Unit 1

Future by design

Learning objectives

After studying this unit, you will be able to:

- explain the design process of bar codes and the engineering mindset behind it;
- discuss the development and ethical implications of humanlike robots;
- define an engineering problem clearly and accurately;
- create an educational video that highlights one of China's engineering feats.

Unlocking the topic

Setting the scene

Engineering is the force that transforms ideas into reality and turns challenges into opportunities for innovation. Whether it's revolutionizing supply chains or creating lifelike robots, engineering drives progress and shapes the future. But how do engineers design effective solutions to complex real-world problems? This question lies at the heart of many remarkable achievements we witness today. In the "Engineering the future" theme event at your school, you will explore one of China's 21st-century engineering feats by creating an educational video on it. In doing so, you will gain insights into the challenges faced, the innovative designs implemented, and the profound impact these achievements have had on the world.

Unit orientation

Activating subject knowledge

Scan the code and complete the knowledge activation exercise on Ucampus.

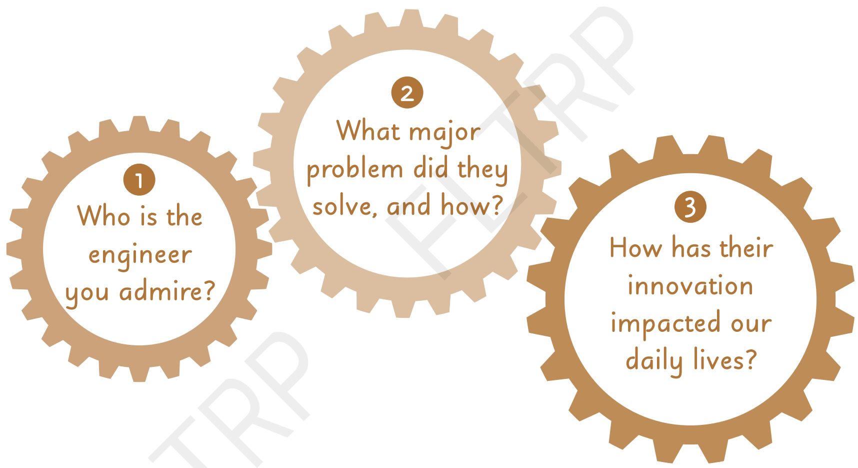
Viewing through the lens

Word bank

artificial intelligence
n. 人工智能
simulation /ˌsɪmjʊˈleɪʃn/
n. 仿真
quantum /ˈkwɒntəm/
computer *n.* 量子计算机
converge /kənˈvɜːdʒ/
vi. 聚合在一起
silo /ˈsaɪləʊ/
n. 独立机制（或程序、部门等）
vt. 将…隔离或孤立
automation /ˌɔːtəˈmeɪʃn/
n. 自动化

Pre-viewing

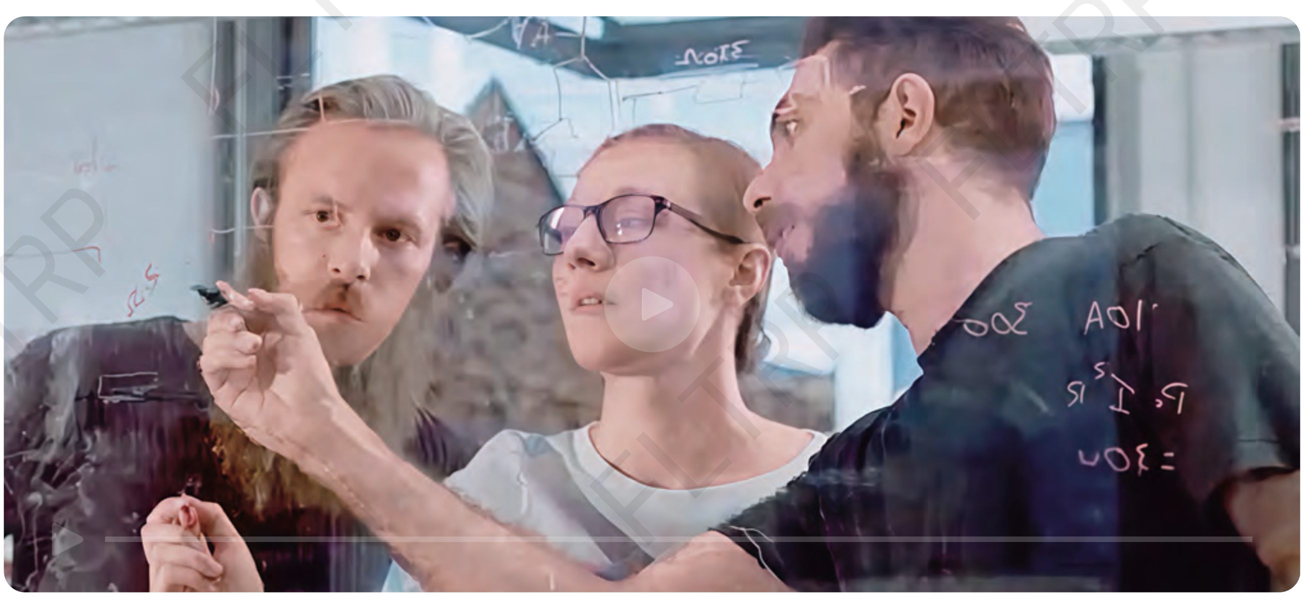
Engineers are constantly pushing the boundaries of what is possible, driven by the relentless pursuit of solutions to complex problems. Work in pairs. Choose an engineer you admire and introduce them to your partner. The following questions are for your reference.



Viewing and synthesizing

Video clip

What do you think the future holds for engineering and the engineering community? Scan the code. Watch the video clip and complete the outline with what you hear.



We are engineers

The nature of engineering

Engineering is all about 1) ______________ and continual improvement.

Future engineering trends

Key trends include advances in artificial intelligence and simulation, increased 2) ______________, and acquiring energy in a sustainable and 3) ______________ manner.

