MODULE 1

# Inventors at Work

"I will not follow where the path may lead, but I will go where there is no path, and I will leave a trail."

—Muriel Strode

Essential Question

# What kinds of circumstances push people to create new inventions?

Get Curious Video

Big Idea Words

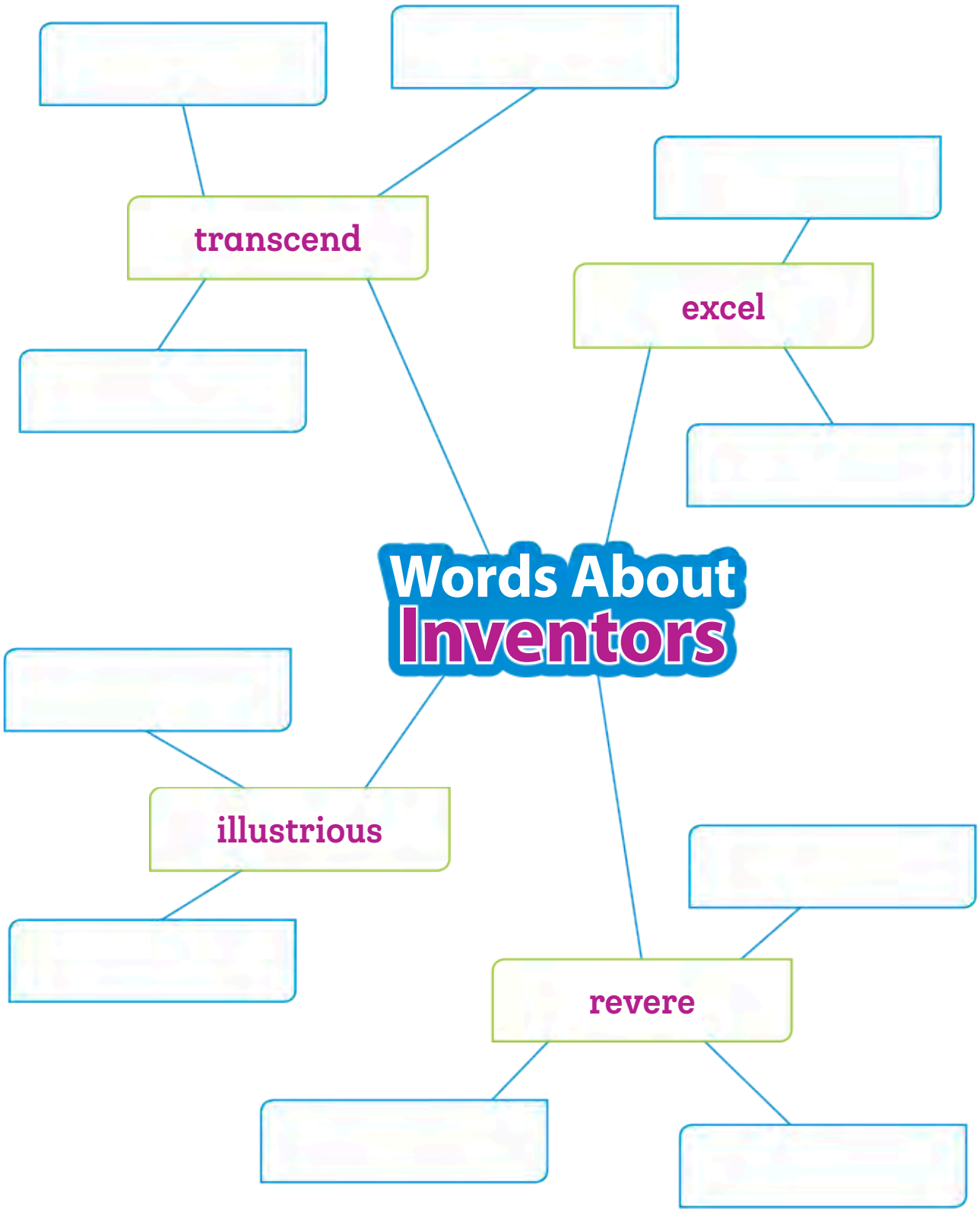
# Words About Inventors

The words in the chart will help you talk and write about the selections in this module. Which words about inventors have you seen before? Which words are new to you?

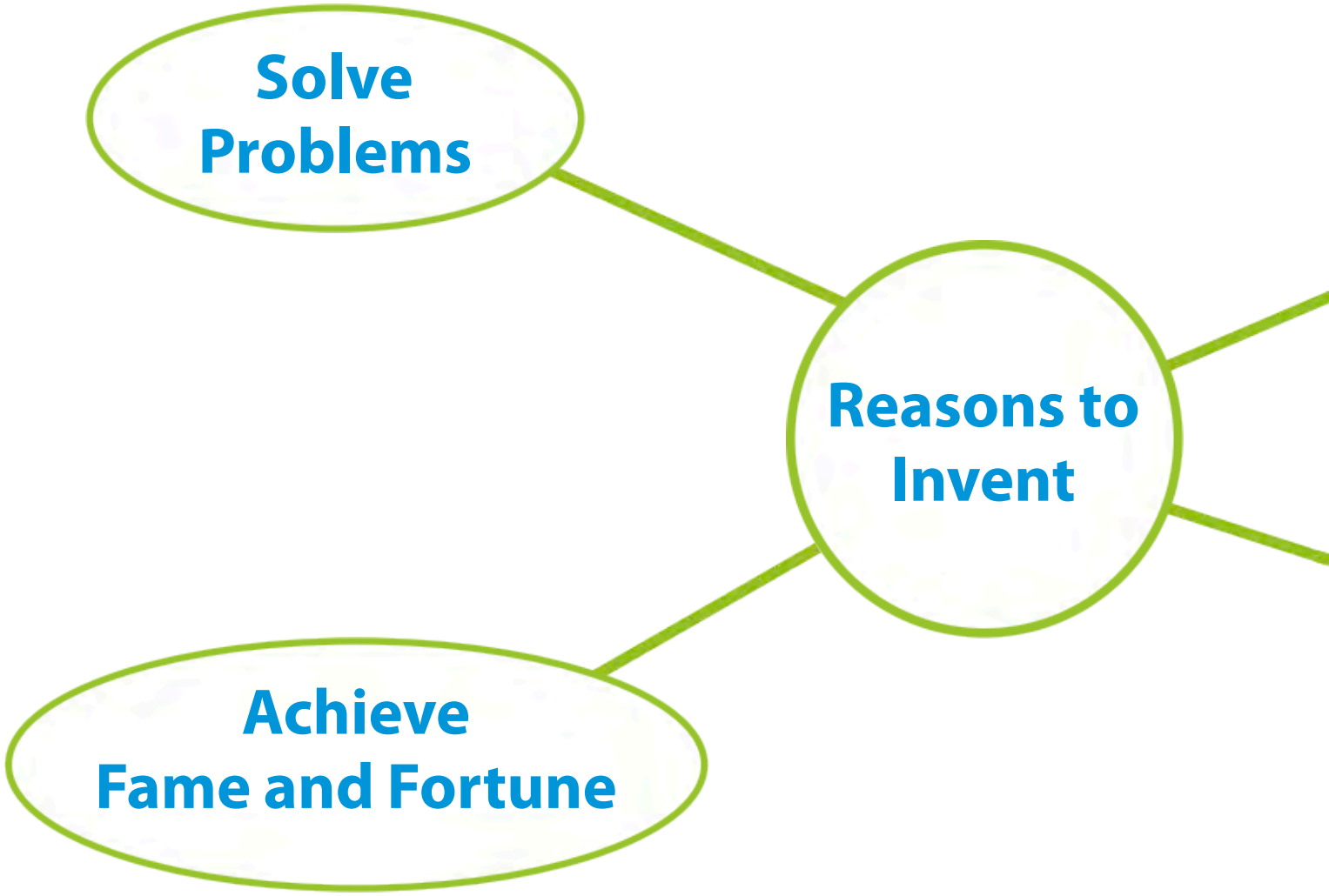
Add to the Vocabulary Network on page 13 by writing synonyms, antonyms, and related words and phrases for each word about inventors.

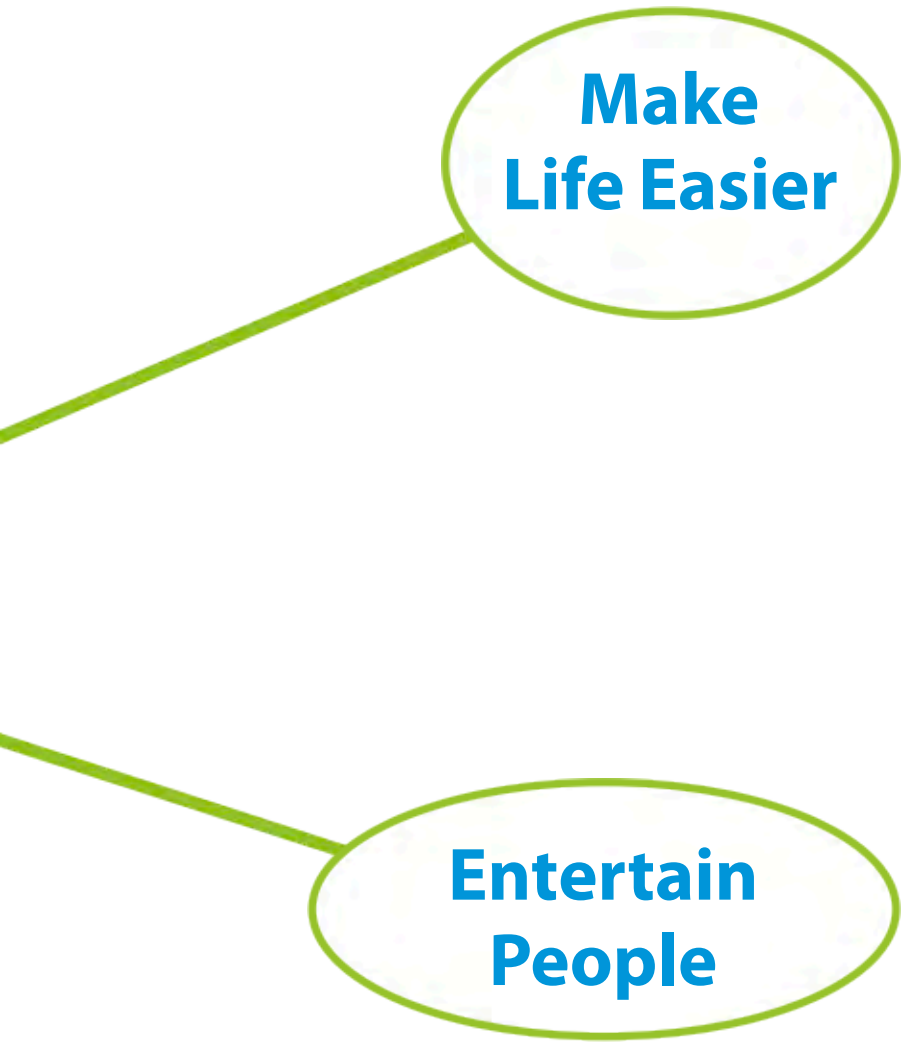
After you read each selection in this module, come back to the Vocabulary Network and keep building it. Add more boxes if you need to.

