5 It's Not Rocket Science

IN THIS UNIT, YOU...

- learn about and discuss different life hacks.
- read about why humans are curious.
- learn about brain research.
- watch a TED Talk about science being for everyone.
- design and write about an experiment.

5 It's Not Rocket Science

Unit overview

In this unit students will talk about science in their lives—what they know about it and the scientists who practice it, how students' lives are better for it, and how they learn it.

Students will learn about life hacks and the Internet, inventions, and the importance of collaboration and teamwork for "pushing the outside of the envelope" of scientific innovation. They'll read about how curiosity is necessary for learning and watch a TED Talk about the similarities between play and experimentation—and how this makes young people natural scientists! Finally, students delve into the scientific method and design and write about an experiment.

Unit objectives

Vocabulary

- Science in action
- **Vocabulary Building** Adjective endings

Grammar

- **Grammar 1** Passives 1
- **Grammar 2** Passives 2

Reading

- Back to the future?

TED Talk

- Beau Lotto and Amy O'Toole: *Science is for everyone, kids included*

Pronunciation

- Stress in passives

Speaking

- Staging
- Preparing research questions
- Hypothesizing

Writing

- A scientific method

About the photo

The photo shows Taylor Wilson, a young American scientist, and his family. Taylor has always been interested in nuclear physics. When he was twelve, he decided he wanted to make a star and that led to his building a nuclear fusion reactor in his garage. Taylor is currently working on a number of science and engineering projects. He's also a TED speaker.

Language note "It's not rocket science" is an expression people use when they think something is not that difficult to do or understand. It's a nod to the fact that the science involved in the development of modern rockets *was* very difficult. People might use the phrase in a humorous way (to a young child, trying to tie his shoes), an encouraging way (to a student learning multiplication), or an exasperating way (to an employee who can't stay focused enough to learn his job).

Warm up

- Tell students to keep their books closed. Display the photo on pp. 56–57, either pointing to it in the book or projecting it with the presentation tool.
- Ask the class who they think the family might be. Why do they think the young man on the left is dressed that way?
- Take students' responses. Explain who the people are by reading aloud the caption and About the photo to the class. Did anyone come close? Then put students in pairs and ask them to think of at least five questions they would like to ask Taylor Wilson.
- Have the class then conduct an "interview" with Taylor, who can be played either by you or a student, or else have students role-play the interview in pairs.
- Tell students they can use their imaginations in conducting the interview, as long as the questions and answers make sense.

Resources

- Classroom Presentation Tool
- Tracks 22–26 (Audio CD, Website, CPT)

5A Life Hacks

VOCABULARY

1 Tell students to read the Activity 1 questions and check that they understand them. You may need to clarify *mysteries of science* or prompt students with the names of famous scientists (Isaac Newton, Albert Einstein, Marie Curie, Stephen Hawking, Jane Goodall, Peter Higgs).

- Put students in small groups. Call on a student to read aloud the first question. Suggest one way yourself, then ask the class for other ideas. Have them discuss the rest of the questions in their groups.
- Circulate and help by correcting errors or giving students the English they need. Write some helpful points on the board, or remember them for class feedback.
- When a few groups have finished, stop the activity and call on groups to share one or two suggestions about the second and third questions.
- Give your feedback. To wrap up the activity, start a web on the board for the qualities of a scientist and have students call out qualities they came up with. Discuss them as a class, then add them to the web.

2 Tell the students to read the phrases and underline any of the words in bold they don't know. Put students in pairs and tell them to explain any words their partner doesn't know, or check them in a dictionary together.

- When the first pairs finish, stop the activity and give feedback on the new language. Say something like, *OK, you knew some of the words. Good! Let's look at a couple you weren't sure about.* . . . Ask a follow-up question to check understanding and deepen students' knowledge, such as: *How do scientists conduct research?* (do experiments, observe nature) *Why might you want to dissolve a substance?* (to see what it's like as a liquid) *How do you track progress?* (use graphs, enter data into a computer)
- You'll have further opportunities for reteaching the vocabulary as the lesson progresses.

3 Read the activity questions aloud. Then read the first phrase in Activity 2 and turn it into a sentence. Model with a student partner. Ask *Do we design experiments in our science classes?* Repeat for one or two other actions. Then have pairs take turns asking and answering questions about the rest. Circulate and help as necessary.

- When the first pairs finish, have everyone change partners and continue, starting from the last action this time.
- Call on pairs to share their dialogues about different actions with the class. Invite comments and provide feedback.

4 Tell students they're going to learn some more collocations for the verbs they've been working with.

- Read the activity directions and say, for example, *Number 1—a theory, an opinion. Hmm, what verb goes with both?* Explain that *form* is the most common verb for this pair of words, but other verbs might make sense in certain contexts (*prove* a theory).
- Tell students to complete the phrases individually, using a dictionary if necessary. When most have finished, have them compare answers with a partner and help each other with any problematic phrases. (Have students write down their collocations to use later, in Activity 6.)
- Review the answers. Write the numbers and verbs on the board. As you write, ask follow-up questions. For example: *After you form a theory, what might you do next? Where might you analyze a sample? A sample of what?*

5 Put students with new partners to compare answers from Activity 4 and to think of other collocates for the verbs. Encourage them to use a dictionary.

- When everyone has at least one new word or phrase for each verb, stop the activity and have pairs share what they came up with. Call on less proficient students first to give them an opportunity to contribute.

ACTIVITY 5 Suggested answers:
1 form – a team/a response; **2** analyze – information/the game; **3** carry out - research/tests; **4** release - from captivity; **5** submit – a plan/a school project; **6** reward – good behavior/an attempt; **7** track – a package/sleep patterns

6 Have students revisit the collocations they came up with for Activity 4. Read aloud the Activity 6 directions. Have students write answers for each collocation.

- Modeling thinking aloud. Say *Form a theory; form an opinion. Let's see. All kinds of scientists form theories—physicists, climatologists, for example—when they're trying to understand how the universe works. And lots of people form opinions! Art and movie critics do; it's their job.* Call on a few students to share their ideas.

7 Prepare your own (ideally true) answers to the questions before the class. Model answering the questions in class. Then put students in small groups to discuss.

- At the end of the task, give some feedback about new language that came up and errors you heard.

Taylor Wilson is the youngest person ever to produce a type of energy called *nuclear fusion*. He did it by building a reactor in his parents' garage.

5A Life Hacks

VOCABULARY Science in action

1 Work in groups. Discuss the questions. Answers will vary.

1 In what ways has science made life easier or better in your lifetime?
2 Can you think of two mysteries science has yet to solve?
3 Which scientists have you heard of? Why are they famous?
4 What personal qualities are most important if you want to be a scientist? Why?

2 Work in pairs. Do you understand the words in bold? Use a dictionary, if necessary. Answers will vary.

1 **design** an experiment
2 **conduct** research
3 **form** a hypothesis and **prove** it
4 **put** a substance in water and **heat** it **up** to help it **dissolve**
5 **create** a chemical reaction that **releases** a gas
6 **track** students' progress
7 **record** the results of an experiment and **analyze** them
8 **write** a report and **add** references at the end
9 **place** something under a microscope
10 **reward** hard work
11 **get rid of** a chemical
12 **submit** an assignment

3 Work in pairs. Do the actions in Activity 2 happen in your science classes at school? Who does each activity? Give examples. Answers will vary.

We don't really design experiments at school. We just follow the ones in the textbook or do what the teacher tells us to do.

4 Complete the phrases. Add verbs from Activity 2 that are commonly used with each set of words.

1 …a theory / …an opinion form
2 …samples / …the results analyze
3 …an operation / …a survey carry out
4 …chemicals into the atmosphere / …an animal release
5 …an essay / …it before the deadline submit
6 …their effort / …her for her work reward
7 …the movement of birds / …your progress track

5 Work in pairs. Compare your answers in Activity 4. Then think of one more word or phrase to go with each verb. Use a dictionary, if necessary.

6 Look again at your completed phrases in Activity 4. Who might perform each action? Why? Answers will vary.

7 **MY PERSPECTIVE**

Work in groups. Discuss the questions. Answers will vary.

1 What science experiments have you done at school that you enjoyed?
2 Have you ever designed an experiment yourself? If yes, what for? If no, why not? What experiment would you like to design?

LISTENING

Work in pairs. Read the definition. Then tell each other any life hacks you know for: Answers will vary.

1 smartphones.
2 computers / computer games.
3 the home.
4 food and drink.

Life hack /laɪf hæk/ *noun* [countable]
A simple solution or a piece of advice that helps you solve a problem, save time, or improve how something works.