Responding to the dynamic environment

- Engineering disciplines are converging, with the boundaries of knowledge having been 4) ______________, while engineering careers are diversifying.
- The emerging generation of engineers demands relevance and wants the opportunity to 5) ______________.

The future community of engineers

- They will embrace the 6) ______________ and work together to see the bigger picture.
- They will collaborate with professionals from completely 7) ______________ and possess knowledge and skills from multiple fields.

Opportunities for modern engineers

The new reality in engineering presents opportunities to innovate, to invent, to inspire, and to create a truly 8) ______________ of engineers, employers, and academics.

Viewing and discussing

Work in groups and discuss the questions.

1. The video clip mentions that "Everyone and everything is multidisciplinary." Can you give examples of how engineers from different disciplines collaborate on real-world projects?
2. Apart from possessing multidisciplinary knowledge and skills, taking responsibility, and collaborating with others, what other important qualities do you think future engineers should have?

Exploring the frontier

Reading 1

Log on to Ucampus for interactive learning.

The two inventions behind modern bar codes

1 Since the late 19th century, railroad companies in the United States had been trying to solve a **vexing** problem. The rail system included a huge number of railcars, but company officials had no way to know the precise location of each car. What was needed was an automated means of identifying and locating the cars.

2 David Collins, an engineer who had once **interned** at the Pennsylvania Railroad, was **intrigued** by the challenge and started exploring this in the lab. He found that each railcar was labeled with a **horizontal** **serial number**, which was a combination of a company code and a car code. These codes came in different widths and **fonts** and had no standard location on the cars. The railcars themselves came in different sizes, and the trains moved at different speeds. The need for new code labels and a dynamic scanning technology that could overcome these problems was obvious.

serial /ˈsɪəriəl/ **number** *n.* 序列号

3 Collins' idea was to develop an **optical sensor** system that could send a white-light beam out to a distant bar code of colored stripes and **decode** the signal that reflected back. He focused on factors such as the code spot size and scan rate, but the initial experiments proved frustrating.

optical sensor /ˌɒptɪkl ˈsensə/ *n.* 光学传感器

One day, one of Collins' colleagues inspired him to turn the code labels sideways and scan them vertically.

4 This worked out to be a technically superior alternative. His scanner was now able to consistently pick up the patterns from the colored codes and **decipher** the railcars' information.

5 Then other issues surfaced. Could the scanner work reliably against **variable** train speeds? Could the sensing be done during snow, rain, and fog? Would the scanning be accurate if there was surface dirt on the codes? "You couldn't do it in a lab," Collins said. "You were playing with real railcars outdoors, and we didn't own a railroad."

6 Collins set up a test site near a train line and tested the scanner on hundreds of railcars that crossed the site with diligence and **clockwork precision**. He named the system KarTrak. By 1967, its practical application had begun to spread across the railway industry.

7 Around the same time, the grocery industry was facing its own challenges. Inefficiencies in **inventory management** were **crippling** the industry. One idea was to use a code-based system to track grocery products. In the early 1970s, engineer George Laurer was assigned to bring this idea to life.

inventory management /ˈɪnvəntəri/ *n.* 库存管理

8 The code to be created had to be no larger than 1.5 square inches, and it had to be read easily by both humans and electronics. Next, the symbol had to be printable on products of irregular sizes, like bar soaps and coffee containers. The code had to be **omnidirectional** with an accuracy of at least 99.995%, which meant only one error for every 20,000 items sold. Furthermore, meeting each of these **specifications** could not add to grocery production costs. Within these **rigid constraints**, Laurer began to work on a solution.

omnidirectional /ˌɒmnɪdɪˈrekʃn(ə)l/ *a.*（接收或发射信号）全向的

specification /ˌspesɪfɪˈkeɪʃn/ *n.* 规格

9 The code Laurer designed contained vertical black and white stripes with differing widths in a zebra-like pattern. The black stripes absorbed light, and the white ones reflected it back. This reflected light could be picked up by an optical sensor and converted to **electrical impulses** that were processed by a computer.

electrical impulse *n.* 电脉冲

10 For Laurer's **prototype** demonstration, an ace softball **pitcher** threw code-labeled **beanbag ashtrays** as fast as he could over a reader. Each item was read **flawlessly**, which far exceeded the expectations of the

prototype /ˈprəʊtəˌtaɪp/ *n.* 原型

Universal Product Code
n. 通用产品代码

grocery industry. His product was ready. The code selection committee called it the **Universal Product Code** (UPC). It became an industry standard in 1973.

11 Weeks later, a problem surfaced. Meat departments in grocery stores had no **mechanism** to verify that the billed price of the product matched the actual price in the store manager's file. Laurer fixed this problem by adding a price check digit to the UPC. Over time, additional testing, coupled with improved label printing and detailed **receipts**, has essentially eliminated these sorts of challenges, thus dramatically changing inventory management and the **checkout** process.

supply chain *n.* 供应链

12 Born in different circumstances and designed under different pressures, innovations like David Collins' KarTrak and George Laurer's UPC eventually converged to create the bar codes we use today. Such efforts helped revolutionize **merchandising** and lay the foundation for the modern **supply chain** system. With the **implementation** of bar codes, a **torrent** of new and exciting applications previously **imponderable** became practical, which we now take for granted.

malfunction /mælˈfʌŋkʃn/
n.（机器的）故障

13 All **perishable** goods now have their own imperishable bar-coded identity. This is possible because engineers like Collins and Laurer systematically transform problems into opportunities. Their creations are deliberate, disciplined, open-minded, yet grounded in reality. Their process for learning from errors and **malfunctions**, and then fixing them, is as important as the **original** idea itself. Their profession has profound consequences. They are the **prospectors** of new opportunities, **propellers** of the economy, designers of our material **destinies**, silent voices in every conversation, and **subliminal** brokers who **facilitate** our experiences with the world.

14 The engineering **mindset** resists simple definition. It's a **rigorous** and systematic approach to problem-solving that distinguishes engineers from other people who are perhaps more philosophical or **argumentative** in their approach to life. This mindset is an all-terrain, multipurpose tool kit, as engineers integrate ideas from multiple streams of knowledge and offer practical solutions to diverse real-world challenges.