| WORD | MEANING | CONTEXT SENTENCE |
|---|---|---|
| **transcend** (verb) | If you transcend a boundary, you go above or beyond it. | Astronauts must transcend limitations and challenges. |
| **excel** (verb) | To excel at something is to be very good at it. | Keep practicing and you will excel. |
| **illustrious** (adjective) | An illustrious person is famous for his or her achievements. | The illustrious inventor was known around the world. |
| **revere** (verb) | If you revere someone, you think very highly of that person. | I revere people whose inventions improve the world. |


transcend
excel
Words About
Inventors
illustrious
revere

Knowledge Map

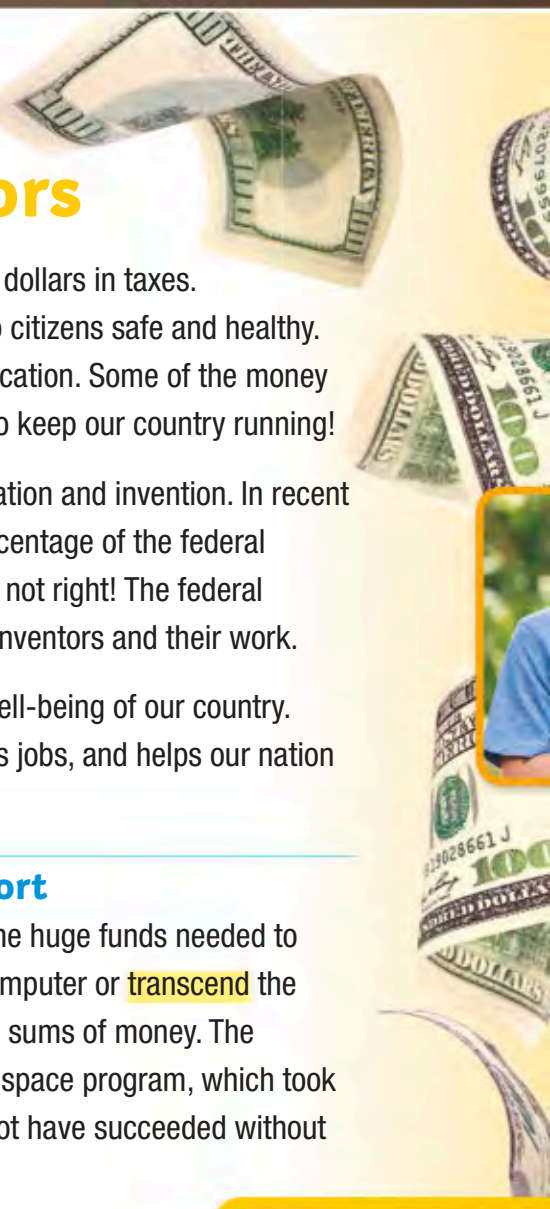



Make
Life Easier
Entertain
People

myNotes

Short Read

# Government Must Fund Inventors



1 Every year, our government collects trillions of dollars in taxes. Most of the funds pay for programs that keep citizens safe and healthy. Other amounts fund programs such as public education. Some of the money goes to run the government itself. It's expensive to keep our country running!

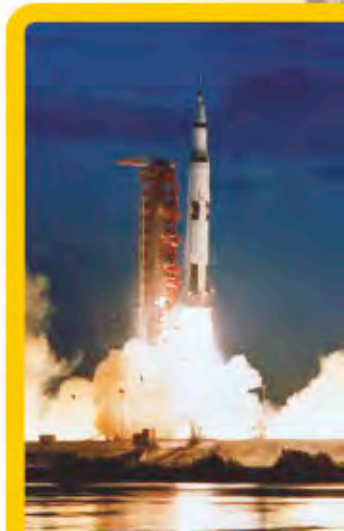
2 Sadly, just a small percentage goes to fund innovation and invention. In recent years, the government has spent only a small percentage of the federal budget on scientific and medical research. This is not right! The federal government must spend more money to support inventors and their work.

3 Invention is crucial for the economic and social well-being of our country. Funding inventors improves people's lives, creates jobs, and helps our nation excel as a leader in science and technology.

## Inventors Need Government Support

4 It's often the case that only the government has the huge funds needed to support truly great innovation. To build a faster computer or transcend the barriers of space travel, inventors need enormous sums of money. The government spent about $20 billion on the Apollo space program, which took astronauts to the moon. The project likely could not have succeeded without government help.

5 Government support of invention has frequently led to more innovation. A simple example is memory foam. This "space age" material first helped protect astronauts from collisions. Consequently, many people today now sleep on mattresses made of this squishy, comfortable material. It's even used to add cushion in shoes! Other innovations include devices that help the deaf hear, probes that help doctors look inside arteries, and scratch-resistant eyeglasses.



## Inventors Change Our Lives for the Better

6 Government support of innovation has always benefited society. Specifically, government funds have contributed to inventions such as cell phones, electric cars, and the Internet.

7 It's the government's job to improve the lives of its citizens. Inventors do this all the time. Think about the contributions of inventors like the illustrious Thomas Edison. Who can doubt that his light bulb made life easier? Think of computer giants like Bill Gates and Steve Jobs, whom many revere for how they changed the world. The government should be doing all it can to help new inventors follow in their footsteps.

## Even Failures Help Inventors Learn

8 Now, some people might feel that invention is too risky a business for the government to be involved in. Yes, most inventors do fail—at first. But failure is a central part of the process. It is how great ideas become great products.

9 In 1967, for example, an Apollo spacecraft caught fire on the launch pad. Three astronauts died. Inventors learned from this terrible accident. They made improvements to the spacecraft. The improvements helped astronauts land on the moon.

## Let's Be World Leaders!

10 Innovation in technology and science helps our country maintain its place as a world leader. Each year, thousands of students travel here from other lands. They come to study at our schools and universities.

11 Inventors improve the lives of everyone. Inventors help make our country strong and prosperous. Our government must continue to invest in inventors and their innovations.

myNotes

**Notice & Note**
Contrasts and Contradictions

# Prepare to Read

**GENRE STUDY** **Narrative nonfiction** gives factual information and tells true events in a way that reads like a story.

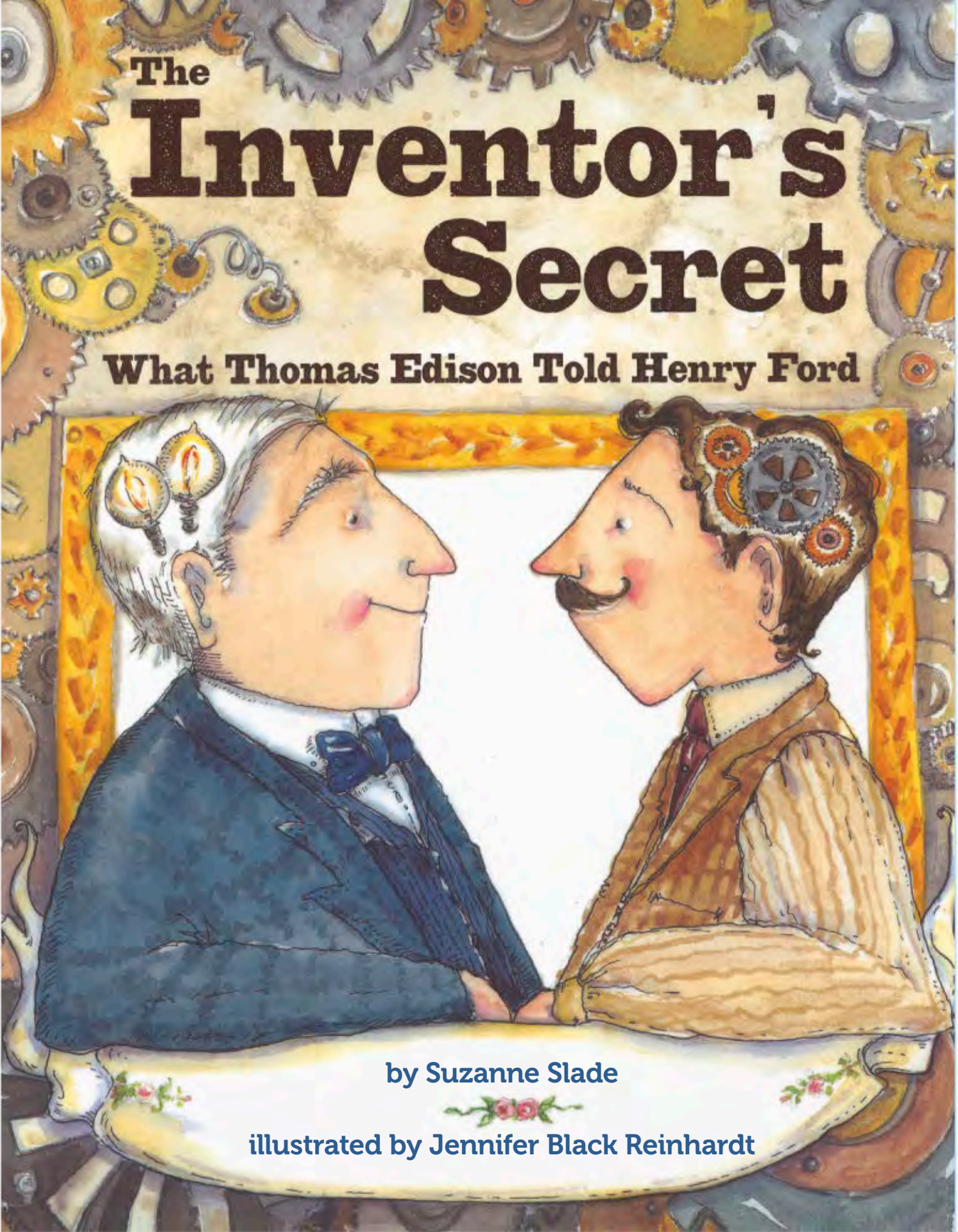
- Narrative nonfiction presents events in sequential, or chronological, order. Ordering events this way helps readers understand what happened and when.
- Texts about events that happened in the past include real people and may include quotations from them, or details about their thoughts and feelings.
- Narrative nonfiction can include visuals, such as illustrations, maps, and diagrams.

