

SELF-ASSESS Consider the language and skills you learned in this unit.

How well can you . . . ?	Very well	Pretty well	I need improvement
use the key vocabulary from this unit	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
evaluate arguments	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
analyze causes and effects	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
use <i>if . . . , (then)</i> structures	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
write a cause-effect essay	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

A VOCABULARY Do you remember the meanings of these words and phrases? Look back at the unit and review the ones you don't know.

alternative <small>AW</small>	awareness <small>AW</small>	comfort	distinctive <small>AW</small>	earn a living
ecological <small>AW</small>	economy <small>AW</small>	enrich	harmful	landmark
maintain <small>AW</small>	necessary	objective <small>AW</small>	official	partnership <small>AW</small>
preserve	renewable	spiritual	sustainable <small>AW</small>	vital

B VOCABULARY EXTENSION Look at the words in **bold**. Write **N** for noun or **A** for adjective.

- 1. People in their 20s are digital **natives**, which means they grew up with the internet. ____
- 2. Solar power is an **alternative** to the use of oil or gas. ____
- 3. Do you consider social media to be an **objective** source for news? ____

C READING SKILL Look at the underlined parts in the sentences below. Write **C** for cause or **E** for effect.

- 1. When tourists eat at local restaurants, the local economy benefits. ____
- 2. Mass tourism often leads to increased traffic and pollution. ____

D LANGUAGE FOR WRITING Complete the sentences with your own ideas.

- 1. If too many tourists visit a particular city or area, ____.
- 2. Both tourists and residents benefit if ____.

SELF-ASSESS Look back at the chart above. Did you assess your skills correctly? What skills or language do you still need help with?

PRODUCT DESIGN6



A product designer working on a model of a chair

IN THIS UNIT, YOU WILL:

- Read an article about modern spacesuits
- Watch a video about 3-D printed hands
- Read an article about a product for service dogs
- Write about a product that solves a problem

THINK AND DISCUSS:

- 1. The photo above shows a product designer comparing a model of a chair to a sketch. What do you think are some characteristics of good product design?
- 2. What products do you use in your daily life? What makes them useful?

EXPLORE THE THEME

Look at the information on these pages and answer the questions.

- 1. How have spacesuits changed over time?
- 2. What factors are important to consider when designing a spacesuit?
- 3. Would you like to go to space? Why or why not?

Extravehicular Activity E

spacesuits allow for work outside the spacecraft.

Intravehicular Activity I

spacesuits are used in emergencies, when there is a problem onboard the spacecraft.

Intra/Extravehicular Activity IE

spacesuits use accessories when the user needs to work outside, eliminating the need for two separate suits and reducing cargo weight.

SUITING UP

Over the years, spacesuits have changed: from pressure suits for pilots in high-altitude planes to keeping astronauts alive in the near-vacuum conditions of space. They provide oxygen and consistent atmospheric pressure, and their design becomes more complex as the

years go on. Furthermore, as missions become longer and more demanding, significant technological improvements are required for each new model.



Oxygen tank

Maneuvering device

NEIL ARMSTRONG
Apollo 11 suit



The moon's dust is so sharp it penetrated the suit's outer layers.

Injection patch for medication

Overshoes

Two visors, one gold coated, protect the user from the sun's rays and heat.

Pressure helmet



1934–1935 I	1959–1968 I	1961–1963 I	1965–1966 IE	1969–1974 IE	1983–today E
The first pressure suit was made of cotton and rubber and was used at altitudes of over 15,000 meters.	Weight: 11 kg	Weight: 10 kg	Weight: 15.5 kg	Weight: 34 kg	Suits, once customized, now have standardized, swappable parts that fit men and women on the International Space Station. Weight: 55 kg
 Lockheed Vega Winnie Mae	 North American X-15	 Mercury capsule	 Gemini capsule	 Apollo capsule	 Shuttle

Reading 1

PREPARING TO READ

A BUILD VOCABULARY The words and phrases in **blue** are used in the reading passage. Read the sentences. Then write the correct form of each word or phrase next to its definition.

In order for us to live on another planet, the **availability** of air and water is vital.

Many activities on spacecraft are **automatic**. For example, the ship can take off and land without a pilot's input.

The shuttle launch had to be **postponed** due to bad weather.

To ensure a successful mission, astronauts have to make **logical** decisions, not emotional ones.

How a product looks is important, but there are **multiple** factors that **contribute to** good design, such as how well it **functions**. A bad design looks ugly and doesn't work well.

Rockets **initially** carried monkeys, rather than human crew members.

Astronauts need to have a wide range of skills because they have to **conduct** many experiments in space.

When astronauts go to Mars, their suits will need to be **flexible** so they can move around more easily.