Reading and synthesizing

Global understanding

Read the passage and complete the summary with information from the passage.

Since the late 19th century, railroad companies in the United States had been struggling to track the 1) ______________ of each railcar. David Collins addressed this challenge by creating KarTrak, a system that used optical sensors to scan colored bar codes. Around the same time, George Laurer developed the Universal Product Code (UPC) to track 2) ______________ in the grocery industry. Innovations like these eventually 3) ______________ to create the bar codes we use today, which helped 4) ______________ merchandising and lay the foundation for the modern 5) ______________. Engineers like Collins and Laurer systematically transform problems into 6) ______________ and their profession has a(n) 7) ______________ impact on shaping our world. They take a(n) 8) ______________ and systematic approach to problem-solving and integrate ideas from 9) ______________ streams of knowledge to solve real-world problems.

Detailed understanding

Read the passage again and complete the table with information from the passage.

	KarTrak	UPC
The problem	Railroad companies lacked a way to know the precise location of each railcar.	The grocery industry struggled with inefficiencies in inventory management and needed a(n) 6) ________________ to track grocery products.
Design constraints	The railcars differed in size, and the trains moved at 1) ________________.	• The code had to be small enough, readable by 7) ________________, and printable on products of irregular sizes. It had to be omnidirectional and highly accurate. • The solution could not add to 8) ________________.
The initial design	A(n) 2) ________________ that could send a white-light beam out to a distant colored bar code and decode the reflected signal	A code of vertical black and white stripes: The black stripes absorbed light, while the white ones reflected it. The reflected light was converted to 9) ________________ for computer processing.
Testing and improvements	• The initial experiments were frustrating until the code labels were turned sideways and scanned 3) ________________. • Collins set up a(n) 4) ________________ and precisely tested the scanner on railcars under real-world conditions.	• In the prototype demonstration, every code-labeled item was read flawlessly. • Laurer added a(n) 10) ____________ to the UPC to ensure the billed price matched the actual price.
The final product	KarTrak	UPC
Impacts	Its practical application had begun to spread across the 5) ________________ by 1967.	It changed inventory management and the 11) ________________.

Cultivating engineering thinking

1. **Work in pairs and identify the details from the passage that show the engineering mindset of David Collins and George Laurer. Do you think this mindset can be described as "an all-terrain, multipurpose tool kit"?**

2. **Work in groups. Identify an engineering problem you face in your daily life and propose a design to solve the problem. In your proposal, you should:**
   - clearly state the problem;
   - identify any constraints that may affect your design;
   - present your design, explaining its key features and how it addresses the problem;
   - describe how you would test the design and gather feedback to improve it;
   - provide an implementation plan for your design.

Enhancing academic writing

Log on to Ucampus to get guidance from your AI tutor.

Defining an engineering problem

Step 1 Defining a problem clearly and accurately is the critical first step in any engineering project, as it ensures that the problem is well understood and helps direct efforts toward effective solutions. Reread Paras. 1-2 and Paras. 7-8 of the passage and analyze how the author defines the two engineering problems.

More about the skill

Step 2 Defining an engineering problem often involves several key elements, including providing the context, stating the problem, reviewing current solutions, stating the objective, and identifying constraints. While not all of these elements are required in every situation, together they help engineers understand the full scope of the challenge and set practical goals. Identify which of the above-mentioned elements are included in the problem definitions given by the author.

Tips

Key elements in defining an engineering problem:

- **Providing the context**
  Introduce the background of the problem. This helps clarify how relevant the problem is and why it is important to address it.
- **Stating the problem**
  Identify the main issue or challenge that needs to be addressed. The statement should be concise and to the point.
- **Reviewing current solutions**
  Briefly discuss the existing approaches or technologies used to address the problem, along with their limitations.
- **Stating the objective**
  Define the desired outcome or goal.
- **Identifying constraints**
  Identify any obstacles or challenges that need to be considered when solving the problem.

Step 3 Read the following paragraphs and identify the five elements.

> Researchers have been developing devices that are intended to function alongside tissue, rather than remaining isolated from it, like most pacemakers and other electronic devices currently used in the body. One of the key challenges is providing consistent power to these devices. Currently, devices near the skin can incorporate antennas to wirelessly harvest power, as long as an external power source is nearby. However, implants often rely on bulky batteries, which need to be replaced periodically. Some devices also use wires to deliver power, but this introduces the risk of infection.
>
> What is needed is a long-lasting power source that doesn't depend on bulky batteries or external energy supply. The solution must be small enough for deep implants, capable of providing continuous power without frequent battery replacements, and it must minimize health risks, such as infection from wires.

Step 4 Choose an engineering problem relevant to your field of study or interest. Write an essay of no less than 150 words to define the problem in a clear and structured manner.

Improving language skills

Technical vocabulary

Complete the sentences with the technical terms given below. Change the form if necessary.

serial number　　malfunction　　electrical impulse
prototype　　omnidirectional

1. The measurement system must be designed to minimize ______________ to ensure accurate readings under various environmental conditions.
2. The sensor array should be capable of processing ______________ within a frequency range from 1 Hz to 100 kHz.
3. A working ______________ of the system will be created and tested in a controlled environment.
4. The sensor system must be ______________, capable of detecting and processing signals from all directions within a 50-meter radius to ensure full coverage.
5. Each device will be assigned a unique ______________, which will be stored in the database for tracking and life cycle management.

Translating technical materials

Translate the paragraph into English.