Listen to an extract from a radio show called *Life Hacks*. Answer the questions. 22

1 What four life hacks are mentioned?
2 What problems do the life hacks help solve?

Correct the false information in each sentence. Then listen again to check your ideas. 22

1 Marie bought herself a phone for her birthday.
2 Marie's a morning person.
3 It's best to put the paper cup right next to your bed.
4 The cup throws the sound around the room.
5 The app alters your sleep patterns.
6 Phones can be charged faster on airplanes.
7 Spicy food increases the temperature in your mouth.
8 The chemical in chilies is easily dissolved with water.

Complete the extracts with three words in each blank. Then listen again to check. 22

1 Well, I ___was recently given___ this lovely new smartphone.
2 And of course it works better as an alarm if the cup ___is then left___ far away from your bed, as then ___you'll be forced___ to get up to turn it off.
3 The cup channels the sound in one direction, whereas normally ___it'd be thrown___ around all over the place.
4 ___It's been designed___ to track your sleep patterns and wake you up during light sleep rather than deep.
5 If your ___phone's being charged___ and you need it done ASAP, then what you need to do is put it in Airplane mode.
6 An email has ___just been sent___ to me by Maxine, who's suggested a hack for anyone out there who likes a spicy curry from time to time.

MY PERSPECTIVE Answers will vary.

Which of the four life hacks do you think is:

- the most useful? the least? Why?
- the easiest to understand from a scientific point of view? the hardest? Why?

GRAMMAR Passives 1

Work in groups. Look at the Grammar box. Then answer the questions.

1 What tense are each of the passive forms in Activity 11?
2 Why is the passive used in each case? Focus is on the object or person experiencing the action.
3 Identify the object(s) in the sentences in the Grammar box. Are the objects direct or indirect? What do they refer to? a *smartphone* / direct object
b *An email* / direct object.

LISTENING

8 Ask if anyone is familiar with the term *life hack* and, if so, have them tell the class what they understand it to mean. Then have students read aloud the definition of *life hack* in Activity 8 on p. 58.

- Say *That's not exactly a new idea. What are other words that mean something similar?* (*a work-around, a quick fix*) Explain that some of these terms, unlike *life hack,* refer to a temporary, rather than a permanent, solution.
- Read the activity directions and the four categories. Think of one or two life hacks yourself to model ideas for students.
- Have pairs stand up and share their ideas with different students. Tell them to change partners from time to time.
- Listen and take notes as students talk. At the end of the activity, share some of the more interesting hacks you heard about with the whole class.

9 22 Tell the class they're going to listen to a recording in which four life hacks are discussed. Read the directions and the questions students will have to answer and play the track once straight through.

- When the recording is done, have students compare their answers to the questions with a classmate's.
- Go around and notice how well the students are doing (without saying anything). If you see the majority have not fully answered the questions or are confused, play the track again.
- Ask the whole class or individual students for their answers. Where everyone agrees, write the number and key words on the board. If students disagree or most don't know, play the audio track again to listen and check.

ACTIVITY 9

1 a paper-cup loudspeaker; a sleep app; "airplane mode" charger; Eat yogurt with spicy food **2** Helps get you out of bed; Wakes you up during light sleep; Saves energy, is faster; Stops burning sensation

10 Have students read the statements. Make sure they understand them. You might remind them why this is important. (See the Exam Tip below.)

- Point out that all the statements are wrong and have pairs confer briefly to see if they can remember what the correct information is. Then have students work individually to correct each statement.
- 22 Play the audio and have students check their statements. Call on individuals to read aloud their corrected sentences.
- If students are unsure of certain details, replay the track, stopping at key points. Play these sections two or three times if students are still struggling to extract the correct information. Draw attention to any problem sounds or words and explain them when you give the answers.

ACTIVITY 10

1 She was given a phone. **2** not a morning person. **3** Put the cup far away. **4** The cup channels the sound. **5** It tracks your sleep patterns. **6** They can be charged faster in Airplane mode. **7** A chemical makes it seem hot. **8** Wash it off with something fatty.

11 Put students in pairs. Tell them to read the sentences and discuss what they remember about the missing words.

- 22 Play the audio once straight through and have students complete the sentences individually as best they can. Then have them compare answers with their partner.
- Call on students to say each answer. Play the audio to confirm. Write the numbers and answers on the board. (Students will need to refer to them for Activity 13 below.)
- Call on students to read aloud the completed sentences.

12 Read aloud the My Perspective text. Call on students to name the four hacks from the audio track. Write them on the board.

- Choose students who gave different answers to explain their choices and allow a discussion to develop, if students are interested. After each discussion, ask if anyone has changed their answer and have them explain why.

Exam Tip Read the questions first

Remind students that whether an activity or test item includes a reading or a listening text, they should always read the questions before reading or listening to the text. They should note key words or ideas in the questions and start thinking about synonyms or related language they might read or hear in the text. If they come across an unfamiliar word in a question, they might still be able to answer it based on the other language in the question and the context of the text.

GRAMMAR Passives 1

13 Either tell students to read the Grammar box silently, or read the text yourself aloud. Ask what the verb is in each sentence and have students call them out all together. (*was given, has been sent*)

- Put students in groups to answer the Activity 13 questions. Tell them that for questions 1 and 2 they'll need to refer to the list of Activity 11 answers on the board.

ACTIVITY 13

1

1 past; **2** present simple, future; **3** conditional; **4** present perfect; **5** present continuous; **6** present perfect

At this point, have students complete Activities 1–2 on p. 137 in the Grammar Reference section. You may also assign these activities as homework.

Teaching Tip

It helps to highlight words and verb forms to emphasize aspects of grammar. The book does this and you can point to the examples there, but it also helps to write examples on the board. As you review grammar activities, write the answers on the board. Underlining the target form, writing the names of the tenses, or creating a chart—all help to make grammar skills clearer.

14 Tell students they're going to read about an invention. Read the Activity 14 directions. Have students read the blog to find out what the invention is and how it has impacted people's lives, but stress that they have just one minute to read it.

- Read aloud the text up to the first blank and say *I have to use the verb* place. *The correct passive form here is . . . what?* Have students respond. (*be placed*)
- Have students do the activity. When most have finished, tell them to compare answers in pairs.
- Review the answers by calling on students to read aloud the text and filling in the blanks. Write the item numbers and passive forms on the board.

15 PRONUNCIATION Stress in passives

- **15a** Read the explanation in the box aloud. Say *Let's practice stress.* Tell students to look at their completed blog entries for Activity 14.
- Model reading the first couple of sentences. Pause after each passive form (include the adverb *completely,* but don't stress it more than *transformed*) and ask *Which word in the verb did I stress the most?* Have students call out the answers. (*placed, transformed, created*)
- Call on different students to model reading the rest of the sentences for the class. Remind them to place the most stress on the main verb.
- Correct any mistakes that come up.
- **15b** Put students in pairs to practice reading with proper stress. Tell partners to read the blog entry aloud to each other. Say *Read the Pronunciation box to yourselves first as a reminder. Then pay attention to how your partner reads the passives.*
- After they finish reading, you might suggest that partners grade each other from 1–10 on their use of proper stress. Partners should justify the grade they give each other, and then read the blog again to better it, if necessary. Monitor pairs as they read.

ACTIVITY 15a

1 be placed; **2** have been transformed; **3** was created; **4** be said; **5** had been used/were used; **6** were being tested/were tested **7** being connected; **8** be given

16 Read the questions aloud and have partners discuss. This exercise can be seen as simply a brief discussion to reflect on the blog text and as a link to the next activity.

- For feedback, you could ask different students to share their ideas on other important inventions.

17 Say *Let's see how much you know about inventions we take for granted.* Do the first one together. Have a student stand and read aloud the first item. Remind her to use proper stress when reading the passives. Provide assistance or correct as needed. Thank the student and tell her to sit down.

- Say *Raise your hand if you know what it is.* If several students raise their hands, have them call it out. (a yo-yo) Provide the answer if necessary. Then say *Now underline the passives in the two sentences. How many are there?* (four) Call on a student to read them aloud.
- Have students complete the activity individually.
- When students are ready, have different volunteers name the other three inventions. After each is correctly identified, have the students who guessed it raise their hands. Say *Give yourselves one point if you knew it.*
- Finally, go through the passives in each item. Tell students to give themselves one point for each one they underlined correctly.
- Tell the class the highest possible score for items 2–4 is 11. (3 inventions; 8 passives) Figure out who got the highest score and declare the winners.

18 Say *Now you get to write your own invention "riddle"!* Read the directions aloud and put students in pairs. (Alternatively, you could assign this as homework for students to do individually.) Make sure everyone understands the task.

- Have pairs brainstorm different inventions. Provide time for them to do research. When pairs are ready to compose their riddles, tell them they have to use passive forms. Say *Use the items in Activity 17 as models for using passives.*
- Circulate as students work, providing assistance as necessary. You might suggest that students choose a different invention if you see that several pairs are doing the same one. (It's all right if just two pairs do the same one.)
- When pairs are satisfied with their riddles, put them with another pair to quiz each other. You could then have pairs move on and repeat the process with other pairs. Alternatively you could have pairs present their riddles to the whole class.
- When everyone has heard all the riddles, have the class vote for the cleverest one.