- _____ : (adj) able to change or move easily
- _____ : (n) when someone or something is able to be used or obtained
- _____ : (v) to work or operate
- _____ : (v) to organize and carry out a task
- _____ : (v) to be delayed until a later date
- _____ : (adj) operating with little or no human involvement
- _____ : (v) to help cause an event or situation
- _____ : (adj) using reason
- _____ : (adv) at the beginning
- _____ : (adj) with several things or parts

B USE VOCABULARY Discuss these questions with a partner.

- When do you think it's important to make a **logical** decision rather than an emotional one?
- How does good product design **contribute to** our lives?

C PREDICT Look at the photos on pages 127–129 and skim the first four paragraphs. What problem do you think the passage is mainly about? Discuss with a partner. Then check your ideas as you read.

For All Humankind

- A**  Spacesuits are vital to the success of space travel. Without them, the change in pressure in space could cause your lungs to burst and gases to bubble out of your blood.
- B** They are also uncomfortable to wear and difficult to move around in. Astronauts are constantly working against internal air pressure. Wearing one is a bit like trying to move around inside a balloon.
- C** “Everything you’re doing seems to be pushing back against you,” says Cathleen Lewis, who is in charge of spacesuits and international space programs at the Smithsonian’s National Air and Space Museum. Astronauts must spend many grueling hours **conducting** experiments and making repairs, and even in a well-fitted suit, they might finish spacewalks with various minor injuries. As NASA has warned: “Space travel is not for the meek.”¹
- D** Until somewhat recently, space travel has not been for women either. In fact, 90 percent of astronauts have been male. But NASA is making changes to their program—and to their spacesuits in particular—to ensure that a wider variety of people are able to **contribute to** space exploration.

A HISTORIC WALK

E NASA astronauts Christina Koch and Jessica Meir made history on October 18, 2019, on the first all-woman spacewalk. They spent more than five hours outside the International Space

¹ If someone is **meek**, they are quiet and gentle.



A prototype of NASA's new spacesuit

Station on a mission to replace a part that wasn't working.

- F** The moment didn't come easily. Seven months earlier, Koch had planned to make the first all-woman spacewalk with Anne McClain, another female astronaut. However, there was only one suit available in their size. A larger size was available, so a male astronaut took McClain's spot, and the historic spacewalk had to be **postponed**.
- G** The change upset many, but the decision—recommended by McClain herself—was **logical** in the situation. Fit is the most important quality in spacesuits, keeping astronauts safe and preventing them from getting too tired.
- H** The spacesuit issue illustrated a more general problem: A lot of everyday products weren't **initially** designed with women in mind. It's usually a matter of size—for example, smartphones are

often too big for women’s hands. Women are also more likely to be injured in certain types of car crashes because—until recently—crash-test dummies² were modeled after male bodies. And it’s not only women that can be left out of design. For example, some **automatic** sinks have difficulty sensing darker skin. And face masks can be a poor fit for certain ethnicities due to the variety in facial structures.

I So, how were spacesuits designed and how will new designs consider the needs of women?

²A **dummy** is a figure designed to resemble a human body.

³The **Apollo program** ran from 1961 to 1972 and was successful in being the first to send humans to the surface of the moon.

⁴A **vacuum** is a space that has no matter in it at all, not even air.

FROM TAILORED SUITS TO MANY SIZES FIT MOST

J In the 1960s, each NASA spacesuit was specially designed for the individual wearers, who were all men. When NASA began to plan travel to the moon, the suits had to **function** in a different way.

K “The NASA Apollo program³ really changed the game,” says Lewis. “They had to design a suit that would not only operate in the vacuum⁴ of space, but also would allow astronauts to explore another world—they could get up, walk around, and be autonomous.”

From 1959 to 1978, all NASA astronauts were white males.



Amy Ross, a spacesuit engineer for NASA, waves to the crowd.

L However, producing a unique spacesuit for each astronaut was expensive, especially in the 1970s, when more people were becoming astronauts. The spacesuits needed to be more **flexible**. Instead of custom-made suits, modular suits were designed. This meant the parts (arms, legs, body) could be put together in different combinations and reused by **multiple** astronauts.

M Around the same time, the first American women were accepted into the astronaut training program. That’s when the differences between male and female bodies became more obvious and fit became especially challenging. NASA started making small and extra small spacesuit parts to address these differences, but they eventually had to stop to cut costs. This lack of **availability** of parts is what ultimately led to McClain being taken out of the March 2019 mission.

N To avoid repeating such a mistake, an all-new suit needed to be designed to ensure that astronauts of all shapes and sizes could go to space.

⁵When something **accommodates** someone, it fits their needs.

SPACESUITS, THE NEXT GENERATION

O In 2022, NASA chose two private companies, Axiom Space and Collins Aerospace, to design and develop new spacesuits for the planned Artemis missions, which will see the first woman and the first person of color to explore the moon. Artemis astronauts will be on the moon longer than Apollo astronauts and could face new challenges, so they need to be able to move more easily and quickly. The new suits should provide this greater flexibility. They will also accommodate⁵ a diverse crew, considering all genders and body types. This includes anyone from 1.5 to 1.9 meters in height and 42 to 110 kilograms.