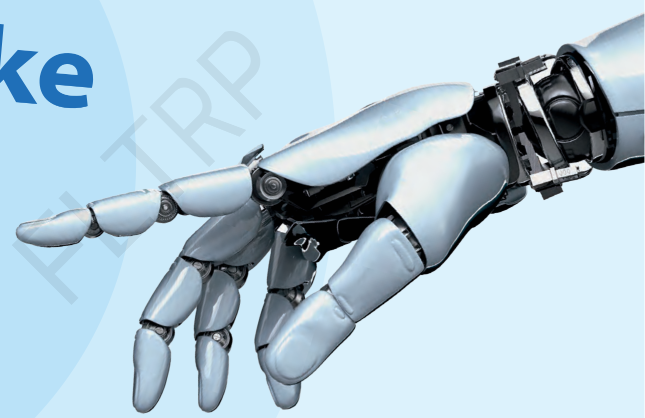
“国家工程师奖”表彰在工程技术领域做出杰出贡献的个人和团队。受表彰的工程师和团队以爱国奉献和锐意创新为指引，通过系统化的方法和勤勉的努力，攻克了关键技术难题，推动了重大工程建设和装备制造。他们不仅是创新解决方案的设计者，更是社会进步的推动者。他们促进科技进步，让技术更好地服务人民，满足社会需求。这一奖项旨在激励更多工程技术人才为全面建设社会主义现代化国家做出贡献。

Scan the code and complete more language exercises on Ucampus.

Reading 2

Log on to Ucampus for interactive learning.

How humanlike do we really want robots to be?



1 From **bionic** law **enforcers** to mechanical warriors, the movie industry has produced a **pantheon** of memorable **cyborgs**. These **hybrids** fascinate us for the same reason: They blur the lines between humans and robots in ways that have never happened in our history – but just might be part of our future.

2 Fully **functional** cyborgs are still quite a way off, but scientists are pioneering a new way to combine humans and machines. A Japanese team has designed a robotic finger that's covered with living skin grown from actual human skin cells. The process gives the robotic **appendage** an extremely **lifelike** look, not least because the skin can move and **flex** naturally as the three-joint **digit** does. To the touch, the skin also feels far more like human skin than **silicone** robot skins do, and can even heal when cut or split.

3 To create the lifelike appendage, the team employed a two-part process. They first prepared a mixed **solution** of **collagen** and **human dermal fibroblasts**, the two main components in our skin's **connective tissues**. The finger was **submerged** in this solution, and while being **cultured** in an **incubator** for around three days, this artificial "**dermis**" **adhered** to the digit as the tissues naturally shrank to produce a solid, close-fitting

appendage /əˈpendɪdʒ/ *n.* 附肢
silicone /ˈsɪlɪˌkəʊn/ *n.* 硅酮
solution /səˈluːʃn/ *n.* 溶液
collagen /ˈkɒlədʒ(ə)n/ *n.* 胶原（蛋白）
human dermal fibroblast /ˌdɜːməl ˈfaɪbrəblæst/ *n.* 人真皮成纤维细胞
connective tissue *n.* 结缔组织
culture /ˈkʌltʃə/ *vt.* 培养（细菌或细胞）
incubator /ˈɪŋkjʊˌbeɪtə/ *n.* 培养器
dermis /ˈdɜːmɪs/ *n.* 真皮

coating /ˈkəʊtɪŋ/ *n.* 覆盖层

epidermis /ˌepɪˈdɜːmɪs/ *n.* 表皮

human keratinocyte /kəˈrætɪnəsaɪt/ *n.* 人角质形成细胞

coating over the finger. This coating served as a foundation for the **molding** and application of a second coat, an "**epidermis**." To form the "epidermal layer," a second solution containing **human keratinocytes** was prepared and carefully poured onto the finger, and then left to be cultured for two weeks to produce the finished product.

anatomy /əˈnætəmi/ *n.*（人体的）解剖构造

electric motor *n.* 电动机

4 This innovative approach addresses a key limitation of existing methods for creating artificial skin. While other methods, such as creating sheets of living human skin, face challenges in conforming to the unique shapes of human **anatomy**, this approach achieves a form fit more easily. The finger, moved by an **electric motor**, is only one small part of the human anatomy, but its movements do represent a way to explore how the skin can cover moving parts in a lifelike way.

5 Of course, appearance isn't everything. Humans don't just look at one another's skin – they touch it, too, and the living skin provides a much more natural feel than silicone. But to enable robots to interact more naturally and safely in our everyday human environment, it's not enough for their skin to feel natural to us – the robots must also have their own sense of touch. Scientists have tried various electronic sensors and other methods to create a sense of touch in robots. For example, researchers in China have developed an electronic skin that enables robots to **navigate** their surroundings through touch when **visibility** is limited. In the case of the finger experiment, the team plans to explore reproducing a natural nerve system to **instill** a sense of touch in the skin.

6 But how humanlike do we really want robots to be? Answers vary. A study from the Georgia Institute of Technology found that most college-aged adults preferred their robots to look like robots, while older adults preferred those with more human faces. A given robot's role is also a factor. For example, most individuals in the study preferred housecleaning robots to look more like machines, while those communicating with us and performing "smart" tasks, like giving information, were preferred to look more like us.

neuroscience /ˌnjʊərəʊˈsaɪəns/ *n.*（研究大脑的）神经科学

7 Increasingly, we'll be interacting meaningfully with social robots in our daily lives. **Neuroscience** studies have found our **empathy** for them, when they are treated harshly, isn't yet at the same level as what we feel for other humans. We view robots as less than human, so making them more humanlike may **strengthen** our relationships. That might

be useful, as robots are increasingly socially tasked with things like caregiving or **dispensing** important information and advice.

8 Yet, some researchers describe our evolving relationships with social robots that look increasingly like us as a paradox. On the one hand, humans want social robots to be human enough in appearance and behavior to fulfill our relationship needs. On the other hand, robots that are "too human" can **threaten** our sense of human identity and uniqueness – a fear that might be fueled by **cognitive** systems that aren't accustomed to confusing, blurred boundaries between humans and machines.

cognitive /ˈkɒɡnətɪv/ *a.* 认知的

9 "If you have machines that are too similar to us, you start to have this blurring of human identity, and people can be threatened by that," one researcher says. "If they are as human as I am, then what does it mean to be human?"

10 Another question may lie near the core of such doubt, "Can we ever really trust robots?" Right now, some individuals remain very wary, perhaps in part because of the **portrayals** of robots in some movies. Our relationships with robots and our attitudes toward them will continue to evolve, for better or worse, as humans have more and more experiences with intelligent machines. In that way, the robots we produce will really shape our attitudes toward them.