**SET A PURPOSE** **Think about** the title and genre of this text. What do you know about these inventors and their work? What do you want to learn? Write your ideas below.

**CRITICAL VOCABULARY**

- locomotives
- chugged
- gadgets
- phonograph
- sputtered
- flop
- incandescent
- cylinder
- patents

**Meet the Author and Illustrator: Suzanne Slade and Jennifer Black Reinhardt**


The
Inventor's
Secret
What Thomas Edison Told Henry Ford
by Suzanne Slade
illustrated by Jennifer Black Reinhardt

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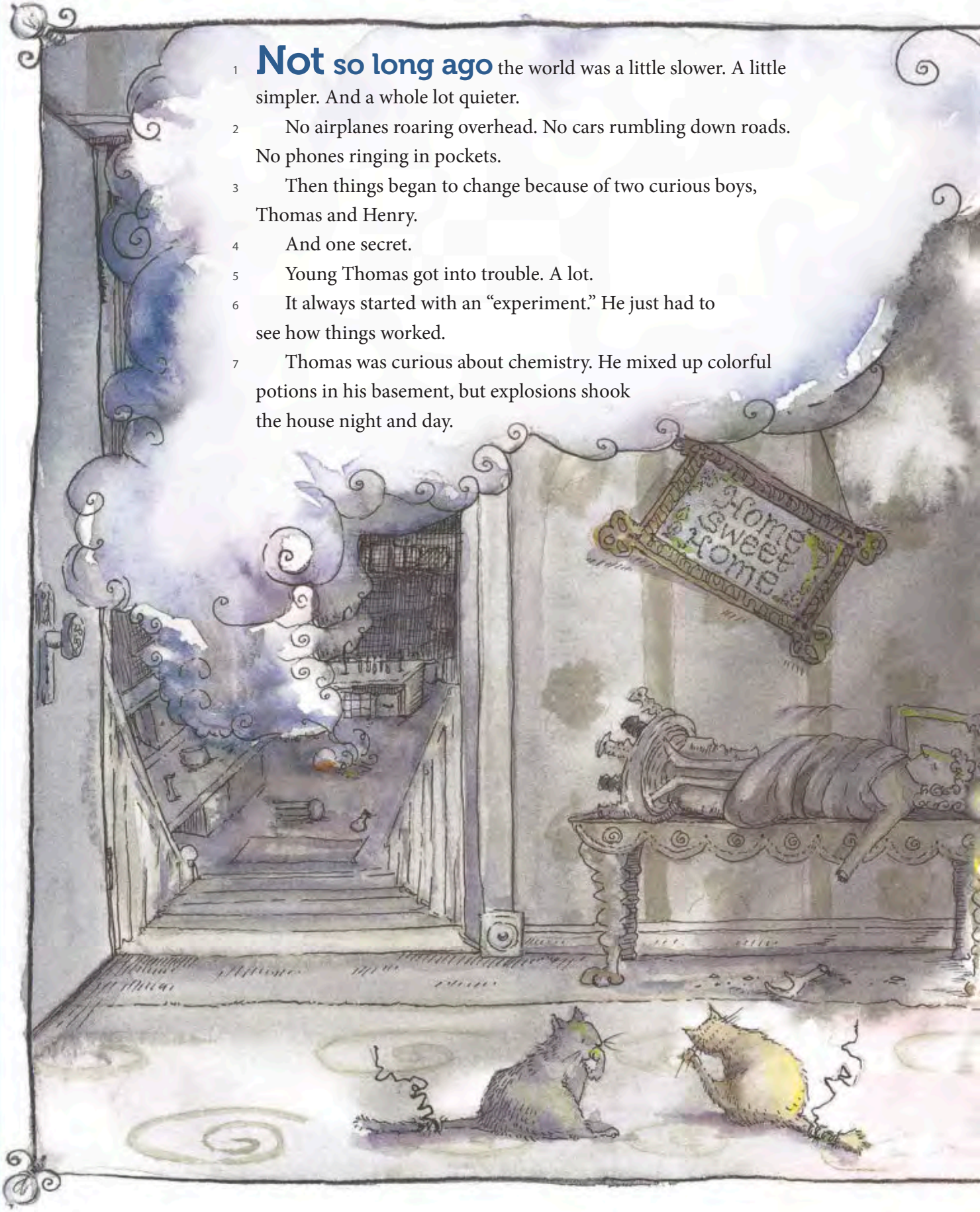



1 **Not so long ago** the world was a little slower. A little simpler. And a whole lot quieter.

2 No airplanes roaring overhead. No cars rumbling down roads. No phones ringing in pockets.

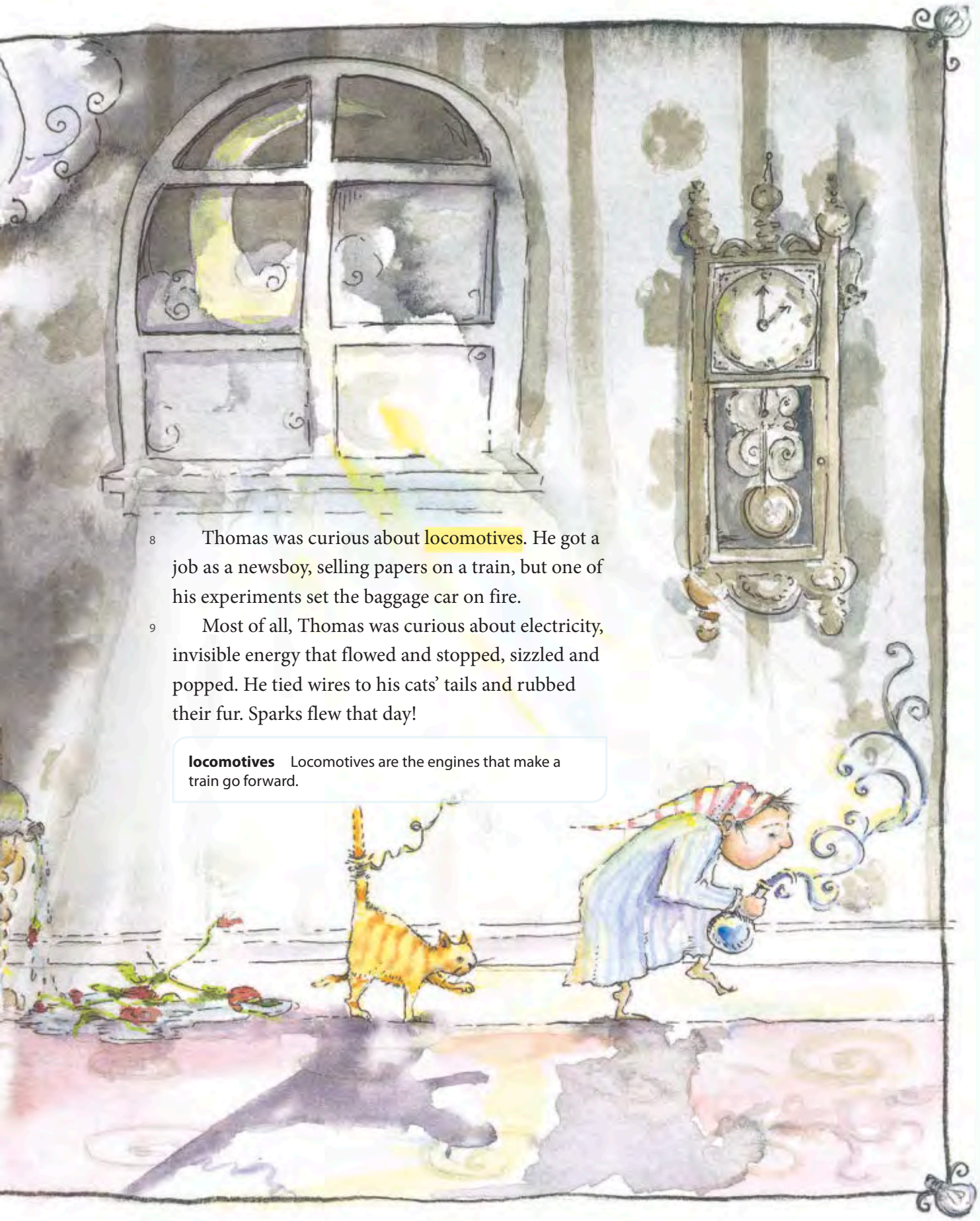
3 Then things began to change because of two curious boys, Thomas and Henry.