P “We have to think about diversity,” says Amy Foster, a space historian at the University of Central Florida, in *Scientific American*. “I don’t want anybody being cut out of the opportunity to fly on Artemis because their body type doesn’t fit a suit.”

UNDERSTANDING THE READING

A SUMMARIZE Read the first sentence of a summary of the passage. Check (✓) three other ideas to complete the summary.

Spacesuits, crucial to astronauts’ success, are being redesigned for a more diverse crew.

- ☐ 1. Spacesuits are necessary to keep astronauts safe, but they aren’t perfect.
- ☐ 2. Cathleen Lewis takes care of the spacesuits at the Smithsonian’s National Air and Space Museum.
- ☐ 3. NASA realized that spacesuits had to be redesigned to fit a range of people.
- ☐ 4. The parts of a modular design can be put together in different ways.
- ☐ 5. New spacesuits that will fit more body types have been designed.

B UNDERSTAND DETAILS Read the sentences. Choose **T** for true, **F** for false, or **NG** for not given.

1. Spacesuits can cause injuries to the wearer.

T F NG
2. The first all-woman spacewalk happened in March 2019.

T F NG
3. NASA stopped making small spacesuit parts to save money.

T F NG
4. Most of the first female astronauts needed medium-sized suits.

T F NG
5. The suits designed for Artemis can fit people who are 1.5 meters tall.

T F NG

C ANALYZE QUOTES Read the following quotes from the reading passage. Which idea from Exercise A (1–5) does each quote support? Discuss with a partner.

1. “Everything you’re doing seems to be pushing back against you,” says Cathleen Lewis. (paragraph C) _____
2. “I don’t want anybody being cut out of the opportunity to fly on Artemis because their body type doesn’t fit a suit.” (paragraph P) _____

D INFER MEANING Find and underline the following words in **bold** in the reading passage. Use context to identify their meanings. Then match the sentence parts to complete the definitions.

1. Paragraph C: If something is **grueling**, it is _____

a. made up of pieces or parts that can be combined in different ways.
2. Paragraph H: Something that is **facial** is _____

b. related to the face.
3. Paragraph K: If something is **autonomous**, it is _____

c. very tiring.
4. Paragraph L: If something is **modular**, it is _____

d. able to exist or operate independently.

CRITICAL THINKING Understanding Speculation

Speculation is thinking about possibilities. When writers speculate, they are thinking about what might be possible, not what they know exists or what they can prove will work. Writers often use modals to signal they are speculating.

Past: *would, could, might*

*I **would** have been an astronaut if it were possible.*

Present or future: *could, may, might, can, should*

*There **could** be water on Mars.*
*One day, we **might** be able to live in space.*

E IDENTIFY SPECULATION Read the sentences. Circle the one that shows speculation.

1. a. They are also uncomfortable to wear and difficult to move around in.

b. Around the same time, the first American women were accepted into the astronaut training program.

c. Artemis astronauts will be on the moon longer than Apollo astronauts and could face new challenges.

F ANALYZE For the sentence you chose in Exercise E, why is the writer speculating? Why are they not more certain? Note your ideas. Then discuss with a partner.

G APPLY Look at the sentences below. Choose the correct options to make sentences that use speculation.

1. I **am / might be** able to go to space.

2. Space travel **may / will** become cheaper in the near future.

3. Soon, other countries **will / could** send astronauts to the moon.

4. Someday, we **will / may** be able to take our pets to space.

5. I **feel / might feel** lonely in space.

H SPECULATE Imagine you had to spend a long time in space. What would the challenges be? Make a list. Then discuss with a partner what the hardest part would be.

Concept art of an astronaut conducting a mission in the new spacesuit



Review this Critical Thinking Skill in Unit 3

Critical Thinking

Critical Thinking

Critical Thinking

DEVELOPING READING SKILLS

READING SKILL Identifying Problems and Solutions

Writers often describe problems and their possible solutions. The following words and phrases can signal problems and solutions.

Problems
nouns: *problem, trouble, disadvantage, downside, challenge, issue, mistake*
verbs: *harm, hurt, damage, destroy*
adjectives: *challenging, problematic, difficult*

Solutions
nouns: *solution, answer, remedy, possibility*
verbs: *resolve, address, answer, ensure, solve*
adjectives: *improved, effective*

A IDENTIFY PROBLEMS AND SOLUTIONS Read the sentences from the reading passage. Write **P** for problem or **S** for solution.