Reading and synthesizing

Global understanding

Read the passage and choose the most suitable topic for each part.

1. **Para. 1**

   A. The future of cyborgs and robotics
   B. The depiction of cyborgs in movies
   C. Technological progress in robotics
   D. Ethical issues related to cyborgs

2. **Paras. 2-4**

   A. The development of lifelike skin for robots
   B. The history of artificial skin research
   C. The advantages of living human skin in robotic design
   D. The materials used to create artificial skin for robots

3. **Para. 5**

   A. How living skin improves our physical interaction with robots
   B. The limitations of current robotic skins in mimicking human touch
   C. The importance of robots having their own sense of touch
   D. Challenges in creating a natural sense of touch in robots

4. **Paras. 6-7**

   A. Humans' emotional connections to robots
   B. How robots are integrated into human society
   C. The role of robots in caregiving and communication
   D. Opinions on how humanlike robots should be

5. **Paras. 8-10**

   A. The potential for robots to threaten human uniqueness
   B. Social and technological challenges with robots
   C. Identity and trust concerns regarding humanlike robots
   D. Public skepticism about robots' capabilities

Detailed understanding

Read the passage again and complete the research report with information from the passage.

Research report

Objective

To create a lifelike appendage

Procedure

Step 1:

The formation of the "dermis"

- **Materials used:** A mixed solution of collagen and 1) ________________
- **Process:** The finger was 2) ________________ in the solution and cultured for around three days.
- **Outcome:** The tissues shrank and produced a solid, close-fitting 3) ________________ over the finger.

Step 2:

The formation of the "epidermis"

- **Materials used:** A solution containing 4) ________________
- **Process:** The solution was applied to the finger and cultured for 5) ________________.
- **Outcome:** The finished product was ready.

Results

- The skin of the robotic finger can 6) ________________ naturally.
- The skin feels far more like human skin than 7) ________________ do.
- The skin can 8) ________________ when cut or split.

Significance and future research

- This approach enables artificial skin to 9) ________________ the unique shapes of human anatomy more easily than existing methods.
- The finger's movements represent a way to explore how the skin can 10) ________________ in a lifelike way.
- The team plans to explore reproducing a natural nerve system to instill a(n) 11) ________________ in the skin.

Improving language skills

Scan the code and complete the language exercises on Ucampus.

Getting on the stage

Creating an educational video on one of China's engineering feats

In this unit, we have explored how engineers tackle complex real-world problems by designing innovative solutions. In the "Engineering the future" theme event at your school, you will create an educational video for a global audience to showcase one of China's engineering feats in the 21st century.

Log on to Ucampus to get guidance from your AI tutor.

Step 1 Select an engineering project

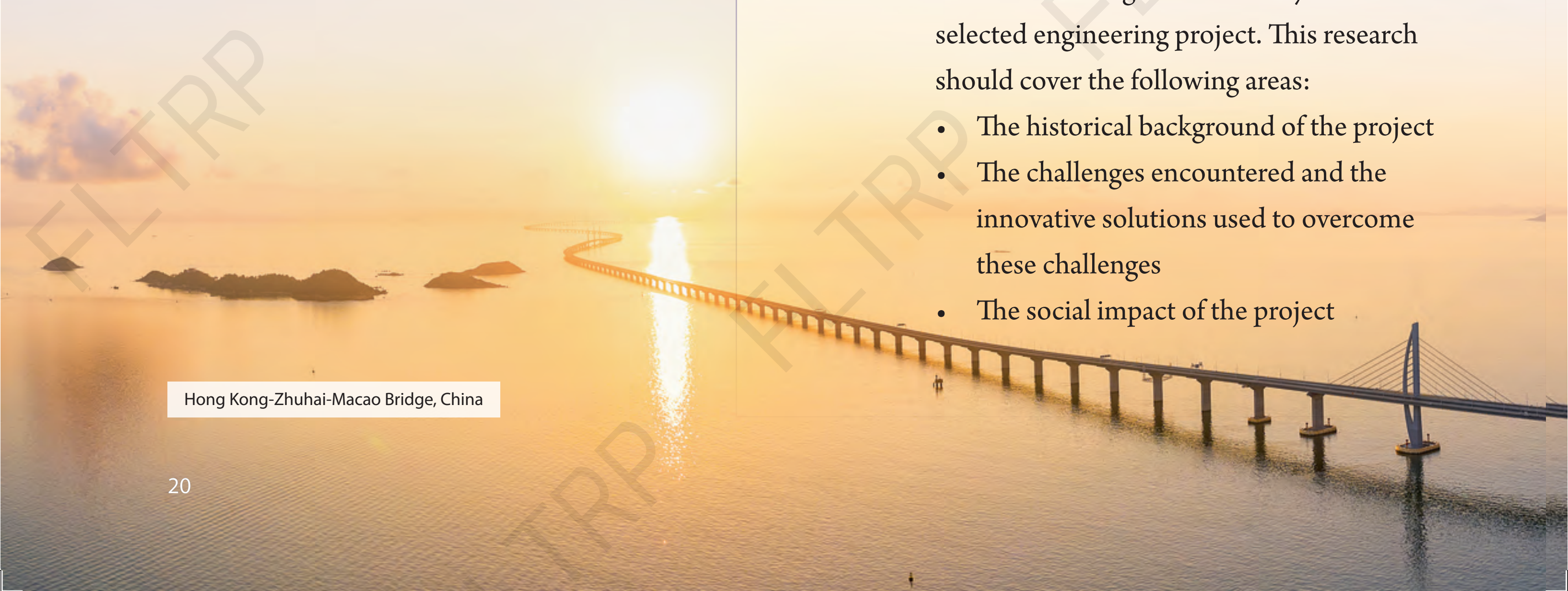
Form groups of four or five. Each group selects one engineering project from China's 21st-century innovations. When choosing your project, consider the following criteria:

- Engineering spirit: Does the project reflect determination, creativity, and resilience in overcoming challenges?
- Engineering mindset: Does the project demonstrate a systematic approach to problem-solving? Does it balance multiple constraints to develop effective and efficient solutions?
- Social impact: Does the project address significant social needs or global challenges? How does it contribute to the lives of people, the development of communities, and the sustainability of the environment, both in the short and long term?