The passive

The passive is made by using a form of the verb *be* + past participle.

a *I was recently given this lovely new smartphone.*
b *An email has just been sent to me by Maxine.*

Check the Grammar Reference for more information and practice.

14 Complete the blog entry with the correct passive forms.

If you're making a list of the most important inventions ever, the internet should (1) ___be placed___ (place) right at the top! Our lives (2) ___have been___ completely ___transformed___ (transform) since the first web page (3) ___was created___ (create) in 1990. It could even (4) ___be said___ (say) that the internet is the ultimate life hack! Of course, various linked systems of computers (5) ___had been used / were used___ (use) for some time before the birth of the world wide web, and early versions of what was to become the web (6) ___were___ regularly ___being / tested___ (test) throughout the 1970s and 80s. Today, though, it's rare to meet someone who has no interest in (7) ___being connected___ (connect). For many young people, that means more than 20 hours a week online! Indeed, the internet has become so essential to our lives that some argue it is like air, and that everyone should (8) ___be given___ (give) free access to it.

15 **PRONUNCIATION** Stress in passives See Activity 14

When using the passive, greater stress is placed on the main verb and less stress is placed on the auxiliary verb.

a Look at the completed blog entry in Activity 14. Which word is stressed in each passive construction?
b Work in pairs. Practice reading the blog entry in Activity 14 with the correct stress.

16 Work in pairs. Discuss the questions. Answers will vary.

1 Do you agree that the internet is the most important invention ever? Why?
2 What other inventions would you put near the top of the list? Why?

17 Underline the passives in the descriptions. Can you name the things described?

1 The name is taken from Tagalog, a language that's spoken in the Philippines, where it was used as a weapon for hundreds of years. It was first produced as a toy in California in the 1920s.
2 It is thought that it was first produced in Mocha, Yemen, over a thousand years ago. It's now consumed all over the world—particularly in the morning.
3 It was first invented in Ancient China over 2,000 years ago for use in government, but wasn't introduced into Europe until the 11th century.
4 You've probably been asked to type letters into one of these when using the web. They're used to prevent spam and were invented by TED speaker Luis Von Ahn from Guatemala.

18 Work in pairs. Write a description of something like in Activity 17. Use the passive. Then work with another pair of students. Can they correctly guess what is being described? Answers will vary.

People have created more original ways to use cups as loudspeakers.

5B Curiosity, Cats, and Kids

VOCABULARY BUILDING

Adjective endings

Adjectives can sometimes be recognized by their endings. Common adjective endings include:

-ous: curious, tremendous, previous
-able: reliable, treatable, adaptable
-ive: effective, innovative, imaginative
-ful: beautiful, hopeful, helpful
-al: practical, electrical, social

1 Work in pairs. Think of a noun that each adjective in the Vocabulary Building box often goes with. Use a dictionary, if necessary.

2 Choose four pairs of words from Activity 1. Write a sentence for each pair. Answers will vary.

*Research needs to have **practical applications**.*

3 Choose the correct options.

It is often thought that (1) *innovation* / *innovative* in science comes from the labor of (2) *curiosity* / *curious* geniuses: the kinds of individuals who work in isolation, find (3) *pleasure* / *pleasurable* in exploration, and who don't worry too much about the (4) *practicality* / *practical* applications of their findings. While it is true that the (5) *use* / *useful* of many new discoveries is not always immediately clear, you only have to look at the results of scientific work conducted by teams to see that it is a (6) *social* / *society* process and involves far more (7) *cooperation* / *cooperative* than is often imagined. (8) *Collaborative* / *Collaboration* can not only help to speed up scientific work; it can also enhance the quality of the work and help share knowledge amongst a wider group of individuals.

4 **MY PERSPECTIVE** Answers will vary.

Work in pairs. Answer the questions.

1 What are the advantages and disadvantages for scientists or researchers working on their own, as part of a small team, and in a much bigger team?
2 How do you prefer to work? Why?

READING

5 Read the article about curiosity. Which sentence is the best summary of the main point? d

a Technology can help us become more curious, but it can also kill our curiosity.
b It's more important than ever to make sure kids learn to be curious.
c Social media doesn't help us know people better.
d We run the risk of becoming less curious if we're not careful.

6 Work in pairs. Which statements do you think the writer would likely agree and disagree with? Refer to the article to explain why. Answers will vary but should cite supporting statements from the text.

1 Parents should make sure kids don't experiment too much.
2 You can't create anything new unless you recognize the limits of your understanding.
3 The people funding scientific research should demand clear outcomes.
4 Humans are basically programmed to ask why.
5 You don't get a full picture of people from the way they present themselves online.
6 We need to share ideas with like-minded people if we are to develop our curiosity.

7 Work in groups. Do you agree with the statements in Activity 6? Why? Answers will vary.

CRITICAL THINKING Asking critical questions

To check ideas and deepen understanding, ask questions about statements or research. For example:

Research has shown that curiosity is just as important as intelligence in determining how well students do at school.

The starting points for thinking critically about this statement might be:

How is student success measured? In what subjects?

How are curiosity and intelligence measured? How different are they?

Can you be intelligent without being curious, and vice versa?

Can you be successful at school without one of these characteristics?

Is curiosity important for doing well in a job? What kind of jobs?

8 Work in pairs. What are two questions you would ask if you wanted to think critically about each statement? Answers will vary.

1 Hard work is more important for success than either curiosity or intelligence.
2 There is some evidence that bees can think like humans.
3 It has been shown that you can only learn seven words in a language lesson.

9 Compare your ideas in Activity 8. How many of the questions can you already answer? What is the best question to explore each statement? Answers will vary.

5B Curiosity, Cats, and Kids

Warm up Remind students of the collocations they learned at the beginning of the unit; for example, *form a theory, reward hard work.* Say *You're going to test one another on how many collocations you can come up with.* You may want to list some verbs on the board.

- Explain that student A says a verb and student B has to give a collocation. Then student B says a verb and Student A says a collocation. Tell them they can repeat a verb, but not a collocation.
- Students get a point every time they can't think of a collocation. The student with the *lowest* score wins.

Language note Explain to students that the section title, "Curiosity, Cats, and Kids," is related to the old saying "Curiosity killed the cat." Ask students if they've ever heard this expression and what they think it means. Explain that it's sometimes said to young children who ask too many questions, or to warn young people not to allow their curiosity to lead them into dangerous situations. Ask students if they think it's a good saying or not.

VOCABULARY BUILDING Adjective endings

1 Ask everyone to close their books. Write on the board: *curious, reliable, effective, beautiful,* and *practical.* Read the words aloud and point out the endings.
- Ask the class what kind of words these are. (adjectives) For each one, have students call out other adjectives with the same ending.

Study Tip
Explain that it's helpful to learn adjective endings. Remind students that they often encounter unknown words as they read. However, if they recognize the ending, it will help them figure out what kind of word it is. Knowing that and using context will often help them to guess the unknown word's meaning.

- Have students open their books to p. 60. Tell them to read the box, Adjective endings. Then read aloud the Activity 1 directions. Say *Let's do one together.* Curious—*What things are often described as curious?* Take students' responses. (*a cat, a child, an idea, a look*) It might be helpful to put the word in a sentence; for example, *The coach gave me a curious look when I asked if the school had a quidditch team.*
- Then have pairs do the rest of the adjectives, using a dictionary if necessary. Review the answers by asking different students to read aloud their adjective-noun pairs.

Activity 1 Suggested answers:
curious person; tremendous respect; previous experience; reliable information; treatable disease; adaptable behavior; effective communication; innovative design; imaginative child; beautiful song; hopeful sign; helpful advice; practical advice; electrical equipment; social skills

2 Read the Activity 2 directions aloud. Call on a student to read the sample sentence to the class. Make sure students understand they need to choose four adjective-noun pairs. Say *You can use your own pairs or some you heard from your classmates.* You might want to display other sample sentences.
- Set a time limit of between five and ten minutes for students to write a minimum of four sentences.
- When the time is up, have students compare their sentences with a partner's. Call on students to share some of their sentences with the whole class.

Expansion
For a fun activity, challenge partners to combine some of their sentences into a short story. They can change some sentences slightly to make them fit together better. Tell them it's fine if the stories are funny or silly, but they should have correct grammar. Have pairs share their stories with the class.

3 Tell students they're going to read about how science gets done. Tell students to read the whole text quickly to get the main point, not to choose any options.
- Ask what the main point is. (Most scientific discovery comes from collaboration and teamwork, not from geniuses working alone.)
- Explain the task. Make sure students see that each choice is between a noun and an adjective. Model with the first two choices if necessary. Have students complete the activity.
- When most have finished, have students compare answers in pairs. Then confirm the answers by calling on students to read completed sentence parts aloud. Write each number and word on the board. You could check students' pronunciation and stress as you do so.