- ____ 1. They are also uncomfortable to wear and difficult to move around in.
- ____ 2. The spacesuit issue illustrated a very real problem: The equipment wasn’t initially designed with women in mind.
- ____ 3. For example, some automatic sinks have difficulty sensing darker skin. And face masks can be a poor fit for certain ethnicities due to the variety in facial structures.
- ____ 4. NASA started making small and extra small spacesuit parts to address these differences.
- ____ 5. An all-new suit needed to be designed to ensure that astronauts of all shapes and sizes could go to space.
- ____ 6. That’s when the differences between male and female bodies became more obvious and fit became especially challenging.

B APPLY Complete the sentences. Use the correct form of the words from the Reading Skill box. More than one word may be possible.

- 1. It can be _____ for visually impaired people to walk around busy cities. One product that _____ this is tactile paving—bumps on the sidewalk that tell the person where to go and if there are hazards ahead.
- 2. Another _____ for visually impaired people is using the internet. One _____ to this is a computer’s voice assistant, which reads out text on-screen and helps the user navigate.
- 3. Simple daily tasks like cooking can be _____ for mobility-impaired people. Specially designed cookware can _____ this problem.
- 4. People who find it _____ to use their hands—such as those with arthritis—might struggle to simply get dressed. Magnetic buttons are one _____ that makes this task much easier.



A student shows her prosthetic hand to her teacher.

Regular prosthetic hands can cost thousands of dollars due to the materials used and complicated design. One company, e-NABLE, is working on an answer to this problem.

A PREDICT Read the information above and look at the picture. What do you think makes this design different from regular prosthetic hands?

Critical Thinking

B MAIN IDEAS Watch the video. Choose **T** for true or **F** for false.

- | | | |
|---|----------|----------|
| 1. e-NABLE’s volunteers are located around the world. | T | F |
| 2. The hands are given away for free. | T | F |
| 3. Children are mostly excited by its appearance. | T | F |
| 4. The hands are a one-size-fits-all design. | T | F |
| 5. The hand uses lightweight electronic parts. | T | F |

C DETAILS Watch the video again. Check (✓) the things you see the children doing.

- ☐ 1. throwing and catching a ball
- ☐ 2. walking a dog
- ☐ 3. holding a bottle
- ☐ 4. riding a bike
- ☐ 5. using a cell phone
- ☐ 6. swimming
- ☐ 7. playing video games

D REACT TO THE VIDEO What other products could be improved using 3-D printing? Do you think this kind of technology will become used more widely? Why or why not? Discuss with a partner.

Critical Thinking

Reading 2

PREPARING TO READ

- A BUILD VOCABULARY** The words in **blue** are used in the reading passage. Read the sentences. Then complete the paragraph with the correct form of the words.

A **circumstance** is a fact or an event that makes a situation the way it is.

An order to do something is a **command**.

Something that is **mechanical** is related to or operated by machines.

The part of a machine or vehicle that moves and makes it work is the **motor**.

A **signal** is a movement, light, or sound that gives information or tells someone or something what to do.

If you have official permission to do something, you have **approval**.

When you **distinguish** something, you recognize the difference between two or more people, ideas, or things.

Something that achieves the desired results is **effective**.

When you use words to show you admire someone, you **praise** them.

Reality is the way a situation really is.

Robots used to only be in books and movies, but now they are a(n) ¹_____. They can do many things. For example, they can follow ²_____ like “Close the door” or “Clean the floor.” They can even send ³_____ to each other to ask for help. They are also useful in various ⁴_____ where humans need assistance. For example, robots can help people who have trouble moving around. Some robots can be ⁵_____ in helping people feel less lonely. They respond to questions and play games. Robots have even received ⁶_____ to help hospital patients with talk therapy. One study in Japan showed that students performed better when robots ⁷_____ them for their hard work. Of course, robots are ⁸_____, not human. Like other machines, they require ⁹_____ to move. People can still ¹⁰_____ between humans and robots, but the differences are becoming less obvious.

- B USE VOCABULARY** Discuss these questions with a partner.

1. What **distinguishes** an **effective** product design from one that isn’t very good?
2. When was the last time someone **praised** something you did?
3. What wearable technology do you know of that is already a **reality**?

- C PREDICT** Look at the photos on pages 135–137 and skim the first paragraph. What do you think this product does? How does it make life easier for the user? Discuss in pairs.



- A** It turns out you can teach an old dog—or at least a middle-aged one—new tricks. A service dog named Tai can follow directions from his handler, but without any verbal or visual **signals** at all. He can turn, back up, lie down, and come on **command**, all without the handler saying a word. Instead, he responds to remote-controlled vibrations. These vibrations come from a newly developed dog vest.¹

- B** The use of technology involving the sense of touch is called *haptics*. For example, when a cell phone vibrates, it is using haptics. A haptic dog vest could have many important uses, explains Yoav Golan, one of the researchers studying how to use this technology for dog training. Golan is a Ph.D student in **mechanical** engineering and Tai’s owner.