Step 2 Conduct research on the project

Conduct thorough research on your selected engineering project. This research should cover the following areas:

- The historical background of the project
- The challenges encountered and the innovative solutions used to overcome these challenges
- The social impact of the project



Hong Kong-Zhuhai-Macao Bridge, China

Tips

When conducting research, use a variety of sources, such as academic journals, reliable news outlets, and official reports, to ensure a comprehensive and balanced understanding of your topic. As you gather information, also collect relevant visuals, such as images, diagrams, and videos, to help illustrate your points and make your video more engaging. Make sure the information you gather is accurate, relevant, and up-to-date. Keep track of your sources, so you can cite them properly in your video to enhance its credibility.

Step 3 Prepare the video script

Create a clear and engaging script based on the information you've collected, and then read and record your script.

Tips

When writing the script for your video, use clear, concise, and conversational language to keep the audience engaged. Break down complex information into simple, easy-to-follow points and maintain a clear structure that guides the viewer through the content. Additionally, plan for visuals to support your narrative and indicate where they should appear.

Step 4 Produce the video

Combine the recording with your visuals using video editing software to create a cohesive and engaging video.

Step 5 Present your video

Present your video to the class and gather feedback from the audience. Then, make necessary revisions to the video before uploading it to the school's platform for public viewing.

Scan the code. Watch the micro course recorded by industry experts to help you better complete the project.

Vocabulary

Viewing through the lens

New words

★ **academic** /ˌækəˈdemɪk/

n. [C] a teacher in a college or university 大学教师

a. (*usu. before noun*) relating to education, esp. at college or university level 学术的（尤指与学院或大学教育有关）

artificial intelligence (AI) *n.* [U] the study of how to make computers do intelligent things that people can do, such as think and make decisions 人工智能

★ **automation** /ˌɔːtəˈmeɪʃn/ *n.* [U] the use of computers and machines instead of people to do a job 自动化

▲ **converge** /kənˈvɜːdʒ/ *vi.*

1. come together and have one interest, purpose, or goal（为了共同的兴趣、目的或目标）聚合在一起
2. move toward one point and join together: come together and meet（向一点）会合，相交，汇聚

★ **diversify** /daɪˈvɜːsɪˌfaɪ/ *v.*

1. change sth. or make it change so that there is more variety（使）多元化；（使）多样化
2. develop new products or activities in addition to the ones you already provide or do 开发（新产品）；（使）扩大经营范围；（使）从事多种经营

electrical engineering *n.* [U] the design and building of machines and systems that use or produce electricity; the study of this subject 电工；电气工程；电气工程学

multidisciplinary /ˌmʌltidɪsəˈplɪnəri/ *a.* involving people with different jobs or from different areas of study 含有多种专业（学科）的；（涉及）多职业的

quantum /ˈkwɒntəm/ **computer** *n.* [C] a very advanced and powerful type of computer that is being developed, which uses the principles of quantum mechanics 量子计算机

★ **reframe** /ˌriːˈfreɪm/ *vt.*

1. look at, present, or think of (beliefs, ideas, relationships, etc.) in a new or different way 用不同的方式看待；用新方式展示；用新方式考虑
2. place (a picture or photograph) in a new frame 给（图片、照片）换框，重新装裱

★ **relevance** /ˈreləv(ə)ns/ *n.* [U] (*also* **relevancy**) the degree to which sth. is related or useful to what is happening or being talked about 相关性；实用性；意义

silo /ˈsaɪləʊ/

n. [C] a system, process, department, etc. that operates in isolation from others 独立机制（或程序、部门等）

vt. separate sb. or sth. from other people or things 将…隔离或孤立

▲ **simulation** /ˌsɪmjʊˈleɪʃn/ *n.* [C, U] the activity of producing conditions which are similar to real ones, esp. in order to test sth., or the conditions that are produced 模拟，仿真（尤用于试验）；模拟的环境

* 词汇表中加星号（★）的单词为四级词汇，加三角（▲）的单词为六级词汇，未做标记的为超纲词汇。

★ **sustainable** /sə'steɪnəbl/ *a.* able to continue without causing damage to the environment 可持续的；不破坏环境的

Exploring the frontier

Reading 1

New words

★ **argumentative** /ˌɑːgjʊ'mentətɪv/ *a.* given to expressing divergent or opposite views 好表示不同（或相反）观点的；好争论的

beanbag ashtray /'æʃˌtreɪ/ *n.* [C] 豆袋烟灰缸

checkout /'tʃekaʊt/ *n.* [C, U] the act or place of checking out purchases, as in a supermarket（付款台前的）结账；（超市等的）付款台

clockwork /'klɒkˌwɜːk/ *n.* [U] machinery with wheels and springs like that inside a clock（有类似时钟齿轮和发条装置的）机械；齿轮发条装置

▲ **constraint** /kən'streɪnt/ *n.* [C] sth. that limits your freedom to do what you want 限制；束缚；约束

▲ **cripple** /'krɪpl/ *vt.*

1. damage sth. badly so that it no longer works or is no longer effective 严重损坏（削弱）
2. hurt sb. badly so that they cannot walk properly 使跛；使瘸

decipher /dɪ'saɪfə/ *vt.*

1. succeed in understanding, interpreting, or identifying sth. 理解；译解；识别
2. convert (a text written in code, or a coded signal) into normal language 破译（密码）；译解（电码）

★ **decode** /diː'kəʊd/ *vt.*

1. recognize and interpret (an electronic signal) 译解（电子信号）
2. find the meaning of sth., esp. sth. that has been written in code 解（码）；破译（尤指密码）

▲ **destiny** /'destəni/ *n.* [C] the things that will happen in the future 前途；命运

electrical impulse *n.* [C] a short electrical signal that travels in one direction along a wire 电脉冲

★ **facilitate** /fə'sɪləteɪt/ *vt.* (*fml.*) make it easier for a process or activity to happen 促进；使便利

