. 依圖(一)，在 72°C 加熱 10 秒後，活病毒量約變為原本的幾分之一？
 (A) 3 (B) 30 (C) 1000 (D) 3000
- () 2. 依圖(一)， 63°C 與 72°C 下的 D 值各約為多少？
 (A) 25 秒；3.3 秒 (B) 5 秒；1.5 秒
 (C) 0.2 秒；1.5 秒 (D) 25 秒；15 秒
- () 3. 若 63°C 時活病毒量持續以相同速率下降，要從每毫升 10^6 個降到偵測下限 10 個，約需加熱多久？
 (A) 25 秒 (B) 50 秒 (C) 125 秒 (D) 150 秒

- () 4. FDA 在市售乳品中「驗出病毒遺傳物質片段」，卻「培養不出活病毒」。
- 下列解讀何者最恰當？
- (A) 驗出遺傳物質就表示牛奶中一定有活病毒，培養結果必然有誤
 - (B) 片段可能是病毒被加熱破壞後的殘留，檢出片段不等於有感染力；培養結果支持病毒已失去活性
 - (C) 兩種結果互相矛盾，所以這次檢測無法提供任何資訊
 - (D) 培養不出活病毒，證明這些乳品從來沒有接觸過病毒
- () 5. 某生看到 72 °C 加熱 20 秒「低於偵測下限」，便說：「加熱 20 秒後牛奶中完全沒有任何活病毒。」若要更嚴謹地檢驗這個說法，下列做法何者最恰當？
- (A) 把同一管樣本的培養時間縮短，加快得到結果
 - (B) 改用起始病毒量較低的生乳重做，比較容易得到「未檢出」
 - (C) 濃縮更大體積的加熱後樣本再培養，並設置未加熱的對照組，確認方法偵測得到活病毒
 - (D) 改用 63 °C 加熱 20 秒，比較兩溫度的結果

Is the Dire Wolf Really Back?

Read the article and the fact file, and answer questions 1–7.

In April 2025, Colossal Biosciences, an American company, made a remarkable announcement: three white, fluffy pups living on a secret nature reserve were dire wolves, a species that became extinct more than 10,000 years ago. Two of the pups, Romulus and Remus, were born in October 2024, and Khaleesi followed in January 2025. Within days, photographs of the pups had circulated worldwide.

Contrary to what many headlines implied, Colossal did not bring an ancient animal back from frozen cells. Instead, its scientists read DNA from two old fossils, a tooth and part of a skull, and compared it with the DNA of the gray wolf, which the company describes as the dire wolf's closest living relative. They then made 20 edits to the gray wolf's DNA, aiming for the large body, wide head, and pale coat that the company believes dire wolves had. Dogs carried the edited embryos and gave birth to the pups.

Not everyone was persuaded. Many scientists pointed out that the two species differ in far more than 20 places, so the pups remain almost entirely gray wolves. Some called them gray wolves wearing a dire wolf costume, and a group of wolf experts said the animals should be described as genetically modified gray wolves. Others argued that the real problem lies in the word “species” itself: if an animal looks and acts like a dire wolf, does it matter how it was made?

There is also a question that genetic information alone cannot answer. Wolves acquire hunting skills and social behavior from their parents and their pack. With no dire wolf alive to teach these pups, even an animal carrying perfect dire wolf genes might never learn to live the way ancient dire wolves did.

The company says the same tools could one day help save animals that are still alive, such as the endangered red wolf, and it announced four cloned red wolves at the same time. Critics reply that the money spent on headline-grabbing projects might do more good if it were used to protect the habitats of wild wolf populations.