- C** A haptic vest could be especially helpful to communicate with dogs in situations where visual or spoken signals aren’t possible. For example, search-and-

rescue dogs often work at a distance from their handlers. These dogs sometimes work in small spaces—such as under collapsed² buildings—or in places where they cannot see or hear the handler. The haptic vest would allow the handler to give instructions in these **circumstances**. Vibration commands could also be used when silence is necessary, such as in secret military operations. Similarly, police and military dogs could use the vest if they are working in loud areas, for example, near noisy aircraft, where it may be hard to hear the handler’s voice.

- D** In addition, haptic signals are the same no matter what language the handler speaks. Tai—a six-year-old mixed breed—understands spoken commands in only one language. However, anyone can give Tai a command using a remote control. Dogs also sometimes pay more attention to the voices of specific people, but vibration commands are the same to the dog no matter who is giving them.

¹A **vest** is a piece of clothing that covers the upper body but has no sleeves.

²If something has **collapsed**, it has fallen down and been broken into pieces.

E The vest allows handlers to call and direct dogs from a distance. For example, if a dog runs off, the handler can push a button to tell it to return. Vibrations would give service dogs another way to understand commands from handlers who might have speech or physical disabilities. Moreover, the vest could help handlers communicate with dogs that have hearing problems, Golan says.

F Consumers can already buy dog collars that use vibrations. However, they are mostly used as “shock collars”—to say “no.” They transmit electrical signals to punish unwanted behavior, like jumping or barking. They don’t teach dogs to follow specific commands. In addition, they are painful, and most vets don’t approve of their use.

G The research team wanted to see if multiple contact points could deliver more complex instructions. To try this out, they put the vibration **motor** inside a special case, which sits inside the vest and is about four centimeters in length. The contact points stick out of the case and touch the skin through the dog’s fur. These points deliver vibrations to the dog’s hips and shoulders. By sending signals to different places on the body, and for different lengths of time, the vest can give more specific commands.

H Tai already knew the four spoken commands for turn, lie down, come, and back up, so teaching him those haptic cues was not difficult. According to Golan, the “smart, but not very smart” dog learned each command in about an hour or less, and tests were done

to make sure he was responding to vibration alone, and not the owner’s body language.

I The results showed that Tai could associate individual commands with vibrations from four different motors near the top of each of his legs. Furthermore, the dog was able to **distinguish** between different kinds of signals, such as short buzzes or constant vibration. This shows the potential for dogs to learn commands at different levels of complexity.³ The scientists report that signals given by vibrations in the vest were as **effective** as spoken commands.

J Before any experiments were done, it took months to get **approval** from the government and the animal research ethics committee at Ben-Gurion University of the Negev, where Golan’s research is based. The university also has veterinary staff who check on the experiments and the conditions for animals involved. The haptic equipment—including the vest and motors—doesn’t hurt the dog. It weighs about half a kilogram—a light

³If something has **complexity**, it is not easy to understand.

Tai wearing the haptic vest



A service dog helps its handler shop.

weight for Tai, who weighs roughly 35 kilograms. The experiments themselves were also not harmful. Golan tested the motors on himself first, and he says the vibrations are like the buzz of a cell phone. Tai seemed comfortable, had time to rest, and was given treats and **praised** for good behavior.

K Golan thinks future research could test the haptic vest with different dogs of various sizes, breeds, ages, fur types, and training backgrounds. For example, would dogs with no previous training at all respond to haptic cues? How would they respond to completely new commands? He also says that dogs could one day be trained in remote two-way communications with handlers using sensors.

L In fact, a lab in the U.S. has already begun to test this idea. In its research, dogs were trained to activate

sensors in their vests by biting, pulling, or touching the sensors with their noses. If development of a two-way communication system is successful, a handler could give a command and the dog could “answer.” For example, the handler might send a search-and-rescue dog to find someone who is lost. The handler could signal to the dog where to look, and the dog could bite a sensor when it finds the person.

M More research on dogs and haptic vests is needed to make these ideas a **reality**. Luckily, Tai has been popular in the university’s robotics lab. For his work, he has been registered with the government as a research dog, and the research team calls him “a truly good boy.” The lab has no shortage of other potential dogs to study, either: “So many students want to bring their dogs.”

UNDERSTANDING THE READING

A UNDERSTAND MAIN IDEAS Match each section of the reading passage with its main idea.

- _____ 1. Paragraph B

_____ 2. Paragraph C

_____ 3. Paragraphs D–E

_____ 4. Paragraph F

_____ 5. Paragraphs G–I

_____ 6. Paragraph J

_____ 7. Paragraphs K–M
- a. procedures to protect the dog

b. description of Golan’s study and results

c. additional research

d. situations where communication is difficult

e. current use of vibrations with dogs

f. definition of haptics

g. haptic signals accessible to wider range of users

B IDENTIFY EXAMPLES Complete the examples using information from the reading passage. Write no more than two words in each space.