4 Ask *What's your perspective on the best way for science to get done? How do you prefer to work on projects?* Have a student read the first question for the class.
- Invite students to suggest one advantage and one disadvantage of working on your own. Then write some prompts on the board. *What about working with a small team? What are the pros and cons of that? How might working on a large team be different?*
- Put students in pairs to discuss their ideas about each activity question.
- Call on pairs to share their ideas. Invite the rest of the class to ask questions and make comments.

For notes on Activities 5–9, see page 61a.

READING

5 Tell students they're going to read an article about curiosity and how it has intersected with science over the years. Say *As you read, be alert to what the main point of the article is.*

- 23 Have students read the article. Set a time limit (say three minutes). Or you can play the recording, or read aloud the text yourself, as students follow along. When students are ready, have them look over the four answer choices.
- Tell students to choose and then compare their choice with a partner's. Say If you disagree, talk it over. Find the evidence that supports your choice. Can you agree after all?
- Read aloud each choice and get a show of hands. Choose individual students to explain their choice, using evidence from the text.

Reading Strategy **Improve your speed**

To do well in a reading test, students need to improve their reading speed. They can do this in different ways: learning more language, especially collocations and phrases (flash cards can help); timing themselves when reading a text (write the time on the text); rereading a text several times over a term, reading it faster each time; reading longer texts that are slightly below their level (use a graded or leveled reader). Of course, the point is not speed for speed's sake, but finding a speed that allows for basic comprehension—and this speed will vary with the genre and topic of each text.

6 Read the directions aloud. You could have the students read the text quickly to refresh their memories and to time themselves to see how quickly they can read it. Read the first statement aloud and do it with students as an example.

- Think aloud. Say *That statement doesn't make sense to me, but I need to check the text. I remember the writer talked about children at the beginning. I'll start there.* Have students look at the text.
- Then call on a student to tell what she thinks—would the writer agree or disagree—and why. Don't immediately say if she's correct, but ask someone else to give their answer and explanation.
- Confirm the answer. If necessary, point out that the writer says curiosity is important for learning and that asking questions and, by inference, experimenting, makes learning enjoyable and effective.
- Put students in pairs to tackle the other statements. When they're finished, review the answers in the same way as above, making sure you get students to justify their answers.
- If short on time, you could also ask students to tell what they personally think about each statement and skip Activity 7.

7 This gives students a chance to consider the statements in Activity 6 from their own viewpoint. They may be reluctant to challenge the article, so try to get them thinking. You might, for example, choose a statement that you think is debatable and express a different viewpoint about it. Then invite students to give their ideas.

- Have students discuss in groups. Circulate and provide assistance. Be a moderator if necessary. Students may feel strongly about some things, for example, the negative aspects of social media.
- At the end of the activity, provide feedback and share interesting things you heard, especially where students had differing but valid opinions or gave examples.

CRITICAL THINKING Asking critical questions

8 Have students close their books. Write this sentence from the article on the board: *Research has shown that curiosity is just as important as intelligence in determining how well students do in school.* Call on a student to read the statement aloud.

- Say *This was surprising to me. And it made me wonder. You can't make such a statement without being able to back it up with facts, right?* Ask the class *What questions would you ask the writer about this statement?* Take students' responses and discuss.
- Explain to students that even if a statement sounds authoritative, or was written by an "expert," it's OK, even good, to be a little skeptical. Asking the right questions shows that you're thinking critically.
- When the discussion has been exhausted, or if students are unsure how to respond, have them open their books to p. 60. Have different students read parts of the Critical Thinking box.
- Discuss any questions or comments students have. Then put them in pairs to do Activity 8. When most pairs have come up with two questions about each statement, stop the discussion.

9 Read Activity 9 aloud. Call on pairs to share their questions for each Activity 8 statement. Write the best ones on the board and discuss with the class why they're good examples of critical thinking.

Expansion

Put students in small groups. Assign each group one of the last three questions in the Critical Thinking box to discuss. Tell students to keep notes as they discuss and then compile them into a short report. Each report should begin with the assigned question and the answer the group came up with. Explain that the answer doesn't have to be definitive. It could be something like, *We're not sure, but here's what we think. . . .*

Back to the future?

Curious explorers make their way through Rising Star Cave in South Africa.

Curiosity allows us to embrace unfamiliar circumstances, brings excitement into our lives, and opens up new possibilities. But how curious are we in the 21st century?

23 Perhaps you've heard the old saying "curiosity killed the cat." It's a phrase that's often used to warn people—especially children—not to ask too many questions. Yet it's widely agreed that curiosity actually makes learning more enjoyable and effective. In fact, research has shown that curiosity is just as important as intelligence in determining how well students do in school.

Curiosity also allows us to embrace unfamiliar circumstances, brings excitement into our lives, and opens up new possibilities. Being curious requires us to be both humble enough to know we don't have all the answers, and confident enough to admit it. Asking the questions that help us bridge the gap between what we already know and what we'd like to know can lead us to make unexpected discoveries.

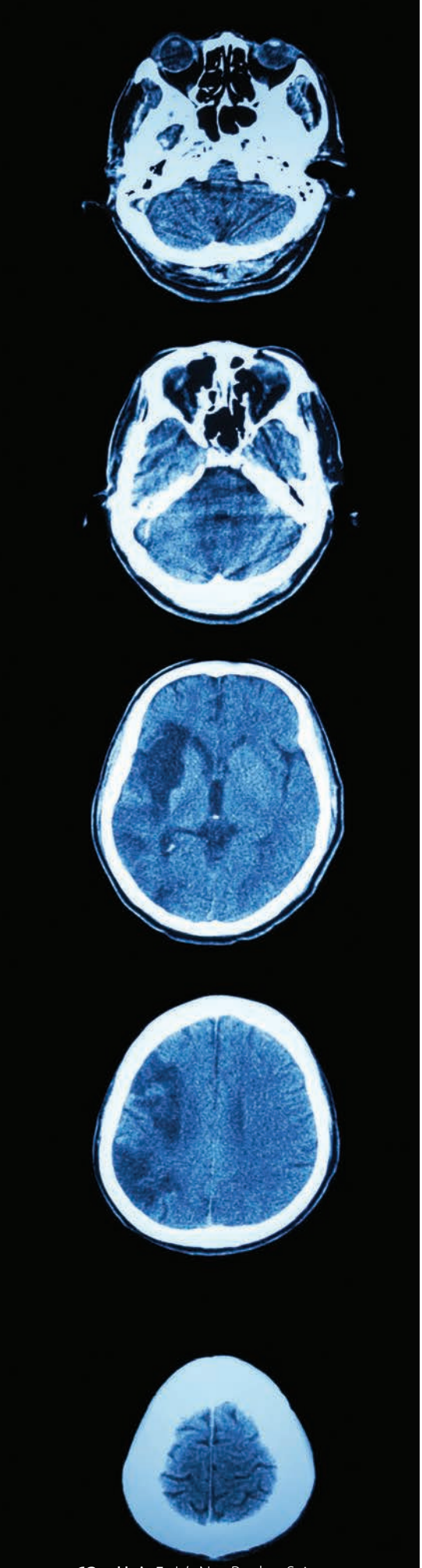
In science, basic curiosity-driven research—conducted without pressure to produce immediate practical results—can have unexpected and incredibly important benefits. For example, one day in 1831, Michael Faraday was playing around with a coil and a magnet when he suddenly saw how he could generate an electrical current. At first, it wasn't clear what use this would have, but it actually made electricity available for use in technology, and so changed the world.

Unsurprisingly, there are chemical and evolutionary theories to explain why humans are such curious creatures. When we become curious, our brains release a chemical called dopamine, which makes the process of learning more pleasurable and improves memory. It is still not known why learning gives us such pleasure, but one theory is that we may have developed a basic need to fight uncertainty—the more we understand about the world around us, the more likely we are to survive its many dangers!

However, curiosity is currently under threat like never before—and perhaps the biggest threat comes from technology. On one level, this is because technology has become so sophisticated that many of us are unable to think too deeply about how exactly things work anymore. While it may be possible for a curious teenager to take a toaster apart and get some sense of how it works, how much do you understand about what happens when you type a website address into a browser? Where does your grasp of technology end and the magic begin for you?

In addition to this, there's the fact that we all now connect so deeply with technology, particularly with our phones. The more we stare at our screens, the less we talk to other people directly. To make matters worse, all too often we accept the images of people that social media provides us with, and then feel we know enough about a person not to need to engage further with them.

The final—and perhaps most worrying—way in which technology stops us from asking more has to do with algorithms, the processes followed by computers. As we increasingly get our news via social media, algorithms find out what we like and push more of the same back to us, meaning that we end up inside our own little bubbles, no longer coming across ideas that challenge our pre-existing beliefs. Perhaps the real key to developing curiosity in the 21st century, then, is to rely less on the tech tools of our age.