4 And one secret.

5 Young Thomas got into trouble. A lot.

6 It always started with an "experiment." He just had to see how things worked.

7 Thomas was curious about chemistry. He mixed up colorful potions in his basement, but explosions shook the house night and day.



8 Thomas was curious about locomotives. He got a job as a newsboy, selling papers on a train, but one of his experiments set the baggage car on fire.

9 Most of all, Thomas was curious about electricity, invisible energy that flowed and stopped, sizzled and popped. He tied wires to his cats' tails and rubbed their fur. Sparks flew that day!

**locomotives** Locomotives are the engines that make a train go forward.

myNotes

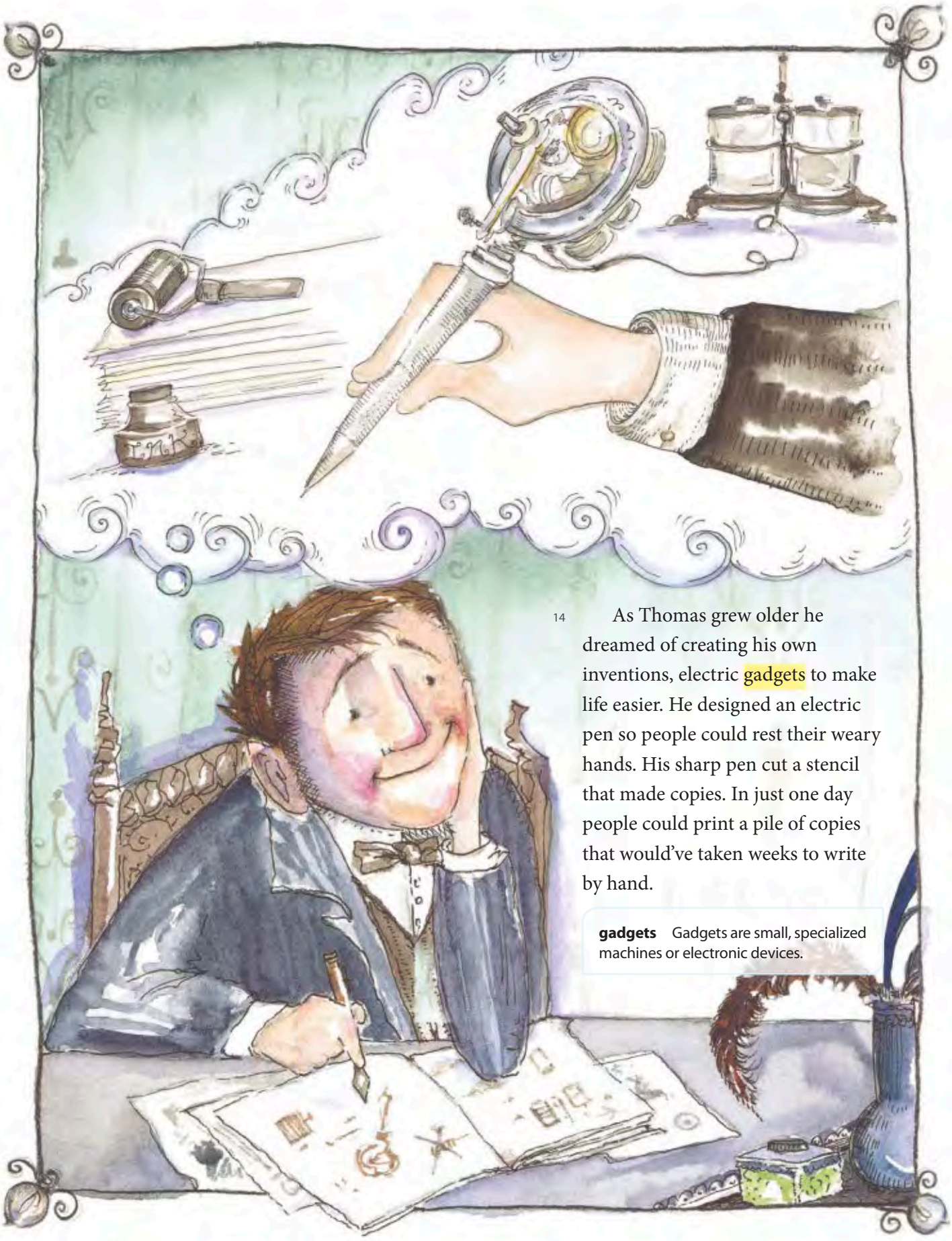
10 Henry was born sixteen years after Thomas. He got in a heap of trouble, too. He was always doing experiments instead of his chores because he just had to see how things worked.

11 Henry was curious about windup toys. He took his sister's toys apart, but couldn't always get them back together.

12 Henry was curious about the rushing river. He built a dam and waterwheel to catch its energy, but flooded the neighbor's field instead.

13 Most of all, Henry was curious about engines—machines that chugged and purred, hiccupped and whirred. He built a steam engine from a ten-gallon can, tin blades, and a pipe, but it exploded and set the school fence on fire!


**chugged** If a machine chugged along, it moved slowly and noisily.



14 As Thomas grew older he dreamed of creating his own inventions, electric gadgets to make life easier. He designed an electric pen so people could rest their weary hands. His sharp pen cut a stencil that made copies. In just one day people could print a pile of copies that would've taken weeks to write by hand.

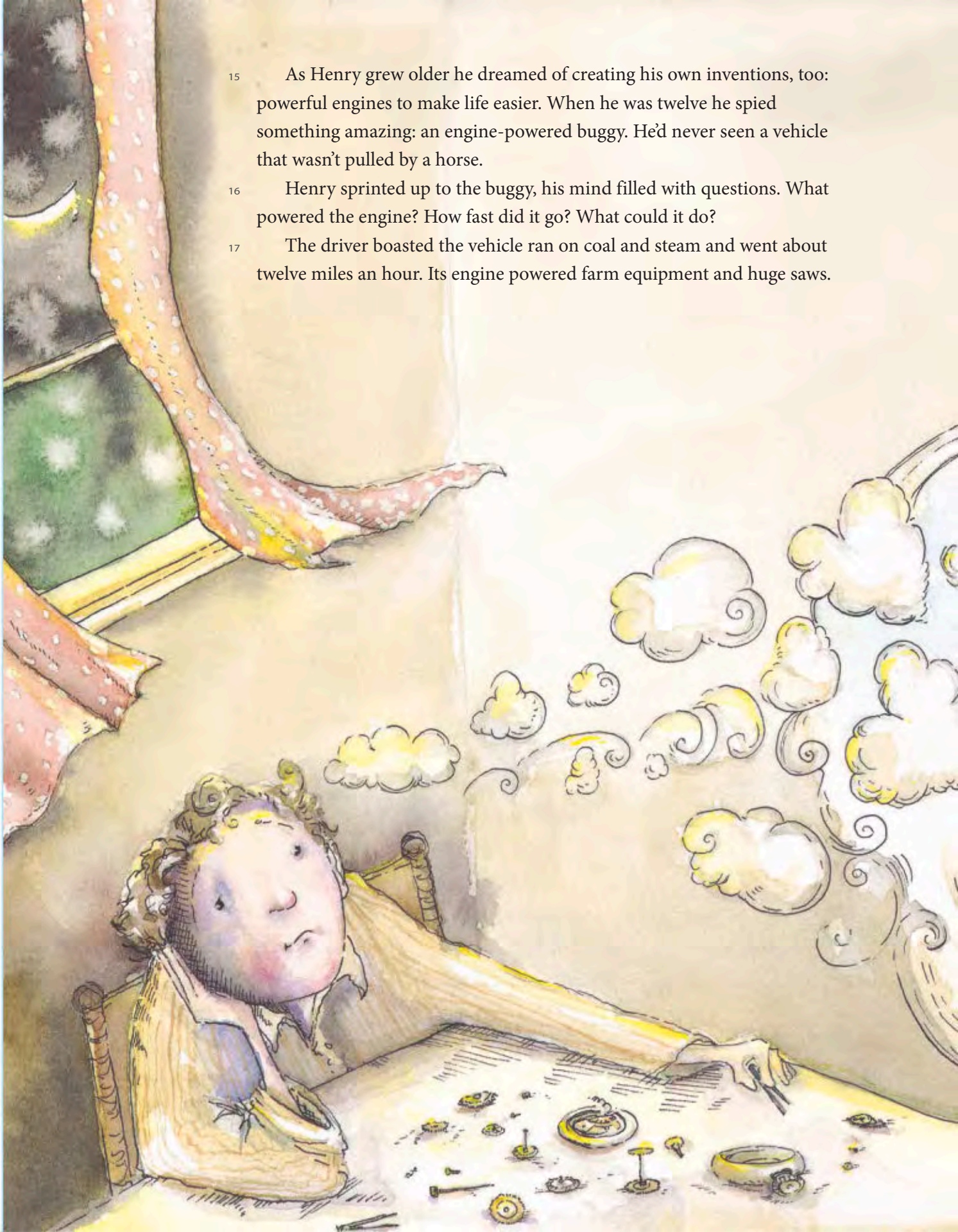
**gadgets** Gadgets are small, specialized machines or electronic devices.

myNotes

15 As Henry grew older he dreamed of creating his own inventions, too: powerful engines to make life easier. When he was twelve he spied something amazing: an engine-powered buggy. He'd never seen a vehicle that wasn't pulled by a horse.

16 Henry sprinted up to the buggy, his mind filled with questions. What powered the engine? How fast did it go? What could it do?

17 The driver boasted the vehicle ran on coal and steam and went about twelve miles an hour. Its engine powered farm equipment and huge saws.



18 The mighty machine got Henry's mind spinning. An engine didn't eat or rest like a horse. It could carry people, mail, and news. Fast!

19 From then on, Henry thought about one thing: making his own vehicle. A car hardworking families could afford. Then folks could go to town anytime, not just the weekly Saturday trip. They could visit faraway places they'd only heard about.