Supporting Idea	Example
1. Can be used in hard-to-reach areas	Under _____
2. Useful when you need to be quiet	In secret _____
3. Useful in places where it’s hard to hear	Near _____
4. Can give commands from far away	If a dog _____

C IDENTIFY PROBLEMS Check (✓) the problems that a haptic dog vest could solve.

- ☐ 1. a handler who can’t speak

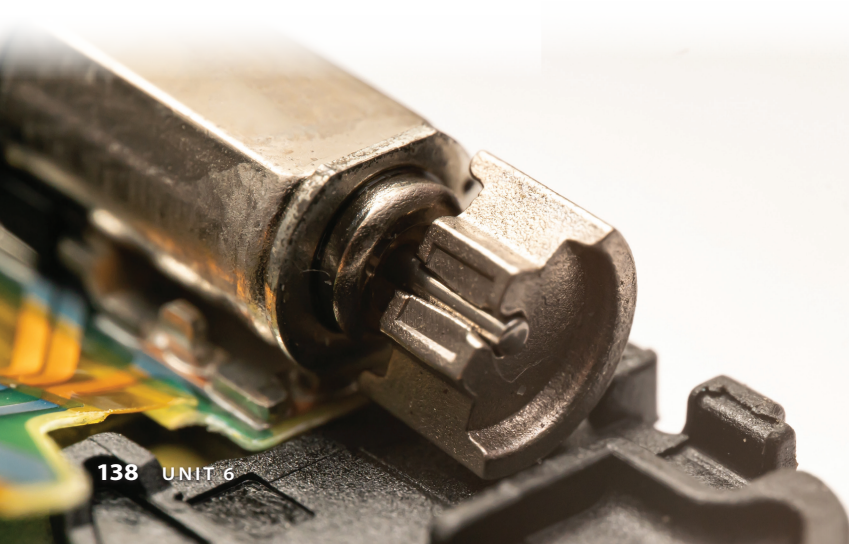
☐ 2. a dog that doesn’t understand the handler’s language

☐ 3. a dog that can’t swim

☐ 4. a dog that can’t hear

☐ 5. a dog that can’t see its handler

☐ 6. a handler who is scared of dogs



A haptic motor in a cell phone

D INFER MEANING Find and underline the words in **bold** in the reading passage. Use context to identify their meanings. Then match the sentence parts to complete the definitions.

1. Paragraph A: **Verbal** means _____

2. Paragraph A: A **handler** is someone who _____

3. Paragraph H: A **cue** is a _____

4. Paragraph I: If you **associate** something with another thing, you _____

5. Paragraph J: A **buzz** is a _____
- a. controls animals.

b. signal to do something.

c. related to words.

d. low and continuous sound, like the sound a bee makes.

e. make a connection between them.

E INFER PURPOSE Choose the correct answers. Then discuss with a partner.

1. What does the author most likely want to show about the dog vest?

a. It is unlikely to be successful in the market.

b. It is useful, but it can be hard for some people to operate.

c. It has a lot of potential, but they still have to do a lot of research.

2. In paragraph H, why does the author mention that Tai is a “smart, but not very smart” dog?

a. to show that Tai worked hard and trusted his owner

b. to show that many dogs can learn to use the vest

c. to show that it is easy to be a service dog

3. What is the purpose of paragraph J?

a. to show that the researchers treated Tai well

b. to show that the experiment’s conclusions are reliable

c. to show that it was not easy to do experiments

4. Which paragraph describes the product’s design?

a. paragraph E

b. paragraph G

c. paragraph H

5. What is the purpose of paragraph L?

a. to show that the technology is getting cheaper

b. to show that dogs are smarter than we think

c. to show potential uses of the vest in the future

F DISCOVER How can haptic technology be used with the things in the box? Research with a partner and share your findings with the class.

virtual reality

video games

movie theaters

automobiles

Critical Thinking

Critical Thinking

VOCABULARY EXTENSION

WORD LINK *auto-*

The prefix *auto-* means “oneself.” For example, *autonomous* means “being able to function separately and independently.”

- A** Complete each sentence with the correct word from the box. One word is extra.
- autobiography autofocus autograph automated automobile autopilot
- When planes fly by themselves, they are operating on _____.
 - There aren’t any cashiers at this supermarket because the checkout is _____.
 - I’ve always enjoyed reading about the lives of historical people like Nelson Mandela. I like his _____ even more because you can read his story in his own words.
 - The invention of the _____ in the late 19th century meant that many people no longer needed horses to get around.
 - A photo of a celebrity is more valuable if it has their _____.