5C Mind-blowing!

GRAMMAR Passives 2

1 Work in groups. Look at the Grammar box. Do you believe the sentences are true? Explain why using these phrases. Answers will vary.

I'm absolutely sure.
I'm not sure but, if I had to guess, I'd say…
I read about it recently. / We did it in class.
I remember hearing about it.
I've got a feeling it's a myth / it's a trick question.

Passive reporting verbs

a *The heart was believed to be the center of intelligence until the Middle Ages.*
b *It is claimed that computer training programs can limit the effects of aging on the brain.*
c *Einstein's brain was said to be bigger than average, which explains his intelligence.*
d *It is estimated that the human brain is about 75 percent water.*
e *It is well known that most of the time we only use ten percent of our brain capacity.*
f *Exercising is thought to create chemicals that reduce your ability to think.*
g *The part of the brain called the hippocampus is known to be connected with our sense of direction.*
h *It has been generally accepted that creative people have a dominant right brain.*

Check the Grammar Reference for more information and practice.

2 Listen and find out which sentences in the Grammar box are true. How many did you get right? 24
a T b F c F d T e F f F g T h F

3 Work in pairs. Look at the Grammar box again and:
It is claimed that; It is estimated; It is well known that; It has been generally accepted that
1 identify the whole passive reporting pattern in the sentences that begin with *It*.
2 identify the form of the verb that follows the passive forms in sentences that do not begin with *It*. ***to be; to be; to create; to be***
3 discuss what you notice about the different patterns. Answers will vary but should include examples of subject + base form of verb and *to be* + base form of verb.

4 Write sentences about the brain using these notes and the passive.

1 The brain / estimate / contain…around 12 percent fat.
The brain is estimated to contain around 12 percent fat.
2 It / once / think / the brain / become…fully mature by the time children were six.
3 The brain / now / know / develop…most during the teenage years.
4 It / once / believe / the brain's networks / become…fixed as we aged.
5 Brain training activities / claim / improve…listening skills and memory.
6 It / sometimes / say / brain size / affect…intelligence.
7 It / still / not really know…why we dream while we sleep.
8 Brain transplants / generally accept / be…impossible.

5 Work as a class. Discuss how you think research into the brain is carried out. Answers will vary.

5C Mind-blowing!

GRAMMAR Passives 2

1 Put students in groups and read the directions and phrases to them. Then have them look over the statements in the Grammar box.

- You may want to provide these definitions: *Middle Ages*: the period of European history from roughly A.D. 500 to 1500; *hippocampus*: a part of the brain located deep within it that's related to memory; *dominant*: stronger, with more control
- Have a student read statement *a* aloud. Give a possible answer yourself, using one or more of the italic phrases. Then ask students whether they believe the statement or not and encourage them to respond using the phrases.
- Organize students into groups to do the activity. Circulate and check that students are doing the task correctly.
- When groups have finished, point out the title of the Grammar box. Ask *Did you notice the passives in the statements?* Have students call out a few and write them on the board. Say *We'll talk about these later.*
- You might want to take a vote on each statement. (Say *Hands up if you think statement* a *is true.* Then, *Hands up if you think* a *is false.*) Tally the votes on the board. Point out which ones students are in agreement on.

At this point, have students complete Activity 3 on p. 137 in the Grammar Reference section. You may also assign the activity as homework.

2 24 Say *Now we'll find out how smart we are!* Play the audio track as students check their answers.

- At the end of each extract, write the item letter and *T* or *F* on the board without stopping the recording.
- Check to see how well students did. (Say *Hands up who got all 8 correct. 7? 6?* and so on.) You might ask different students which ones they got wrong and why they thought what they did. Point out any big discrepancies between the answers and the tally on the board. (Say, for example, *Wow, most of us were wrong about (c). I wonder why that is. Any thoughts?*)

Teaching Tip

Having students translate English sentences into their own languages and then back into English is a good way to get them to notice form and check meaning. Even where students don't share the same language, they can still discuss their English retranslations and notice mistakes they made compared to the original.

3 Ask students if they noticed anything in particular about the passive verbs in the Grammar box statements. Students might say that some include a present form of *be* (*is*) and others include past forms of *be*: *was, has been.* You could ask if they know why different passives were used.

- Tell students we use passives to report ideas, beliefs, or actions when we don't know who said, believed, or performed them, or when the most important part of the sentence is *what's* being reported—not *who* said or did it. We can begin these sentences with a specific subject or with *it.*
- Then have students answer the Activity 3 questions in pairs, or make it a whole-class activity. Either give the answers now or wait for them to read the Grammar Reference and then ask the class the grammar checking questions or call on individuals to give their answers.

4 Have students close their books and write the Activity 4 example on the board: *The brain / estimate / contain . . . around 12 percent fat.*

- Explain the activity and ask for a volunteer to say the complete sentence. Do item 2 as a further example as it starts with *it* and requires a different pattern.
- Have students open their books and complete the activity individually. When the first few students finish, put students in pairs to check their sentences and help each other complete the activity.
- Review answers by having different students read their sentences to the class. When the sentence is correct, have the class repeat the first part. When there's an error, write the sentence on the board and have the class help you correct it.
- Finally, have students correct their sentences, if necessary, and read them over for content.

Activity 4

2 It was once thought (that) the brain became . . .
3 The brain is now known to develop . . .
4 It was once believed (that) the brain's networks became . . .
5 Brain-training activities are claimed to improve . . .
6 It is sometimes said (that) brain size affects . . .
7 It is still not really known . . .
8 Brain transplants are generally accepted to be . . .

5 This activity is an introduction to the text in Activity 6. Read the topic aloud. Give students a few minutes to think or to brainstorm ideas with a partner. Say *Think about all you've read so far about the brain and all the ideas, right and wrong, that people have had about it and how it works.*

- Then begin a discussion. Prompt students if necessary: *How do you think the brain was studied long ago? What makes it difficult to examine the brain? What do you know about brain imaging?* Tell students they'll learn more about the brain in the next activity.

6 Read the first part of the Activity 6 directions. Model the task for the class. Read up to the first choice. Try reading the sentence part aloud with each option. Then ask *Should it be "was thought to be" or "was thought that it was like"?* Have students respond. Do the next item if necessary.

- Have students skim the text and answer any vocabulary questions they have. Tell them Galen was a second-century Greek physician and philosopher who did important work on medical theory and anatomy. Have them complete the activity individually and then compare with a partner.
- Check the answers. Ask for a show of hands for each option. Ask different students to explain their answers. Write the numbers and correct answers on the board.
- Read the second part of the activity directions. Ask *Were any of your ideas about how brain research is done correct?* Have students who respond affirmatively tell the class what the ideas were. Call on others to tell what they found most interesting in the text.

7 Explain that students are going to look at another passive form. Draw their attention to the Grammar box and read the sentences aloud. Point out that the sentences say essentially the same thing in different ways.

- Then tell students to complete the grammar rules in Activity 7 individually, in pairs, or read the sentences aloud and have the class call out the answers all together. Review the answers as a class.

At this point, have students complete Activity 4 on p. 137 in the Grammar Reference section. You may also assign these activities as homework.

8 Write on the board *They had their brains scanned while they were singing.* Read the activity directions and call on a student to come up to the board and rewrite the sentence. (*Their brains were scanned while they were singing.*)

- Have students do the rest of the sentences individually. Review answers by having different students read a sentence to the class.

ACTIVITY 8 Suggested answers:

1 Their brains were scanned …
2 A new MRI scanner is being installed … by a local firm.
3 The scientists' research was evaluated by experts.
4 My examination will be done later by the nurse.
5 My dad's head was examined by the doctor.

9 Read the directions. Complete item 1 as a class. Call on students to volunteer suggestions. See how many you can get. Write a few on the board.

- Put students in pairs to work on the other sentences. Set a time limit of between 5 and 10 minutes for the task.
- When time is up, go through each sentence and ask who has the most ways of completing it. Ask pairs to take turns reading aloud their suggestions and encourage the rest of the class to challenge them if they think either the grammar or the meaning is wrong. Provide any necessary feedback. Thank the class for their efforts and acknowledge the pair or pairs that did the best or most imaginative work.

ACTIVITY 9 Suggested answers:

1 The patient had his liver scanned. **2** I had my stomach examined. **3** They should have their blood tested. **4** The scientists are having the laboratory repainted; **5** I'm going to have my injury looked at; **6** The research center is going to have its budget cut.

10 Read the activity options aloud. Say *Here's an opportunity for you science geeks to show your stuff!* If students pick the first one, tell them they can choose any science topic, but they'll need to have their facts straight and be able to back them up, whether or not they choose to write a variety of true and false sentences. Tell students they can pair up for this one if they want.