★ **flawlessly** /'flɔːləsli/ *ad.* in a way that is perfect or without mistakes 完美地；无暇地

font /fɒnt/ *n.* [C] the particular size and style of a set of letters that are used in printing, etc. 字体；字型

★ **horizontal** /ˌhɒrɪ'zɒntl/ *a.* flat and level 水平的

★ **implementation** /ˌɪmplɪmən'teɪʃn/ *n.* [U] the act of implementing a plan, process, etc. 实施；贯彻；执行

imponderable /ɪm'pɒnd(ə)rəbl/ *a.* (*fml.*) difficult or impossible to estimate, assess, or answer 难以估量（或回答）的；不可估量（或回答）的

intern /ɪn'tɜːn/ *vi.* work for a company or organization for a period of time, sometimes without pay, in order to get experience of a particular type of work 实习

▲ **intrigued** /ɪn'triːgd/ *a.* very interested in sth. and wanting to know more about it 着迷的；感兴趣的

inventory /'ɪnvəntəri/ **management** *n.* [U] (*also* **inventory control**) the process of making sure that the right amount of goods, parts, and materials are available for sale 库存管理；存货管理；存货控制

malfunction /mæl'fʌŋkʃn/ *n.* [C] a fault in the way a machine or part of sb.'s body works（机器的）故障，失灵；（人体器官的）功能障碍

* **mechanism** /'mekəˌnɪz(ə)m/ *n.* [C]

1. a method or a system for achieving sth. 方法；机制
2. part of a machine or a set of parts that does a particular job 机械装置；机件；工作部件

▲ **merchandising** /'mɜːtʃ(ə)nˌdaɪzɪŋ/ *n.* [U] (*esp. AmE*) the activity of selling goods, or of trying to sell them, by advertising or displaying them 推销；展销

▲ **mindset** /'maɪndˌset/ *n.* [C] sb.'s general attitude, and the way in which they think about things and make decisions 思维模式

omnidirectional /ˌɒmnɪdɪ'rekʃn(ə)l/ *a.* receiving or sending signals in all directions（接收或发射信号）全向的

optical sensor /ˌɒptɪkl 'sensə/ *n.* [C] a device that converts light into electrical signals, primarily designed to detect changes in light patterns, intensity, and wavelength 光学传感器

* **original** /ə'rɪdʒn(ə)l/ *a.* (*only before noun*) existing or happening first, before other people or things 原先的；最早的；最初的

▲ **perishable** /'perɪʃəbl/ *a.* (esp. of food) likely to decay or go bad quickly（尤指食物）易腐烂的，易变质的

* **pitcher** /'pɪtʃə/ *n.* [C] a person who pitches, specifically the baseball player who pitches the ball to the opposing batters 投球手

* **precision** /prɪ'sɪʒn/ *n.* [U] the quality of being very exact or correct 精确（性）；准确（性）

▲ **propeller** /prə'pelə/ *n.* [C]

1. a person or thing that propels 推进者；推动者；推动因素
2. a piece of equipment consisting of two or more blades that spin around, which makes an aircraft or ship move（飞机或轮船的）螺旋桨，推进器

* **prospector** /prə'spektə/ *n.* [C] sb. who looks for gold, minerals, oil, etc. 勘探者；探矿者

▲ **prototype** /'prəʊtəˌtaɪp/ *n.* [C] the first form that a new design of a car, machine, etc. has, or a model of it used to test the design before it is produced（新型汽车、机器等的）原型，雏形

* **receipt** /rɪ'siːt/ *n.* [C] a piece of paper that you are given which shows that you have paid for sth. 收据；收条

▲ **rigid** /'rɪdʒɪd/ *a.* not easily changed 不易改变的；刻板的

▲ **rigorous** /'rɪgərəs/ *a.* careful, thorough, and exact 严格的；缜密的；精确的

serial /'sɪəriəl/ **number** *n.* [C] a number put on things that are produced in large quantities, so that each one has its own different number 序列号

* **specification** /ˌspesɪfɪ'keɪʃn/ *n.* [C, U] a detailed description of how sth. is, or should be, designed or made 规格；规范；明细单；说明书

subliminal /ˌsʌb'lɪmɪnl/ *a.* affecting your mind in a way that you are not conscious of 潜意识的；下意识的；潜在的

supply chain *n.* [C, usu. sing.] the series of processes involved in the production and supply of goods, from when they are first made, grown, etc. until they are bought or used 供应链

torrent /ˈtɒrənt/ *n.* [C]

1. a large amount of sth. that comes suddenly and violently 迸发；连发；狂潮
2. a large amount of water moving very quickly and strongly in a particular direction 湍流；急流

Universal Product Code (UPC) *n.* [C] (*AmE*) 通用产品代码；通用商品条码

* **variable** /ˈveəriəbl/ *a.* likely to change often 易变的；多变的

vexing /ˈveksɪŋ/ *a.* annoying, worrying, or causing problems 引起烦恼的；令人恼火的；伤脑筋的

Phrases and expressions

be grounded in / on sth. be based on sth. 以…为根据

couple sth. with sth. if one thing is coupled with another, the two things happen or exist together and produce a particular result 与…结合

pick (sth.) up

1. identify or recognize sth. 辨认；识别出
2. receive an electronic signal, sound, or picture 接收（信号、声音、图像等）

play with sth.