20 But Henry couldn't even repair his broken watch! How would he ever build a car?

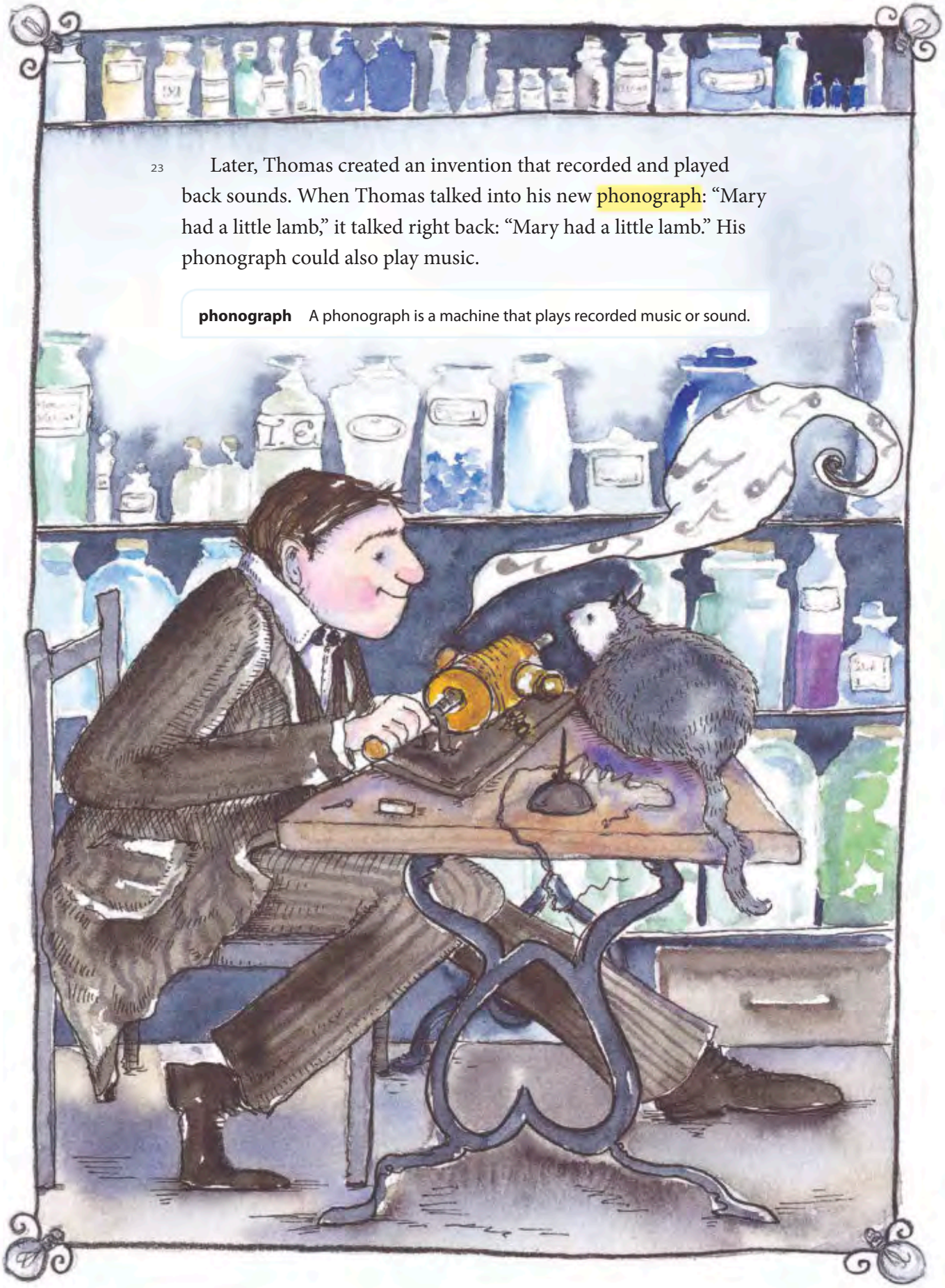
21 Then he heard about Thomas's electric pen.

22 What's his secret? Henry wondered. How did he make such a marvelous machine?

myNotes

23 Later, Thomas created an invention that recorded and played back sounds. When Thomas talked into his new phonograph: "Mary had a little lamb," it talked right back: "Mary had a little lamb." His phonograph could also play music.

**phonograph** A phonograph is a machine that plays recorded music or sound.




24 Henry was still dreaming about cars. Everywhere he went, his pockets rattled with metal parts. When he was seventeen he took a job at a machine shop to learn more about engines and machinery. Then, two years later, a farmer hired Henry to operate a new steam engine.

25 Soon Henry began tinkering on a steam engine of his own. He strapped the homemade engine to an old mowing machine. His contraption sputtered along for forty feet, then collapsed.

26 Henry's design was a flop!

27 But everyone was buzzing about Thomas's talking phonograph.

28 *What's his secret?* Henry wondered.

**sputtered** If something sputtered, it worked in a rough or uneven way and made popping noises.

**flop** Something that is a flop is a complete failure.

myNotes

29 Meanwhile, Thomas was working on an electric light so people could read past dark. After changing his design many times, he created an incandescent light bulb that burned all night!

30 Henry was determined to make his vehicle work, so he took a job at a company that made engines. One day he repaired a fancy engine from England. It had a four-stroke cylinder that burned gas to create power. Fascinated, he built a model of the engine to see how it worked.

31 After that, Henry spent long nights, and Saturdays, working on his car. Friends and coworkers helped, too. When he finally rolled his creation out of his workshop, it had two cylinders for double the power, a three-gallon tank for gas, and four bicycle tires for wheels.

32 Henry's Quadricycle could go up to twenty miles per hour—but it cost a fortune to make. Most people thought his rattling gas buggy was a joke.

**incandescent** Something that is incandescent gives off a lot of light.

**cylinder** A cylinder has circular ends and straight sides. In an engine, a cylinder takes in gas to make other parts move.

33 "Get a horse!" people shouted at Henry.

34 But the whole country was crazy about Thomas's electric light.

35 Henry scratched his head. What's his secret?

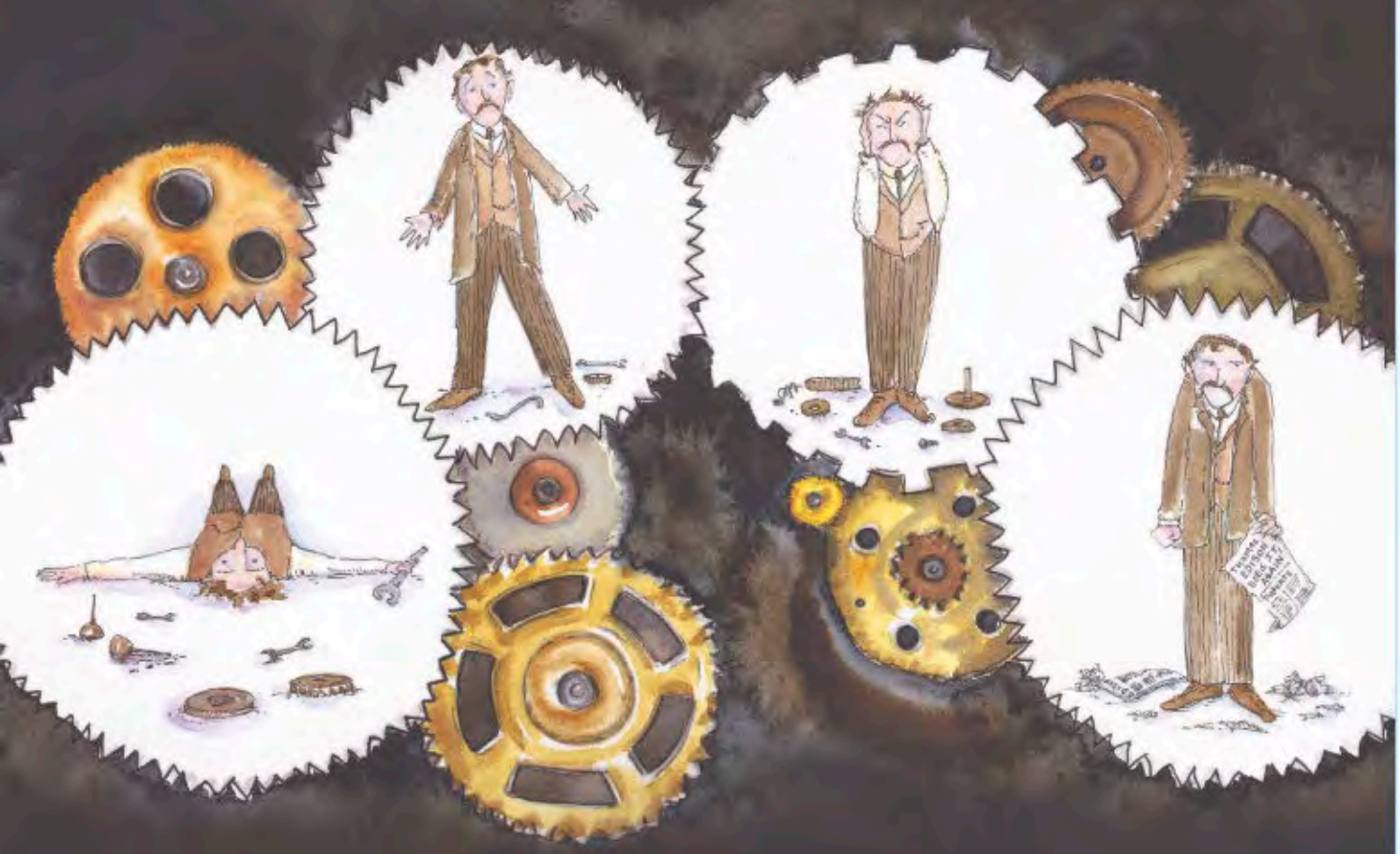
36 Still, Henry believed in his dream. Although he knew that other people were working on gas cars, he was determined to make the best. One that was easy to drive. Big enough for families. And most important—a car everyone could afford.