- Say *The second option requires a little more imagination. You artistic or literary types might like this one.* Students can discuss in pairs or small groups. Tell them they can draw pictures or write poems to make their comparisons.
- If students choose to write about a medical test they had, tell them they should include as many medical details as they can, but they should feel free to embellish the narrative with other details as well; for example, were they nervous, or curious? Was it uncomfortable? Was it enlightening, or boring?
- Say *The last option is for anybody interested in becoming an investigative journalist.* Tell students they can work with a partner, if they like. If they don't know of such a news story right away, they'll have to do some research. Tell them to find out how the error was discovered and what the real story was. Say *You'll have to do some digging*!

Expansion

Have students take their activities to the next level. Those who did the science sentences should make them the basis for a game, with a set of rules. Those who worked on the brain can make a poster or a display of their comparisons. Students who researched a news story can turn their report into a news article or a script for a scene to be acted out by the reporter and other key people.

6 Choose the correct options to complete the article about brain research. Does the article cover the ideas you thought of in Activity 5?

Our understanding of the brain has changed with developments in science, surgery, and medical technology. For example, as new technologies were invented, the brain was thought (1) *to be* / *that it is* like a mechanical watch or telephone communication. More recently, it (2) *has been described* / *describes* as a computer.

After Galen proved that the brain was the center of intelligence, it was generally assumed that different parts of the brain (3) *to control* / *controlled* certain senses and functions of the body. However, the brain could only really (4) *understand* / *be understood* from the outside by studying animal brains and dissecting human bodies. Knowledge increased as a result of surgery where a patient had a tumor removed from their brain and the resulting physical change meant that functions could be mapped to the part of the brain that had been operated on. This mapping came about as much through failed operations as successful ones. Now, operations (5) *sometimes conduct* / *are sometimes conducted* while the patient is awake and talking. If a part of the brain (6) *touched* / *is touched* and it affects one of the patient's senses, he or she can tell the surgeon!

Since the late 1970s, medical technology, such as MRI scanning, (7) *has allowed* / *has been allowed* safe research into the brain without the need for surgery or X-rays. MRI uses powerful magnets and computer imaging to see high blood flows in different parts of the brain that (8) *believe* / *are believed* to show brain activity. If people (9) *have* / *is* their brains scanned while doing various thinking activities, researchers think they can (10) *identify* / *be identified* more accurately how the brain works. One result of this research is to show the limits of the brain-computer comparison. For example, it is now understood that memories are not stored in one place, but are the result of activity in many parts of the brain.

Causative *have* and *get*

a *Scientists can do research into the brain by using scanners.*
b *Research into the brain can be done (by scientists) by using scanners.*
c *To get the research done, scientists used a brain scan.*

Check the Grammar Reference for more information and practice.

7 Look at the Grammar box. Then complete the explanation.

- In the first sentence, ___research___ is the object of the verb *do*.
- In the second sentence, *research* becomes the ___subject___ of the passive structure *can be done*.
- In the third sentence, we use the structure *get* + something + ___past participle (done)___ so we can make the person affected by an action (scientists) the subject of the sentence.

8 Write normal sentences in the passive, based on these sentences.

1 They had their brains scanned while they were singing.
2 The hospital is having a new MRI scanner installed.
3 The scientists had their research evaluated.
4 I'm going to have my examination later.
5 My dad had his head examined when we were in the hospital.

9 Work in pairs. Complete the sentences in as many different ways as you can. Use a dictionary, if necessary.

Answers will vary.

1 The patient had _____ scanned.
2 I had _____ examined.
3 They should have _____ tested.
4 The scientists are having the laboratory _____ .
5 I'm going to have my injury _____ .
6 The research center is going to have _____ .

10 CHOOSE

Choose one of the following activities. Answers will vary.

- Write a set of sentences like the ones in the first Grammar box. Share your facts.
- Discuss ways in which the brain could be compared to:
  - a city.
  - a computer.
  - an orchestra.
  - a spider's web.
- Write about one of these experiences.
  - a time you had to have something scanned or tested
  - a time something in the news proved to be wrong

Since the late 1970s, medical technology, such as MRI scanning, has allowed safe research into the brain without the need for surgery or X-rays.

5D Science is for everyone, kids included

> "Play is one of the only human endeavors where uncertainty is actually celebrated. Uncertainty is what makes play fun."
>
> **BEAU LOTTO**

Read about Beau Lotto and Amy O'Toole and get ready to watch their TED Talk. ▶ 5.0

AUTHENTIC LISTENING SKILLS

Fillers

You can use words and phrases like *right, all right,* and *you know* to ask for agreement, to check that people are understanding, or as a filler while we pause or move on to the next point.

So, this game is very simple. All you have to do is read what you see. ***Right?***

1 Look at the Authentic Listening Skills box. Listen to the extract. Identify where Beau adds *right* or *all right*. 25

What are you reading? There are no words there. I said, read what you're seeing. It literally says, "Wat ar ou rea in?" That's what you should have said. Why is this? It's because perception is grounded in our experience. The brain takes meaningless information and makes meaning out of it, which means we never see what's there, we never see information, we only ever see what was useful to see in the past. Which means, when it comes to perception, we're all like this frog. It's getting information. It's generating behavior that's useful.

2 Practice reading aloud the extract in Activity 1 in a similar style to Beau. Answers will vary.

WATCH

3 Work in groups. Discuss the questions. Answers will vary.

1. Are you good at science? Why?
2. In what ways do you think science is similar to play?
3. Have you ever asked someone a question about science that they could not answer? What was it?

4 Put the sentences (a–h) in order. The first and last are given.

1 Perception is grounded in our experience.
- **a** These are the exact same ways of being you need in order to be a good scientist. 8
- **b** If perception is grounded in our history, it means we're only ever responding according to what we've done before. 2
- **c** Uncertainty is what makes play fun. It opens possibility and it's cooperative. 7
- **d** The question "why?" is one of the most dangerous things you can ask, because it takes you into uncertainty. 5
- **e** But actually, it's a tremendous problem, because how can we ever see differently? 3
- **f** So what is evolution's answer to the problem of uncertainty? It's play. 6
- **g** So if you add rules to play, you have a game. That's actually what an experiment is. 9
- **h** Now… all new perceptions begin in the same way. They begin with a question. 4

10 So armed with these two ideas—that science is a way of being and experiments are play—we asked, can anyone become a scientist?

5 Watch Part 1 of the talk. Check your order of the sentences in Activity 4. ▶ 5.1

6 What does Beau not mention when he talks about uncertainty making play fun? d

- **a** Play is adaptable to change.
- **b** Play is cooperative.
- **c** Play opens up possibility.
- **d** Play is unrewarding.

5D Science is for everyone, kids included

- **Warm up** Tell students they're going to watch a TED Talk about science and play. Read aloud the quote from Beau Lotto, the man in the photo on p. 65. Ask them to translate it or say what they think it means in English.
- Explain that Beau Lotto is a neuroscientist who studies the biology and psychology of perception. Play the first section of the video. Have students do the exercises.

AUTHENTIC LISTENING SKILLS Fillers

1 Read aloud the explanation of the listening skill and the example sentence from the talk as students follow along. Then call on different students to read the sample sentence aloud for the class. Make sure they use the proper intonation after the one-word question at the end.
- Ask if students know any other fillers in English. (*er, um, anyway, whatever, you know,* and so on). You could also discuss fillers they use in their own languages.
- Tell students that even though such fillers might be frowned upon or seen as uneducated, they're a normal part of everyone's speech and—as they'll hear—used a lot by the TED speaker.
- 25 Read the Activity 1 directions. Give students a minute to reread the skill explanation, then play the audio track. Suggest that students mark the places in the text where they hear a filler. When the track is done, have students compare in pairs.
- Read aloud the extract and tell students to shout out the filler, or stand, or raise their hands when you should say *Right?* or *All right?*

ACTIVITY 1

... I said, read what you're seeing. **Right? ...** "Wat ar ou rea in?" **Right?** That's what you should have said. **Right? ...** grounded in our experience. **Right? ...** what was useful to see in the past. **All right?** ... we're all like this frog. **Right?**

Listening Strategy Recognize fillers

Recognizing fillers for what they are—a word or sound that "fills" a pause in speech—allows students to focus on what they really want to hear and understand and not be distracted by these expressions.

2 Replay the audio track. Then put students in pairs to take turns reading the text to each other. You might suggest they give each other a grade from 1–10 for how well they mimic Beau Lotto's speaking style.
- You could get the best student to perform for the class or even talk along with the video with the sound turned down, karaoke-style. Keep the task light. This is just a playful way for students to practice their language skills.

WATCH

3 Have students read the Activity 3 questions to themselves. Then call on different students to ask you each of the questions. Give candid responses. Then put students into small groups to discuss.
- Go around and help by correcting students or giving them the English they need. Remember things to cover in feedback.
- Have groups share their ideas about the questions; in particular, you might want to probe their ideas about how science is related to play.