1. try doing sth. in different ways to decide what works best 试验（以找出解决问题的最佳方式）
2. keep touching sth. or moving it 摆弄；玩弄

with clockwork precision / accuracy in an extremely exact way 极精确地

Proper names

David Collins /ˈkɒlɪnz/ 戴维・科林斯（美国工程师）

George Laurer 乔治・劳雷尔（美国工程师）

KarTrak /ˈkɑːˌtræk/ 一种早期的铁路车辆自动识别系统

Pennsylvania /ˌpensɪlˈveɪnɪə/ 宾夕法尼亚州（美国州名）

Reading 2

New words

▲ **adhere** /ədˈhɪə/ *vi.* (*fml.*) stick firmly to sth. 黏附；附着

anatomy /əˈnætəmi/ *n.*

1. [C, usu. sing.] the structure of a body, or of a part of a body（人体的）解剖构造
2. [U] the scientific study of the structure of human or animal bodies 解剖学

appendage /əˈpendɪdʒ/ *n.* [C]

1. (*fml.*) an arm, leg, or other body part 附肢，附器（指臂、腿或身体其他部位）
2. sth. that is connected to a larger or more important thing 附加物；附属物

bionic /baɪˈɒnɪk/ *a.* having parts of the body that are electronic, and therefore able to do things that are not possible for normal humans（因体内有电子装置）能力超人的

coating /ˈkəʊtɪŋ/ *n.* [C] a thin layer of sth. that covers a surface 涂层；外层；覆盖层

▲ **cognitive** /ˈkɒgnətɪv/ *a.* (*fml.*) related to the process of knowing, understanding, and learning sth. 认知的；认知过程的

collagen /ˈkɒlədʒ(ə)n/ *n.* [U] 胶原（蛋白）

connective tissue *n.* [C, U] 结缔组织（如肌肉、脂肪等）

* **culture** /ˈkʌltʃə/ *vt.* grow bacteria or cells for medical or scientific use 培养（细菌或细胞）

cyborg /ˈsaɪˌbɔːg/ *n.* [C] a creature that is partly human and partly machine 电子人；半机械人

dermis /ˈdɜːmɪs/ *n.* [U] 真皮

* **digit** /ˈdɪdʒɪt/ *n.* [C] a finger, thumb, or toe 手指；拇指；脚趾

▲ **dispense** /dɪˈspens/ *vt.* (*fml.*)

1. provide sth., esp. a service, for people 施与，提供（尤指服务）
2. give out sth. to people 分配；分发

electric motor *n.* [C] a device that converts electrical energy to mechanical torque 电动机

empathy /ˈempəθi/ *n.* [U] the ability to understand other people's feelings and problems 同情；同感；共鸣

* **enforcer** /ɪnˈfɔːsə/ *n.* [C] sb. whose job is to make sure people do the things they should（法规等的）执行者

epidermis /ˌepɪˈdɜːmɪs/ *n.* [C, U] 表皮

* **flex** /fleks/ *v.* bend, as a part of the body 弯曲（人体部位）

* **functional** /ˈfʌŋkʃnəl/ *a.*

1. operating in the correct way 正常运转的
2. designed to be useful rather than beautiful or attractive 为实用而设计的；实用的

human dermal fibroblast /ˌdɜːməl ˈfaɪbrəblæst/ *n.* [C] 人真皮成纤维细胞

human keratinocyte /kəˈrætɪnəsaɪt/ *n.* [C] 人角质形成细胞

▲ **hybrid** /ˈhaɪbrɪd/ *n.* [C]

1. sth. that consists of or comes from a mixture of two or more other things（两种或两种以上不同物质组成的）混合体
2. an animal or plant produced from parents of different breeds or types 杂种动物；杂交植物；杂交而成的生物体

incubator /ˈɪŋkjʊˌbeɪtə/ *n.* [C]

1. an apparatus in which environmental conditions can be controlled, often used for growing bacterial cultures, hatching eggs artificially, or providing suitable conditions for a chemical or biological reaction 孵化器；培养器
2. a piece of equipment in a hospital which new babies are placed in when they are weak or born too early, in order to help them survive（体弱或早产婴儿）恒温箱

instill /ɪnˈstɪl/ *vt.* (*BrE* **instil**) gradually make sb. feel, think, or behave in a particular way over a period of time 逐渐灌输，逐步培养（感受、思想或行为）

lifelike /ˈlaɪfˌlaɪk/ *a.* exactly like a real person or thing 逼真的；生动的；栩栩如生的

* **mold** /məʊld/ (*BrE* **mould**)

vt. make a soft substance have a particular shape 用模子制作；塑造；使成形

n. [C] a hollow container that you pour a liquid or soft substance into, so that when it becomes solid, it takes the shape of the container 模具；铸模

▲ **navigate** /ˈnævɪˌgeɪt/ *v.* find which way you need to go when you are traveling from one place to another（为…）导航，指引方向

neuroscience /ˌnjʊərəʊ'saɪəns/ *n.* [U] the scientific study of the brain（研究大脑的）神经科学

pantheon /'pænθiən/ *n.* [C] a group of illustrious or notable persons or things（一批）卓越人物；（一组）显耀事物

▲ **portrayal** /pɔː'treɪəl/ *n.* [C, U] the way sb. or sth. is described or shown in a book, film, play, etc. 描绘；描写；描述；扮演；表现

silicone /'sɪlɪˌkəʊn/ *n.* [U] a chemical that is not changed by heat or cold, does not let water through, and is used in making artificial body parts, paint, and rubber 硅酮

* **solution** /sə'luːʃn/ *n.* [C, U] a liquid in which a solid or gas has been mixed 溶液

* **strengthen** /'streŋθ(ə)n/ *v.* become stronger; make sb. or sth. stronger 加强；增强；巩固

▲ **submerge** /səb'mɜːdʒ/ *v.* go under the surface of water or liquid; put sth. or make sth. go under the surface of water or liquid（使）潜入水中，没入水中，浸没，淹没

* **threaten** /'θretn/ *vt.*
  1. be likely to cause harm or damage to sb. or sth. 威胁到；危害到
  2. say that you will cause sb. harm or trouble if they do not do what you want 威胁；恐吓

* **visibility** /ˌvɪzə'bɪləti/ *n.* [U] the distance it is possible to see, esp. when this is affected by weather conditions（尤指受天气状况影响时的）能见度，能见距离

Phrases and expressions

for better or (for) worse used to say that sth. must be accepted, whether it is good or bad, because it cannot be changed 不论好坏

not least (*fml.*) used to emphasize that sth. is important（用于强调重要）尤其，特别

Proper names

Georgia /'dʒɔːdʒə/ **Institute of Technology** 佐治亚理工学院（位于美国）

Unit test

Scan the code and take the unit test on Ucampus.