37 While Henry was working on his design, Thomas earned patents for over one hundred new inventions.

38 Henry couldn't stand it any longer.

39 He had to find out Thomas's secret!

**patents** Patents are legal documents. If you get a patent for an invention, no one else is allowed to make or sell it.



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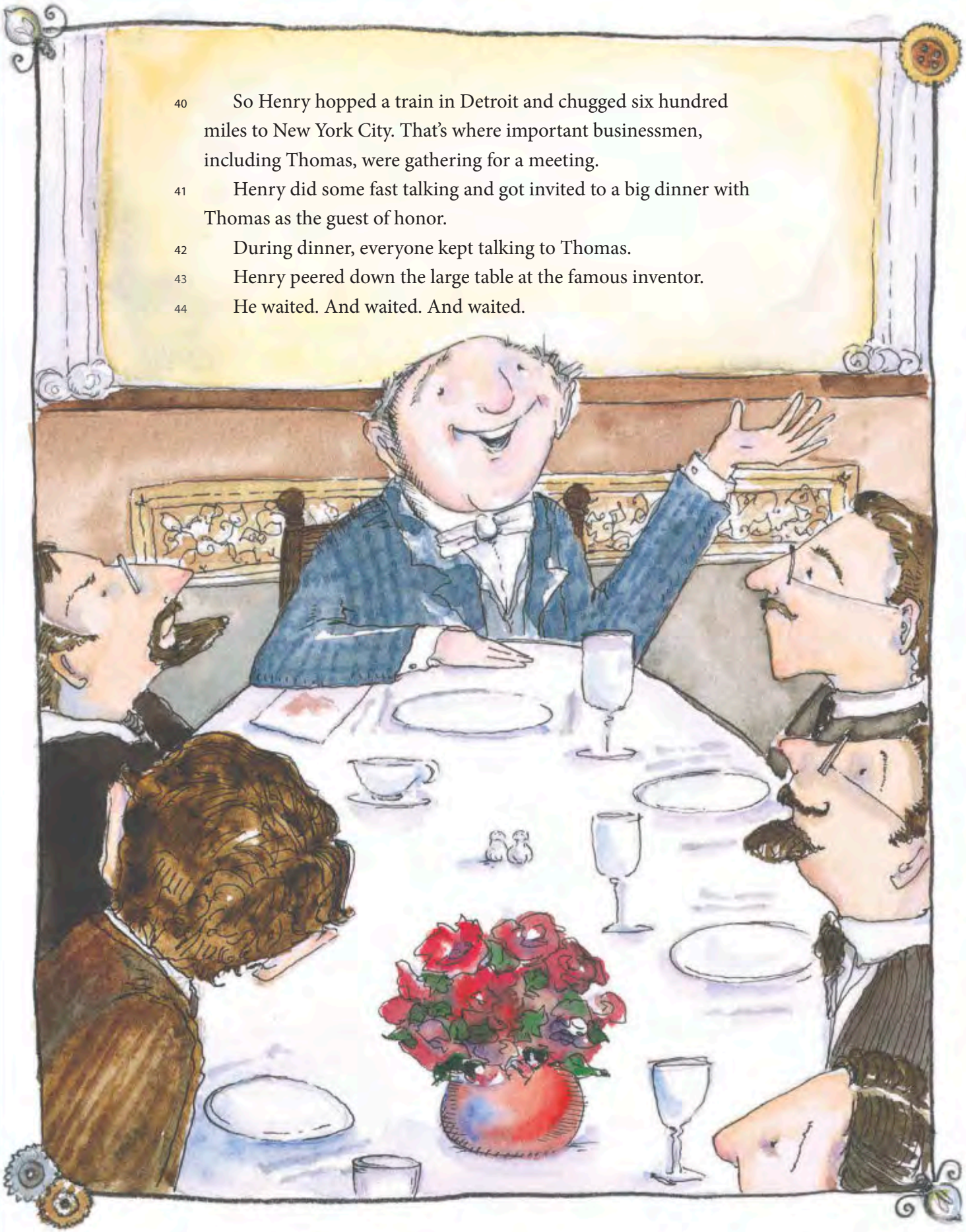
40 So Henry hopped a train in Detroit and chugged six hundred miles to New York City. That's where important businessmen, including Thomas, were gathering for a meeting.

41 Henry did some fast talking and got invited to a big dinner with Thomas as the guest of honor.

42 During dinner, everyone kept talking to Thomas.

43 Henry peered down the large table at the famous inventor.

44 He waited. And waited. And waited.



45 Finally Henry gathered his courage. He moved right next to Thomas and told him he was building a gas car.

46 "Is it a four-cycle engine?" Thomas asked.

47 Henry lit up brighter than any light bulb. He grabbed a menu and started sketching his engine.

48 Thomas fired off question after question.

49 Henry happily answered each one.

50 And that's when it happened.

51 Blue eyes sparkling, Thomas leaned in close to Henry.

52 He banged his fist on the table. "Keep at it!" he shouted.

53 Henry smiled.

54 *Keep at it?*

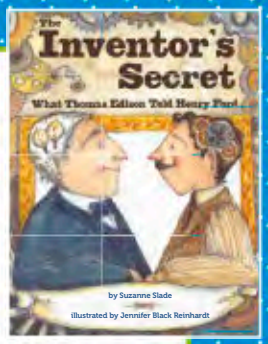
55 Henry laughed.

56 He'd known Thomas's secret all along!

57 *Thomas Edison and Henry Ford are two of the most important men in American history. Thomas Edison was an American inventor and businessman who is best known for developing the long-lasting light bulb. Many earlier inventors had made attempts to devise a light bulb for widespread use, but their versions failed to last long enough, were too expensive to produce, or used too much electrical current. After several experiments, Edison succeeded, in 1879, in creating a bulb that lasted 13.5 hours. This was the first commercial incandescent bulb. Henry Ford was an industrialist who founded the Ford Motor Company. Like Edison, his efforts were not focused on inventing something, but on improving it so that it could be manufactured for the public. Ford developed and manufactured the first automobile that many middle-class Americans could actually afford. Edison and Ford were also good friends who often gave each other business advice and even vacationed together. Edison was the person who gave Ford the confidence to build his own gas-powered car.*

Respond to the Text

# Collaborative Discussion




Look back at what you wrote on page 18. Tell a partner two things you learned during reading. Then work with a group to discuss the questions below. Find details in *The Inventor's Secret* to support your thoughts. In your discussion, respond to others by asking questions and making comments that build on their ideas.

1. Reread pages 20–25. What words and actions in the text show how Thomas and Henry are alike?

2. How does the author reveal Henry's feelings about Thomas?

3. Explain what the author means in this sentence on page 32: "He'd known Thomas's secret all along!"

## Listening Tip

Listen carefully to the responses of others. What questions do you have about their ideas?

## Speaking Tip

Ask questions to encourage a speaker to tell more about the topic. Add comments of your own to build upon the speaker's ideas.

Cite Text Evidence

# Write a Personal Account

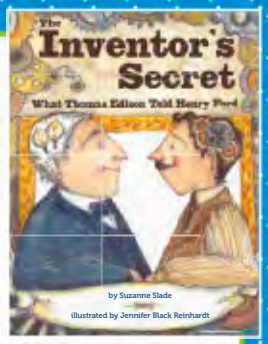
## PROMPT

In *The Inventor's Secret*, you read how Henry learns from Thomas that the "secret" to success is simply not giving up.

Imagine that your class is creating a collection of personal stories about their paths to success. Think about a time when you had to "keep at it" in order to succeed. Write a two-paragraph personal account telling about a challenge you faced and what it took to overcome that challenge. Use evidence from *The Inventor's Secret* in your personal account. Don't forget to use some of the Critical Vocabulary words in your writing.

## PLAN

**Make notes about the central ideas and important details related to overcoming a challenge. Then use a two-column chart to compare and contrast a challenge you faced with one that is faced by someone in the text.**




## WRITE

**Now write your personal account about a challenge you faced.**

### Make sure your personal account

- ☐ introduces the challenge that you faced.
- ☐ describes how the challenge was overcome.
- ☐ compares and contrasts with the text.
- ☐ uses sensory details to describe the experience.
- ☐ provides a conclusion.