4 Read the directions aloud, then have students read through the sentences quickly to check understanding. You may want to provide these explanations: *Grounded in our experience (*or *history)* means our personal experience is the basis for understanding what we perceive; and just as people can be armed with a weapon, they can be *armed with ideas* to use to argue a point, "defend" a position, or "attack" an opposing viewpoint.
- Model thinking aloud. Read sentence 1 and say *I'm not sure what that means. I need more of an explanation.* Ask the class *What do you think will come next?* Wait for a student to volunteer or nominate someone. Point out, if necessary, that sentence *b* says more about perception being grounded—in "our history" this time.
- Have students do the activity. Say *Don't worry if you're not sure of the sequence, just do your best. It might help if you say the sentences out loud, but quietly.*
- When a few have finished, you can ask one or two for their answers or just go straight to the video of the talk. Say *Let's see if you're right.*

5 ▶ 5.1 Play Part 1 of the video. Tell students they'll hear other sentences in between the sentences in Activity 4, so they'll need to pay attention. You could put students in pairs to check the order together.
- Review the answers as a class, by calling on different students for the next sentence in the sequence. Write each number and letter on the board.
- Replay the video and stop after each sentence from Activity 4. Ask students again for the answer.

6 Read the Activity 6 question and the answer choices. You might want to play the relevant section of the video again and have students check off each answer choice as they hear it. Say *Raise your hands when you hear the sentence that provides the answer.* (*d,* "Play is its own reward.") As the ideas about play may be hard for students to grasp, replay the section and discuss each point.

Teaching/Exam Tip

Some true-false exam activities that test comprehension occasionally include the answer option "not stated." These activities can trip students up if they're not familiar with them. Students know that true and false statements in comprehension tests refer to the information in a reading. The information is either restated accurately (true) or inaccurately (false). Examples of things that are not stated are often commonly known facts connected to the topic of the reading that, although true in real life, are not mentioned in it. Make sure students get practice with these activities.

7 Read the directions aloud. Make sure students know what *not stated* means. Have them look over the sentences. Answer any questions they have. Tell them that *journal* in sentence 7 refers to an academic magazine that publishes research.

- ▶ 5.2 Play Part 2 of the video. Have students complete the activity. Circulate and notice how well they're doing. Decide whether or not you need to replay the video.
- Check the answers as a class, making sure you have students justify their answers with evidence from the video. Record the sentence numbers and *T, F,* or *NS* on the board.

8 ▶ 5.3 Play Part 3 once straight through. Give students a few minutes to write their answers, then have them compare and discuss them with a classmate. Replay Part 3 so students can clarify and revise their notes.

ACTIVITY 8

1 An expert added commentary and references; **2** Overwhelmingly positive; **3** Anyone has the potential to discover something new. A small question can lead to a big discovery.

9 Write on the board: *"Changing the way a person thinks about something . . . depends on the way the person feels about change."* Remind students that Amy said that in the TED Talk. Ask *How do you feel about change?* Think about it.

- Call on a student to read aloud Activity 9, including the three discussion points. Tell students to think about how they would feel about changing those things. Ask *Do you think other people would feel the same way you do?* Give students a few minutes to think then have them discuss their ideas with a partner.

10 Say *Amy discovered that changing the way she thought about science was easy.* Tell students to think about how they've always felt about science and the people who like it—and whether they feel any differently now.

- Call on a student to read aloud the My Perspective question. Have students write down their thoughts about it. When they've had sufficient time, call on students to share their ideas. Have a class discussion.
- Sum up by asking for a show of hands from the people who are feeling energized about science. Ask them what they want to find out.

11 Vocabulary in context

- **11a** Tell students that they're going to watch some clips from the talk which contain new words and phrases. Explain that you'll pause the video when the options come on screen and ask everyone to call out the correct meaning together.
- ▶ 5.4 When a lot of students are giving the wrong answer, provide additional explanations or examples before moving on to the next clip. Play the video.
- **11b** Put students in pairs. Have them look over the discussion points. Answer any questions students may have about the words in italics. Reteach some, if necessary.
- Help pairs get started. Give one or two examples from your own life for a couple of the questions. Call on students to give their own examples. Then have pairs discuss.
- Circulate and check that they're doing the task correctly. If discussions are lagging, have students change partners and continue.
- At the end of the task, ask *Which topic excited or interested you and your partner the most?* Have pairs share their most interesting ideas. Give some feedback about new language that came up, and errors to correct (which you may have written on the board).

CHALLENGE

- Read aloud the Challenge introduction. Ask *Did any of you wish you'd heard more details about the experiment in the TED Talk? Or did you come up with your own ideas about how to do it?* Ask for a show of hands. Then say *Now's your chance to think and learn more about it.*
- Have students read the discussion points silently to themselves. Then organize students into small groups to talk about different ways they might do each of the things listed. You might want to appoint someone in each group to keep track of the groups' suggestions. Say *Remember, science is for everyone!*
- The paper can also be found online. You might want to have students access this and read it at home. Students will also find out something of the method for the experiment through the writing lesson in section 5E.
- Circulate as students discuss. Provide assistance as needed. At the end of the task, tell groups to prepare a short presentation about how they'd conduct the experiment, incorporating the group's most promising or novel ideas.

7 Watch Part 2 of the talk. Are the sentences *true*, *false*, or *not stated*? ▶ 5.2

1. None of the questions the children thought of had ever been studied before. F
2. The children wanted to research if bees adapt their behavior to solve problems like humans do. T
3. Bees are one of the most intelligent insects. NS
4. The experiment required bees to recognize the correct color to get a reward. T
5. There were several ways for the bees to solve the puzzle the children set up. T
6. The results of the experiment were surprising. NS
7. Beau wrote the journal article. F
8. The paper was rejected by the publisher because it was written in the wrong style. T

8 Watch Part 3 of the talk. Answer the questions. ▶ 5.3

1. How did the research finally get published?
2. What was the reaction to the research?
3. What were two lessons that Amy learned?

9 Amy says that changing the way a person thinks about something can be easy or hard. Explain why you think it would be easy or hard to change the way people think about: Answers will vary.

- what they eat.
- what they watch on TV.
- where they shop.

10 MY PERSPECTIVE

Did the TED Talk change your views about science and scientists at all? In what way? Answers will vary.

11 VOCABULARY IN CONTEXT

a Watch the clips from the TED Talk. Choose the correct meanings of the words and phrases. ▶ 5.4

b Work in pairs. Talk about: Answers will vary.

- a time you received a *reward* for doing something.
- a time you regret *not bothering* to do something.
- an interesting or possible *link* that scientists have discovered in recent times.
- a time you had to *adapt* to a new situation.
- people you think should be given more of *a voice*.

CHALLENGE

Beau and Amy do not explain much about how the experiment worked, apart from showing the one pattern of flowers. Work in groups. Discuss how you would:

- give rewards to bees for going to "good flowers."
- identify which bees are going to which flowers.
- train the bees to learn the pattern of one color surrounded by another.
- check that the bees aren't just "smelling" the good flowers.
- check that the bees aren't just choosing the good flowers by color.
- check that the bees aren't just choosing the flowers in the middle.

Read the paper about Blackawton Bees and see exactly how the children set up the experiment and what they discovered. It's available on the TED website.

5E Conducting Experiments

SPEAKING

Useful language

Staging

The first thing we'd need to do is…

We'd also need to make sure that we (didn't)…

I suppose then we should…

Preparing research questions

I wonder if / how / why…

It'd be good to know what / whether…

We'd need to try to figure out…

Hypothesizing

I'd expect the results to show…

I'd imagine that the data would probably reveal…

I would / wouldn't have thought it would be possible to prove that…

1 Work in pairs. Look at the questions. Discuss why it might be useful to know the answer to each of them. What do you think the answers are? Answers will vary.

1 How much does homework improve exam results?
2 Do goldfish only have a ten-second memory?
3 How many words can you learn in an hour?
4 Does going out with wet hair cause colds or the flu?
5 Do boys get more attention in class? If so, why?
6 Are people who listen to pop music happier?
7 What is the quickest way to have people board a plane?

2 Work in groups. If you were going to design an experiment for a question like one of those in Activity 1, what steps would you need to complete? Answers will vary.

3 Listen to a short lecture on how to design experiments. Note the six main steps. Then compare your answers with a partner. Use the light bulb experiment to explain each stage. 26

4 As a class, discuss why you think:

1 certain kinds of hypotheses are easier to prove than others.
2 proving a hypothesis wrong can be an important step towards learning.
3 it's important to record in detail how experiments are set up and conducted.
4 proving a hypothesis right in the way described could be seen as insufficiently scientific.

5 Work in pairs. Design an experiment to: Answers will vary.

a find the answer to a question in Activity 1.
b see if one of the life hacks you learned about earlier actually works.
c test another life hack you have heard about.