WORD PARTNERS Phrasal Verbs *back up, stick out, try out*

Phrasal verbs have two parts: a verb and at least one preposition or adverb. Some phrasal verbs have more than one meaning.

back up: 1. to reverse; 2. to support; 3. to make a copy of something on a computer

stick out: 1. to extend beyond the edge of something; 2. to be very easy to notice; 3. to do something until the end

try out: 1. to test something to discover if it works; 2. to use something to find out if you like it; 3. to be tested to see if you are good enough for something, e.g., a team

- B** Read the sentences. Match each phrasal verb below with the correct definition (1–3) above.
- I tried to **back** the car **up**, but the hill was too steep. _____
 - Ask for more time on the assignment. I’ll **back** you **up**. _____
 - With his red hair, he really **sticks** **out** in a crowd. _____
 - We didn’t like the concert, but we **stuck** it **out**. _____
 - She’s good at tennis. She wants to **try** **out** for the school team. _____
 - When the researchers **tried** **out** the dog vest, they were happy with the results. _____

EXPLORING WRITTEN ENGLISH

LANGUAGE FOR WRITING Using Language for Speculation

When you speculate, you can consider the degree to which something is possible. Writers often use modals to speculate or make deductions.

Very certain: *will, won’t, can’t, couldn’t, must*
*The new spacesuits **will** be more comfortable.*

Somewhat certain: *should*
*The spacesuits **should** allow the astronauts to do more complex tasks.*

Not very certain: *could, might, may*
*Haptic vests **could** help save more lives.*

Other expressions for speculation include:

Very certain: <i>There’s no way/chance that ...</i> <i>No doubt ...</i> <i>It’s very likely/probable/unlikely/improbable that ...</i> <i>In all probability/likelihood ...</i>	Somewhat certain: <i>The chances are ...</i> <i>It’s possible that ...</i> <i>Perhaps ...</i> <i>There’s a chance that ...</i>
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- A NOTICE** Read the sentences. How certain is the writer about the information? Rate the sentences (1 = very certain; 2 = somewhat certain; 3 = not very certain). Then discuss with a partner which words helped you decide.
- A haptic vest could be especially helpful to communicate with dogs in situations where visual or spoken signals aren’t possible. _____
 - A spacesuit that fits well might prevent injuries. _____
 - On the Artemis mission, astronauts will spend more time on the surface of the moon. _____
 - The new suits should provide this greater flexibility. _____
 - Dogs may one day be trained in remote two-way communications with handlers using sensors. _____

A service dog in a forest ►



- B APPLY** Complete the sentences with correct words. Some sentences have more than one possible answer. Use the words in parentheses to decide how certain the writer is.
1. The new spacesuits _____ help astronauts on the next mission. (very certain)
 2. The new suits _____ be ready very soon. (somewhat certain)
 3. Researchers _____ reveal other uses for haptic vests soon. (not very certain)
 4. There’s no _____ that clothing can provide air conditioning! (very certain)
 5. The _____ are that it will solve the problem. (somewhat certain)
 6. There’s no _____ that the device won’t work for you. It has already helped millions of people. (very certain)
 7. In all _____, haptic technology can solve other problems. (very certain)

WRITING SKILL Writing a Problem-Solution Essay

In a problem-solution essay, you first describe a problem and then propose a solution. Your introduction will give a summary of the problem and why it is important. The thesis statement will identify the solution.

Your first body paragraph will describe the problem in detail. The second will describe a solution that addresses that problem. Then you will give reasons why it is a good solution.

You can use words and phrases for problems, solutions, and speculation when you talk about possible effects.

- C** Look at the topic below and read the topic sentence for the first body paragraph. Choose the two best supporting ideas.
- Single-use plastic bags are bad for the environment and for human health.*
1. Single-use plastic bags are produced in countries all over the world.
 2. Single-use plastic bags don’t biodegrade—they just break down into small particles that pollute the water and land.
 3. The same small particles get into the water supply and affect human health, and they cause cancer and birth defects, among other health problems.
 4. This is because companies must use a lot of fossil fuels to produce single-use plastic bags.
- D** Read the second body paragraph. Choose the best words to complete the supporting ideas and details.
- Reusable silicone bags with zip tops can solve problems created by single-use plastic in several ways. First, silicone bags ¹**reduce** / **issue** the impact of fossil fuels in production. Second, they don’t break down into small particles, which ²**prevents** / **supports** the problem of food and water contamination. Because they are lightweight, they could be a more convenient ³**solution** / **challenge** than glass or metal containers. In each household, reusable silicone bags with zip tops could significantly ⁴**challenge** / **reduce** the use of regular plastic sandwich bags.

WRITING TASK

GOAL You are going to write a problem-solution essay on the following topic:

Think of a problem that could be solved by a new product. It can be a product already available or one you think is close to being available. What is the problem? What is the solution? What makes the solution effective?

- A BRAINSTORM** Think of four problems that you or other people face in their daily lives. What products, currently available or possible, might help address each problem? Do research if necessary.

Problems	Products
1.	
2.	
3.	
4.	