myNotes

**Notice & Note**
Contrasts and Contradictions

# Prepare to Read

**GENRE STUDY** **Magazine articles** give information about a topic, person, or event.

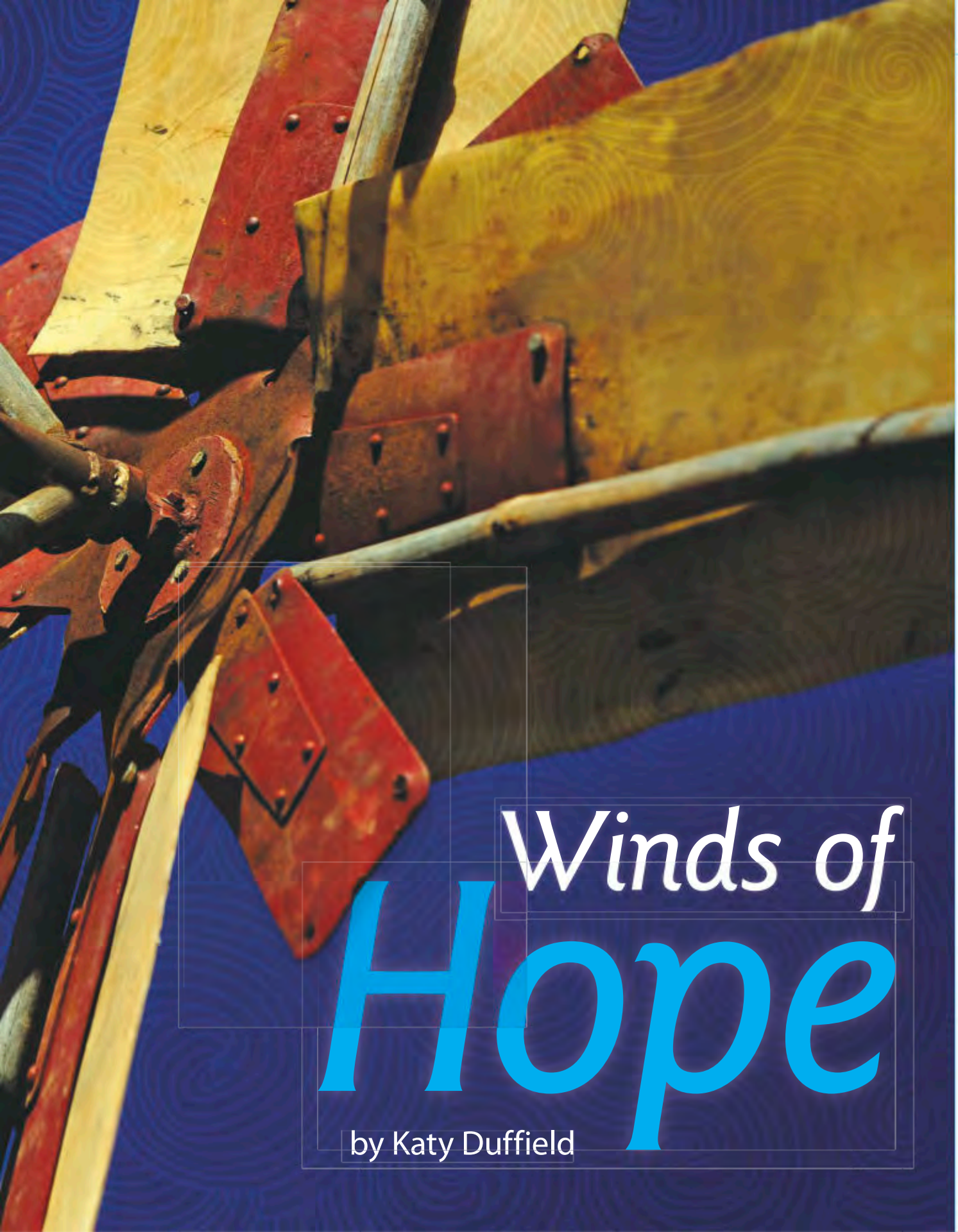
- Magazine articles often tell events in sequential—or chronological—order to help readers understand what happened and when.
- Magazine articles usually include visuals, such as photographs with captions.
- Magazine articles may include words that are specific to the topic or idea being discussed.

**SET A PURPOSE** **Think about** the title and genre of this text. What do you know about wind power? What do you want to learn? Write your ideas below.

**CRITICAL VOCABULARY**

- irrigate
- inspector
- photographed
- prestigious
- auditorium
- impoverished

**Build Background: Alternative Power**



# Winds of Hope

by Katy Duffield

myNotes

William Kamkwamba

1 *Parched red dust* swirled on the wind as William Kamkwamba (kam-KWAHM-bah) stooped between rows of *chimanga*, or maize, near his family's mud-brick thatched home in Malawi, Africa. As the searing sun scorched his back, the fourteen-year-old wrapped his hand around a withered stalk. Instead of being plump and green, the maize was dry and brittle. It had grown barely knee-high. The maize should have been up to his father's chest by that time, but the rains had not come to nourish it.

2 The drought of 2001 dragged on and on. For many months, William's family had only enough maize for one meal each day. And then, for just a small handful at night; and finally, for only four mouthfuls. As they grew thinner and thinner, William feared they all would die of starvation.

3 The following spring, William and his father knew that all they could do was begin again. They planted a new maize crop. This time, the rains came. The maize grew—ankle-high, knee-high, chest-high.

4 William hoped that life could now return to normal. He'd worked hard to pass the exams to enter high school. When the term began, however, William's father explained that, because of the drought, there was no money to pay his school fees. It appeared that William's education would end at eighth grade.

5 Though he could not attend school, William still wanted to learn. He was curious about many things. He took apart radios, trying to discover how they made music. One day, turning a bicycle upside down and cranking the pedals by hand, he figured out that the dynamo that generated electricity for the headlight could be wired to power a radio instead.

6 Some days, William visited the village library. It had only three shelves, but William found books that interested him—science books about how things worked. One day, while looking for a dictionary on the bottom shelf, he found a book he hadn't seen before pushed behind the others. It was an American school textbook called *Using Energy*. On the book's cover was a picture of a row of windmills, tall steel towers with blades spinning like giant fans.

myNotes

7 From this book William learned that wind—something of which Malawi had plenty—could produce electricity. William was delighted! Only two percent of the houses in Malawi have electricity. If William could build a windmill, his family could have lights in their home. And a windmill could be used to pump water to irrigate the family's maize fields. If another drought came, the windmill could provide the water for life.

8 William could picture in his mind the windmill he wanted to build, but collecting the parts and tools he needed would take months. In a junkyard across from the high school, William dug through piles of twisted metal, rusted cars, and worn-out tractors, searching for anything that might help him construct his machine. He took a ring of ball bearings from an old peanut grinder and the cooling fan from a tractor engine. Cracking open a shock absorber, he removed the steel piston inside. He made four-foot-long blades from plastic pipe, which he melted over a fire, flattened out, and stiffened with bamboo poles.

9 Earning some money loading logs into a truck, he paid a welder to attach the piston to the pedal sprocket of an old bicycle frame. This would be the axle of the windmill. When the wind blew, the rotating blades would turn the bicycle wheel, like someone pedaling, and spin a small dynamo. Although he had no money for a dynamo, a friend came to the rescue and bought one from a man in the road, right off his bike.

10 When he had collected all the parts, William took them out of the corner of his bedroom, laid them outside in the shade of an acacia tree, and began putting them together. Since he did not have a drill to make bolt holes, he shoved a nail through a maize cob, heated it in the fire, then pushed its point through the plastic blades. He bolted the blades to the tractor fan, using washers he'd made from bottle caps. Next he pushed the fan onto the piston welded to the bicycle frame. With the help of his two best friends, William built a 16-foot-tall tower from trunks of blue gum trees and hoisted the ninety-pound windmill to the top.

11 Shoppers, farmers, and traders could see William's tower from the local market. They came in a long line to find out what the boy was up to.

**irrigate** To irrigate crops is to supply them with water through a system of pipes, sprinklers, or streams.

12 William knew this was his moment—his moment to show everyone he wasn't crazy, to find out if his experiment would work. He connected two wires from the dynamo to a light socket he'd made from a reed and that held a small bulb. As the wind whipped around him, he removed the bent spoke he'd jammed into the wheel to lock it. Then he held his breath . . .

13 The blades began to turn, slowly at first, then faster and faster. The light bulb flickered, then flashed to life. The crowd cheered from below.

14 A month later William found enough wire to reach from the windmill into his house. His family crowded around to marvel as the small bulb lit up in William's room. Reading *Explaining Physics* by its light, he stayed up long after others had gone to bed.

William's cousin climbs one of the windmills on the Kamkwamba farm.

William's parents stand outside their home. William's windmill towers in the background.

myNotes

15 *In 2006,* a school inspector saw the windmill and informed his head office. William's machine now powered four lights and two radios in his house. He'd added a storage battery with homemade switches and a circuit breaker. He also recharged village cell phones.

16 Soon William was being interviewed on the radio and photographed for the newspapers. The story of the boy with only an eighth grade education who'd built "electric wind" spread across the Internet.

17 In 2007, the nineteen-year-old who had not attended school for five years was flown to Tanzania to speak at the prestigious TED conference, featuring innovators from around the world in Technology, Education, and Design. Nervously struggling with his English, William received a rousing ovation from the auditorium of inventors and scientists when he modestly described what he had done.

18 William attended Dartmouth College in the United States, where he studied environmental science and engineering. He graduated in 2014. William is dedicated to bringing wind- and solar-powered electricity and water pumps to impoverished villages in rural Africa.

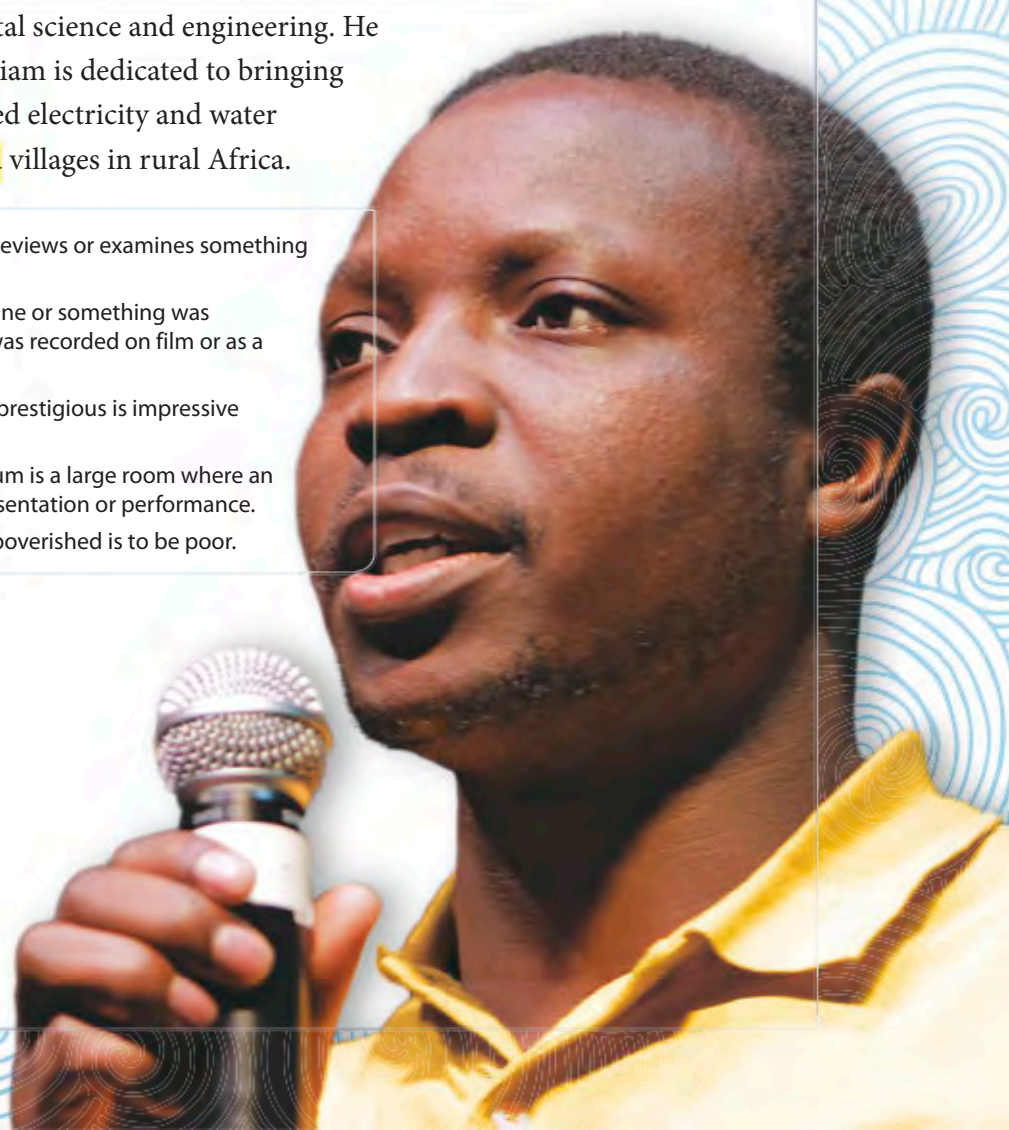
**inspector** An inspector reviews or examines something carefully.