Use some of the language in the Useful language box. Decide:

- how you would set the experiment up.
- what kind of data you would record.
- what points of comparison you would need.
- what you would expect the results to prove.

6 Work with another pair. Explain the design of your experiment. Can your partners see any way in which it could be improved? Answers will vary.

How can you find out if goldfish really have a ten-second memory?

5E Conducting Experiments

SPEAKING

1 Tell students that in this lesson they're going to talk about designing and conducting experiments. Have students read the Activity 1 questions to themselves. Ask *Have you ever wondered about any of these things?*

- Read aloud the directions. To get pairs started say *I can think of one reason to know the answer to the first question. Do you know what I'm thinking?* Prompt students to realize it might mean less homework if homework was found to have no effect on exam results.
- When the first pairs finish, have students who are still working change pairs and work back from the last question.
- Check students' ideas by asking individuals the activity questions again and use it as an opportunity to introduce some of the phrases in the Useful language box. (*It'd be good to know; I'd expect the answer to be;* and so on)

2 Ask *As you discussed the questions in Activity 1, did you think about what you'd have to do if you were to actually try to find out the answer to any of them?*

- Say *You know that there are certain steps to follow when you conduct an experiment. See how many you know. Use your background knowledge to brainstorm together what some others might be.*
- Tell students to each write down the steps the group comes up with. You might tell them there are six stages.

3 26 Read the activity directions and play the audio track. Tell students to make notes on the six main steps of an experiment.

- Give students time to compare their steps with a partner's. Then list numbers *1–6* vertically on the board. Call on individuals to name each of the six steps. Make sure everyone agrees, then write them on the board. If students are unsure, play the track again. Stop at key points to have students call out the part of the light bulb experiment that matches each step. Add that to the board as well.
- Keep the steps on the board for students to refer to later.

ACTIVITY 3 Suggested answers:
1 Define the purpose of the experiment. **2** Do your research. **3** Form your hypothesis. **4** Design your test. **5** Analyze the data. **6** Draw your conclusions.

4 Have students read the activity questions to themselves. Then discuss as a class. Ask each question and call on someone to start. If you're in a monolingual group, you could allow students to say their ideas in their own language first, and then ask the speaker or someone else to translate them into English.

ACTIVITY 4 Suggested answers:
1 Easier to prove hypotheses in hard sciences (e.g., physics) – easily repeated and controlled. More variables in social sciences and often no definitive answers; **2** You often work out what's right through negative deduction; **3** Keeping a record is crucial if the experiment is to be repeated; **4** Proving a hypothesis once isn't enough – it needs to be repeated.

Teaching Tip
While students need to use as much English as they can in class, recognize that translating and interpreting are very valuable skills. Help students develop these skills during lessons. It's helpful to ask students to think in their L1 and then translate or interpret when they're dealing with difficult (nonlinguistic) concepts or doing a complex task. Having strong English speakers model this helps to involve and support less proficient students.

5 Read the first part of the directions and the options aloud. Put students in pairs and have them discuss the options and decide what experiment to design. Call on each pair to tell you what they've decided to investigate.

- If you have time, use an option that wasn't chosen and model briefly, with a strong student partner, how to go about designing an experiment for it.
- Before pairs begin, point out the Useful language box and have students glance through it. Then have pairs read the second part of the directions. Say *Using the language in the box and the six steps on the board will help you through the process.*
- Have pairs get to work. When everyone has completed the task, stop it and move on to Activity 6.

6 Tell pairs to explain their designs to each other. Say *See if you can suggest ways to clarify or improve the other pair's design.*

- When everyone has discussed their experiments, ask each group for comments on the activity. Ask questions, such as *Was the process of designing an experiment easy, difficult, educational, revealing? Were the other pair's comments helpful? Will you actually conduct the experiment you designed?*

WRITING

7 Tell students they're going to learn to write a report of a science experiment. Say *But before you do, think about the features of a story and of a science report. Are there any similarities? Or are they totally different?*

- Have students read the 10 guidelines in Activity 7 and decide whether they apply to stories or scientific reports, or maybe both.
- Have them work in pairs. When they're done, read each guideline and have students call *story* or *report* and write the number and answer on the board.
- Be prepared in case students argue that one or two of the features are shared by both genres. Allow them to explain their thinking. Students will discuss these further in the next activity.

8 Have students read the directions and locate the text on p. 151. Students can do the activity individually or in pairs. You might suggest that one student keep p. 67 open and the other the model page (p. 151) to avoid a lot of flipping backwards and forwards.

- Have students about the scientific method for the bee experiment. Then give them time to go through all the features in Activity 7 and see if they can find examples in the report.
- Review the answers as the class and write them on the board. Call on students to read aloud examples of the relevant features from the Blackawton Bee report for the class.

9 Have students read through the Useful language box on p. 67. Tell them they've read some of this language in the bee report on p. 151. Then draw their attention to the diagram at the bottom of the page. Say *Examine the illustrations. Do they seem familiar? What do they show?* Have students respond. Confirm that they illustrate the steps of the bee experiment.

- Read aloud the first part of the Activity 9 directions. Put students in pairs. Say *This is going to be a fun challenge! See if you can describe the steps of the experiment shown in the diagram, in order, without rereading the text at the back of your book.*
- You might suggest they begin by trying to number the verbs in the right order. But remind them that they then have to describe the steps in writing, using the verbs and the useful language. Tell them there are more steps to describe than pictures in the diagram.
- When pairs have worked for a while, ask if anyone is confident that they've described the steps in the right order. Have those pairs retell the process. Ask the class *Did they get it right?* Have the class rate the retelling(s).
- Then have all pairs check the text on p. 151 to see how they did.

Writing Strategy **Use transition words and phrases**

Tell students that for all writing that describes a process, whether it's directions, a scientific method, or their grandmother's *paella* recipe, the most important thing to do is to describe the steps in the correct order. Science experiments have to be repeatable to be valid, so the order of the steps is crucial. Tell students that sequence and transition words and phrases, such as the "Linking steps" language in the Useful language box, will help them to organize a science report and help their reviewers and readers to understand the process.

10 Explain the task. Tell students that the model and pointers on p. 151 will help them organize their writing, and the useful language on p. 67 will help them write the steps of the experiment clearly.

- Put students in pairs to brainstorm an experiment to choose. You may need to set aside extra time for students who want to research historical experiments. Set the writing for homework or set a time limit for doing it in class.
- As students are writing, circulate and help them. Remind them to use passives to report some of information. You might note some common mistakes to cover for feedback.
- Have students exchange their first drafts with their partner. Check that the purpose of the experiment is stated at the beginning and that the method is clearly stepped out. Students should then revise and finalize their work.

Teaching/Exam Tip

Good writers reread and revise several times. Tell students that after they've written and revised a first draft, they should make a clean copy. Then read the whole text again several times, focusing on something different with each reading—for example, one pass for spelling, one for grammar and punctuation, one for organization and ideas, one for common mistake they make. Then they'll need to correct and make a final copy. In an exam situation, they may not have a lot of time for rereading and editing, but they should try to leave time for one or two passes.

WRITING A scientific method

7 WRITING SKILL Describing a process

Work in pairs. How do you think writing about a process is different from telling a story? Is the guidance typical of stories or scientific reports?

1 You avoid using personal pronouns, such as *I*, *he*, or *she*. SR
2 You use a wide variety of words and descriptive language. S
3 You use a lot of passive sentences. SR
4 You write steps in the order they happened. SR
5 You define words you think your reader may not know. SR
6 You use idioms and colloquial language. S
7 You summarize what you are going to tell people at the beginning. SR
8 You explain the reason for doing something. SR
9 You may add a diagram of what you are describing. SR
10 You have a final sentence or comment that summarizes the point of the text. SR

8 Read about the process that was completed in preparation for the Blackawton Bee experiment on page 151. Which of the features in Activity 7 can you identify?
1, 3, 4, 5, 7, 8

9 Look at the Useful language box. Use the language and these verbs to retell the process in the diagram on this page. Then look at the process on page 151 and check how well you did. Answers will vary.

let into	paint	pick up	place	put into
release	remove	return	turn off	warm up

10 Write a method like the one on page 151, describing: Answers will vary.

- one of the experiments you designed in Activity 5.
- an experiment you have conducted at school.
- a famous historical experiment that you are interested in.

Useful language

Introducing the process

The experiment aimed to show that…
The purpose of the experiment was to find out if…
The diagram illustrates the process used to…
Figure one shows how…

Linking steps

First of all,…
Before starting the experiment,…
The bees were then released…
Once the bees had been released…
After being released, the bees…
Finally,…

Explaining the steps

*They were marked **to** identify them.*
*They were marked **in order to** identify them.*
*They were marked **so that** they **could** be identified.*
In order to do this,…