* embryo 胚胎 clone 複製（以一個生物的細胞產生基因相同的個體）

Fact File

Item	Detail
Genes changed	14
Edits made	20 (15 copy dire wolf versions)
Pups born	3
Fossils used	2 (a tooth and part of a skull)

- () 1. Which of the following best describes the main idea of the article?
- (A) Gene editing let Colossal recreate dire wolves exactly as they once lived.
 (B) The main debate is whether the pups will be able to hunt in the wild.
 (C) The pups raise doubts about whether gene editing can revive a lost species.
 (D) Colossal studied dire wolf DNA mainly to find a way to save the red wolf.
- () 2. In the last paragraph, the word “headline-grabbing” is closest in meaning to _____.
- (A) reported inaccurately (B) attracting wide attention
 (C) costing more than expected (D) criticized by experts
- () 3. In the third paragraph, what does “it” in “how it was made” refer to?
- (A) A gray wolf born to a dog. (B) The word “species” itself.
 (C) A dire wolf from long ago. (D) An animal that acts like a dire wolf.
- () 4. Based on the article and the fact file, which of the following can be inferred?
- (A) Some genes got several edits, and not every edit used a dire wolf version.
 (B) Colossal edited 20 different genes, one for each change it wanted to make.
 (C) Each of the two fossils provided the DNA for about ten of the edits.
 (D) The pups’ DNA now differs from gray wolf DNA in exactly 15 places.
- () 5. Which situation is most similar to the problem described in the fourth paragraph?
- (A) A cloned sheep looks exactly like the sheep whose cells were used.
 (B) A bird raised alone in a zoo never learns the songs of its own kind.
 (C) A dog grows larger than other dogs because of the genes it carries.
 (D) A gray wolf’s coat turns pale when it moves to a colder place.
- () 6. Which of the following, if true, would best support the critics’ view in the last paragraph?
- (A) Other companies are also planning to edit the DNA of extinct animals.
 (B) The four cloned red wolves are healthier than most wild red wolves.
 (C) Red wolves are disappearing mainly because their habitats are being destroyed.
 (D) The three pups have grown to the size that Colossal predicted.
7. Complete the summary with ONE word from the article (not the fact file) in each blank. Change the form of the word if necessary.
- Colossal’s scientists (A) _____ gray wolf DNA in 20 places, hoping the pups would look like dire wolves. Wolf experts, however, insist that the animals are gray wolves that have been (B) _____ modified. Since a wolf’s way of life comes from its pack rather than its genes, the pups, with no dire wolf to learn from, may never (C) _____ the hunting skills and social behavior of their extinct relatives.

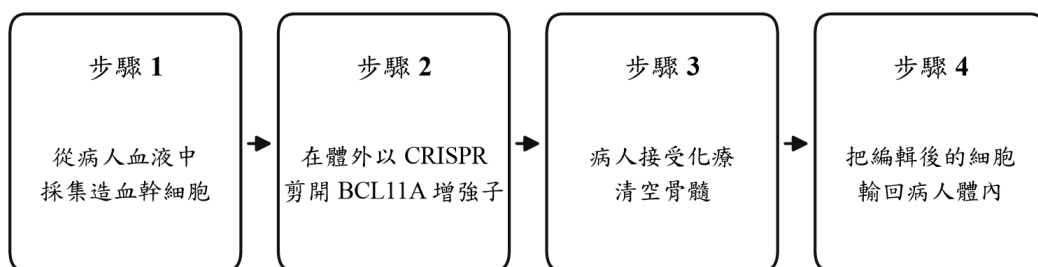
改寫一個開關，治好一種遺傳病

閱讀下列短文後，回答 1~5 題。

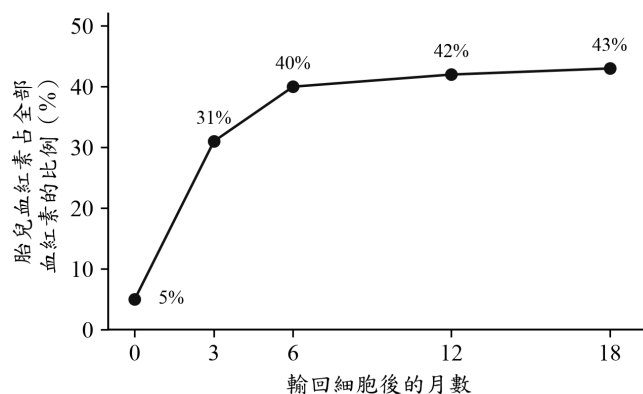
2023 年 12 月，美國 FDA 核准第一個以 CRISPR 基因編輯技術治療鐮刀型紅血球疾病的療法。這種疾病源自製造血紅素 β 鏈的基因突變：成人的血紅素（HbA）由兩條 α 鏈與兩條 β 鏈組成，突變的 β 鏈使紅血球在缺氧時變形形成鐮刀狀，阻塞血管、引起劇痛。