- B EVALUATE** Which of the products in Exercise A do you think is the most useful? Why? Decide which one you will write about in your essay.
- C IDENTIFY SUPPORTING DETAILS** What details show why the product is an effective solution? Make a list below.
- _____
 - _____
 - _____
 - _____
 - _____
- D IDENTIFY SUPPORTING DETAILS** Choose two of the strongest details you wrote in Exercise C and add them to the outline on the next page.
- E WRITE A THESIS STATEMENT** Read the example thesis statement. Then write a similar one for your essay in the outline on the next page.

Reusable silicone bags could reduce the amount of plastic in landfills and help the environment significantly.

F PLAN Complete the rest of the outline below.

OUTLINE

Introduction

Hook (optional): _____

Summary of the Problem: _____

Thesis: _____

Body Paragraph 1

Topic Sentence (state the problem): _____

Supporting Ideas / Details: _____

Body Paragraph 2

Topic Sentence (state the solution): _____

Supporting Idea 1 (describe the product) / Details: _____

Supporting Idea 2 (explain how it solves the problem) / Details: _____

Conclusion:

Summary Statement: _____

Final Thought: _____

G FIRST DRAFT Use the information in your outline to write a first draft of your essay. Refer to the paragraphs in Exercises C and D on page 142 and the writing model on the next page to help you.

WRITING MODEL

This model essay is similar to the one you are going to write. It is about a hat that cools the head and body.

Five million people a year die because of extreme heat. Rising temperatures worldwide have led to an increase in heat-related health problems. Fortunately, designers are finding a way to help—with smarter clothing, including a “cool” hat.

With an increase in average temperatures, more people than ever before are experiencing heat-related health problems. One problem caused by heat and humidity is heat cramps. Although your muscles hurt and may seize up, this is the mildest symptom. A more serious condition is heat exhaustion. People with heat exhaustion feel headaches, weakness, and nausea. The third illness—heat stroke—is the most serious. It happens when your body can no longer regulate its own temperature, and untreated, can lead to death.

One product that addresses health problems related to heat is a cooling hat. The company that makes the hats was founded by two successful professional athletes, Serena Williams and Dwyane Wade. It uses a technology that increases the rate of evaporation. When you wet the hat, the temperature of the fabric drops. If people use it correctly, they will be less likely to get serious heat-related symptoms. This might allow more people to exercise safely on extremely hot days. This technology and other “smart” fabrics could even prevent deaths.

Specially designed “smart” clothing, such as cooling hats, can be an effective tool in tackling the harmful effects of climate change and rising temperatures. If smart clothing can keep us cool, what else can it do?

H REVISED DRAFT Now use the questions below to revise your essay.

- ☐ Does your introductory paragraph have a clear thesis statement?
- ☐ Does your thesis statement state the solution to the problem?
- ☐ Did you include enough details to explain the problem and the solution in the body paragraphs?
- ☐ Does your concluding paragraph have a summary statement and a final thought?

I FINAL DRAFT Follow these steps to write a final draft.

1. Check your revised draft for mistakes with language for speculation.
2. Now use the checklist on page 250 to write a final draft. Make any other necessary changes.
3. Work in pairs and read your partner’s final draft. Give feedback on each other’s writing.

SELF-ASSESS Consider the language and skills you learned in this unit.

How well can you ... ?	Very well	Pretty well	I need improvement
use the key vocabulary from this unit	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
understand speculation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
identify problems and solutions	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
use language for speculation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
write a problem-solution essay	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

A VOCABULARY Do you remember the meanings of these words and phrases? Look back at the unit and review the ones you don't know.

approval	automatic AW	availability AW	circumstance AW	command
conduct AW	contribute to AW	distinguish	effective	flexible AW
function AW	initially AW	logical AW	mechanical AW	motor
multiple	postpone	praise	reality	signal

B VOCABULARY EXTENSION Complete these tasks with a partner.

- What words do you remember with *auto*-? Take turns making sentences with them.
- Take turns making sentences with the phrasal verbs below. Use each one in two ways.

back up	stick out	try out
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C READING SKILL Read each sentence. Write **P** for problem or **S** for solution.

- One advantage of this suggested remedy is its effectiveness. ____
- People have struggled to address the challenges. ____

D LANGUAGE FOR WRITING Work with a partner. Complete the sentences with a correct word.

- It's very _____ this product will solve all of your data-saving problems.
It's really great.
- There's no _____ the current products will work.

SELF-ASSESS Look back at the chart above. Did you assess your skills correctly? What skills or language do you still need help with?

GLOBAL CHALLENGES7



IN THIS UNIT, YOU WILL:

- Read an interview about climate change
- Watch a video about a man who observes snowfall
- Read an article about how we're working toward a sustainable future
- Write about what we can do to live sustainably

THINK AND DISCUSS:

- The photo above shows a large area of land being used for a solar power plant. What do you think are the pros and cons of using this kind of energy?
- What other sources of renewable energy do you know?