有趣的是，胎兒時期的血紅素（HbF）由兩條 α 鏈與兩條 γ 鏈組成，完全不需要 β 鏈。出生後，一種名為 BCL11A 的調控蛋白會抑制 γ 鏈基因的表現，HbF 因而逐漸被 HbA 取代。醫師也早已觀察到：天生 HbF 含量較高的鐮刀型患者，症狀往往較輕。

新療法並不修補突變的 β 鏈基因，而是在體外剪開 BCL11A 基因上一段只在紅血球前驅細胞中發揮作用的「增強子」，使紅血球前驅細胞中的 BCL11A 減少，讓 γ 鏈基因重新開啟。療程如圖(一)；圖(二)為某位接受治療者的 HbF 比例變化（情境數據）。治療需先以化療藥物清空骨髓，這一步本身也帶有副作用與風險。



圖(一)



圖(二)

() 1. 提高 HbF 能減輕鐮刀型紅血球疾病，最主要的原因是下列何者？

(A) HbF 能修復突變的 β 鏈基因

- (B) HbF 不含 β 鏈，不受 β 鏈突變的影響
- (C) HbF 使紅血球數量大幅增加
- (D) HbF 能抑制 BCL11A 的作用
- () 2. 下列哪一條推理鏈，最符合本文所述的療法原理？
- (A) 剪開增強子 $\rightarrow$ BCL11A 增加 $\rightarrow$ γ 鏈基因被抑制 $\rightarrow$ HbF 減少
- (B) 剪開增強子 $\rightarrow$ β 鏈突變被修正 $\rightarrow$ HbA 恢復正常
- (C) 剪開增強子 $\rightarrow$ 紅血球前驅細胞中 BCL11A 減少 $\rightarrow$ γ 鏈基因表現 $\rightarrow$ HbF 增加
- (D) 剪開增強子 $\rightarrow$ α 鏈基因關閉 $\rightarrow$ 紅血球不再變形
- () 3. 接受此療法而痊癒的患者，將來生育的子女會不會遺傳到鐮刀型的 β 鏈突變基因？
- (A) 不會，因為基因已經被 CRISPR 修正
- (B) 會，因為被編輯的是造血幹細胞，不是生殖細胞，且編輯的不是 β 鏈基因
- (C) 不會，因為子女會遺傳到大量 HbF
- (D) 無法判斷，因為 CRISPR 會隨機改變全身的基因
- () 4. 依圖(二)，有人說：「第 12 個月之後 HbF 比例幾乎不再上升，表示治療開始失效。」下列評論何者最恰當？
- (A) 正確，HbF 應持續上升才代表有效
- (B) 正確，因為 43% 仍低於 50%
- (C) 不恰當；比例趨於穩定，代表編輯後的細胞持續產生 HbF，是否「失效」要看比例是否下降與症狀變化
- (D) 不恰當，因為圖中第 18 個月的數值最高，治療還在加速
- () 5. 為什麼要在輸回細胞前先以化療清空病人的骨髓？下列推論何者最合理？
- (A) 讓編輯後的造血幹細胞有空間定居並增殖，而不被原本未編輯的細胞占滿
- (B) 化療藥物能幫助 CRISPR 在體內繼續剪開基因
- (C) 清空骨髓可以直接消除血液中的鐮刀型紅血球
- (D) 化療能把 BCL11A 從細胞中移除

The Day We Pushed an Asteroid

Read the passage and the chart, and answer questions 1–7.

On September 26, 2022, a spacecraft roughly the size of a vending machine deliberately collided with an asteroid at about 22,000 kilometers per hour. The crash was the climax of NASA's Double Asteroid Redirection Test, or DART, the first experiment to find out whether a kinetic impact, simply hitting a space rock very hard, could alter its trajectory.

The target, Dimorphos, is a small asteroid about 150 meters across that orbits a larger companion called Didymos. Since neither body posed any threat to Earth, the pair offered a safe laboratory for the test. Their arrangement had another benefit: because Dimorphos circles Didymos, astronomers on the ground could time each orbit and detect even a marginal change after the impact. Meanwhile, a small Italian satellite that had separated from DART about two weeks earlier photographed the enormous plume of debris that the crash produced.

Before the impact, one orbit lasted 11 hours and 55 minutes. NASA had defined success modestly, as a reduction of just 73 seconds. Yet careful measurements later showed that the orbit had become about 33 minutes shorter. Calculations suggest that the momentum of the spacecraft alone should have shortened it by only about seven minutes. This compelling gap led researchers to conclude that the ejecta, the rock and dust dislodged from the surface, acted like the exhaust of a rocket. The recoil of this material substantially multiplied the effect of the original blow.

Such a minor shift might seem negligible. However, if a hazardous asteroid were detected decades before it reached Earth, a tiny change in its speed would grow over millions of kilometers into a comfortable miss. That is why experts argue that the decisive factor in planetary defense is not the force of the hammer but the length of the warning. The warning, in turn, depends on telescopes that scan the sky for objects nobody has spotted yet.

The investigation is not over. In 2024, the European Space Agency launched a spacecraft named Hera, which will scrutinize Dimorphos at close range. By measuring its mass precisely, Hera should reveal exactly how much push the impact delivered.

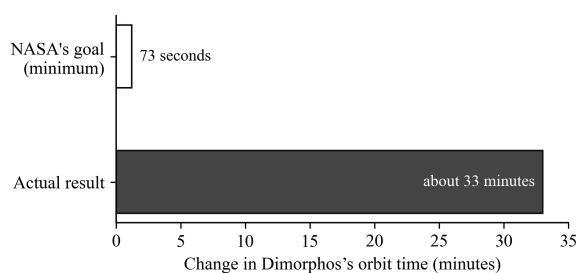


Chart: How much shorter Dimorphos's trip became

- () 1. Which question does the passage mainly answer?
- (A) How did NASA prove that hitting an asteroid can change its path, and why does the force of the hit matter most?
 - (B) How did a test show that an asteroid's path can be changed, and why does finding threats early matter?
 - (C) Why was DART designed to destroy a small asteroid, and how was Earth protected from the debris?
 - (D) How was the debris from DART's crash studied, and what will Hera measure on Didymos?
- () 2. In the second paragraph, the word "marginal" is closest in meaning to _____.
(A) located at the edge (B) occurring regularly
(C) barely noticeable (D) easily predicted
- () 3. According to the passage and the chart, which of the following is TRUE?
- (A) The ejecta added about 26 minutes, roughly the same as NASA's minimum goal.
 - (B) The spacecraft's momentum alone produced a change more than 25 times NASA's goal.
 - (C) After the impact, one orbit lasted about 11 hours and 28 minutes.
 - (D) The ejecta added about 26 minutes, nearly four times the effect of the momentum alone.
- () 4. Which was a reason for choosing Dimorphos as the target?
- (A) Its orbit around another asteroid allowed even a slight change to be measured from Earth.
 - (B) It posed no threat to Earth, and telescopes could photograph the impact directly from the ground.
 - (C) It was the larger of the two asteroids, so DART was less likely to miss it.
 - (D) Its dusty surface guaranteed that the crash would produce an enormous plume.
- () 5. In the third paragraph, what does "This compelling gap" refer to?
- (A) The difference between NASA's 73-second goal and the 33-minute result.
 - (B) The difference between the change expected from the spacecraft alone and the change measured.
 - (C) The distance between Dimorphos and its larger companion, Didymos.
 - (D) The time between DART's launch and its collision with the asteroid.
- () 6. Which situation best illustrates the main lesson of the fourth paragraph?
- (A) A heavy truck brakes hard at the last second and stops just in time.
 - (B) A strong wind pushes a ship off its course for a few minutes.
 - (C) A boat turns its wheel slightly while still far from a rock and passes it safely.
 - (D) A pilot measures the height of a mountain after flying over it.
7. Complete the summary with ONE word from the passage in each blank.
- DART showed that a (A) _____ impact can change an asteroid's course. The orbit changed far more than expected, because the (B) _____ of the rock and dust blasted off the surface added an extra push. For planetary defense, what matters most is getting enough advance (C) _____.