**photographed** If someone or something was photographed, its photo was recorded on film or as a computer file.

**prestigious** Something prestigious is impressive and important.

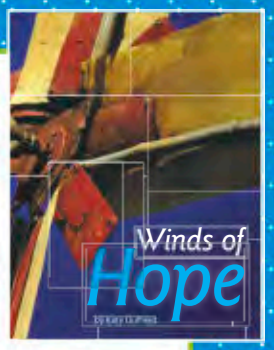
**auditorium** An auditorium is a large room where an audience gathers for a presentation or performance.

**impoverished** To be impoverished is to be poor.



Respond to the Text

# Collaborative Discussion




Look back at what you wrote on page 36. Tell a partner two things you learned from the text. Then work with a group to discuss the questions below. Support your answers with details from *Winds of Hope*. Before your discussion begins, choose a leader who will make sure everyone in the group has a chance to share ideas.

1. Reread page 38. What details in the text show how the drought affected William and his family?

2. Review pages 40–41. What does William do to find the parts he needs to build a windmill? What kinds of problem-solving skills does he demonstrate while he's working?

3. What details in the text show how William feels about helping others?

## Listening Tip

Listen carefully to others in your group. Wait until your group leader calls on you to add your ideas.

## Speaking Tip

Look at other group members as you speak. Speak loudly enough for everyone to hear you. When you're finished, ask if anyone has questions for you.

Cite Text Evidence

# Write a News Article

## PROMPT

In *Winds of Hope*, you read how William becomes known around the world after local newspapers write about his windmill. Reporters must prepare for conducting interviews so that they are able to record the most important facts and details related to the article.

Imagine that you are a reporter and your newspaper has sent you to interview William. Write a news article about William and his windmill. Begin by writing interview questions. Using the 5 Ws and H (*who, what, when*, *where, why*, and *how*) will help you create questions that include the most important information. Then use information from the text to answer your questions as you think William would answer. Don't forget to use some of the Critical Vocabulary words in your writing.

## PLAN

**Use the 5 Ws and H to prepare interview questions that focus on the central ideas and important details from the text. Then use the text to answer the questions as William would answer them.**

## WRITE

**Now write your news article about William and his windmill from *Winds of Hope*.**


### Make sure your news article

- ☐ introduces William and his invention.
- ☐ asks and answers questions using the 5Ws and H.
- ☐ develops the topic with facts and other examples from the text.
- ☐ uses informative words and language that show understanding.
- ☐ ends with a concluding statement.

myNotes

**Notice & Note**
Contrasts and Contradictions

# Prepare to Read

**GENRE STUDY** **Informational texts** give facts and examples about a topic.

- Authors of informational texts may organize their ideas using headings and subheadings, by grouping main ideas and key details, or by explaining causes and effects.
- Science texts also include words that are specific to the topic.
- Informational texts often include visuals, such as charts, diagrams, graphs, timelines, and maps.

**SET A PURPOSE** **Think about** the title and genre of this text. What do you know about wheelchair sports and how they affect the lives of people who are not able to walk? What do you want to learn? Write your ideas below.

**CRITICAL VOCABULARY**

- maneuver
- specialized
- elite
- objective
- traditional

**Build Background:**
**Sports for the Physically Challenged**

# Wheelchair Sports:

## Hang Glider to Wheeler-Dealer

by Simon Shapiro
art by Theo Krynauw and Warwick Goldswain

myNotes

In her new wheelchair, Marilyn Hamilton excelled at tennis, winning the U.S. Open Women's Wheelchair Championship twice, both in singles and doubles. (Eventually she did get her yellow wheelchair.)

1 Before you jump off a mountain, there are a few things you have to do. Usually, Marilyn Hamilton did them all, and had a great time soaring in California's Sierra mountain range under her hang glider. But one day in 1978, she forgot to clip her harness to the glider. She was lucky not to be killed, but the crash broke her back. At the age of 29, Hamilton's life changed forever—but the lives of millions of others would also be changed by that simple mistake.

2 Hamilton was never able to walk again. After a stay in the hospital and three weeks of therapy, she was given a wheelchair and encouraged to get on with her life. She was eager to do that but worried about the things she would never be able to do again, like running, biking, squash and racquetball, hiking, and hang gliding.

3 Still, Hamilton was determined to live a full and active life, and ready to try new things. Regular tennis was out, but a friend got her started on wheelchair tennis. It was frustratingly difficult, and she'd come home from the courts at the end of the day with badly blistered hands. She hated her wheelchair! Its steel frame made it heavy (close to 27 kilograms, or 60 pounds) and hard to maneuver. And it was ugly. Being imprisoned in that wheelchair was the exact opposite of being able to fly in a hang glider. One day, that difference gave her an idea.

**maneuver** To maneuver something is to move it.


4 Hamilton talked to two friends who made hang gliders. She persuaded them to build her a new wheelchair using hang-glider technology. An aluminum frame made it strong, but light; it was half the weight of her regular chair, and she could really move in it. It even looked good. In fact, the only thing that stopped it from being absolutely perfect was that it was blue; she would have preferred yellow.

5 Hamilton and her friends knew they were on to something. Hamilton couldn't be the only one out there looking for a lighter, speedier chair. They formed a company to make and sell "Quickie" wheelchairs and specialized in meeting the needs of athletes. The company was hugely successful.

**specialized** If a company specialized in something, it provided a specific type of product.

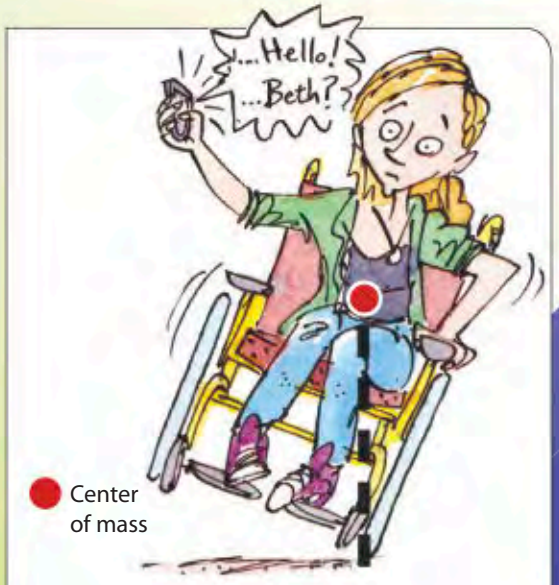
## Wheelchair Sports

Wheelchair sports can be very competitive and very demanding. Elite wheelchair athletes have an awesome level of fitness, skill, and upper body strength. Wheelchair basketball is very similar to stand-up basketball. Rules are adapted for wheelchairs. For example, only two pushes are allowed before a player must dribble the ball. Wheelchair rugby was developed by a group of Canadian athletes whose reduced arm and hand functions didn't allow them to compete equally in basketball. The objective is to carry the ball over the opponents' goal line.

**elite** Elite members of a group are those who are the best or most skilled.

**objective** An objective is a goal.

myNotes




A regular wheelchair tips over fairly easily. The vertical dotted black line shows that the center of mass is directly over the tipping point.

## Why They're Better

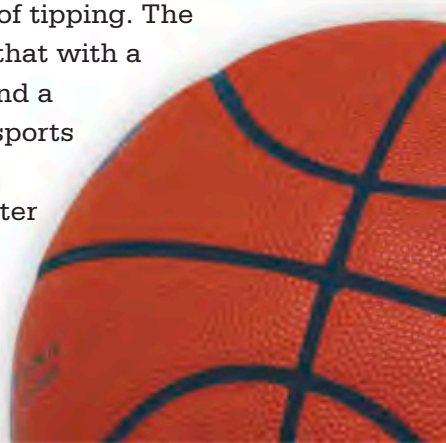
6 The reasons why a lightweight wheelchair is better for athletes than a traditional wheelchair are pretty easy to understand. In fact, Sir Isaac Newton figured out the exact math formulas to explain this stuff back in 1687, but here are the basics:

- to move something heavy, you have to push harder;
- given the same push, something light will go faster than something heavy; and
- it's easier to slow down a lighter object than a heavier one.

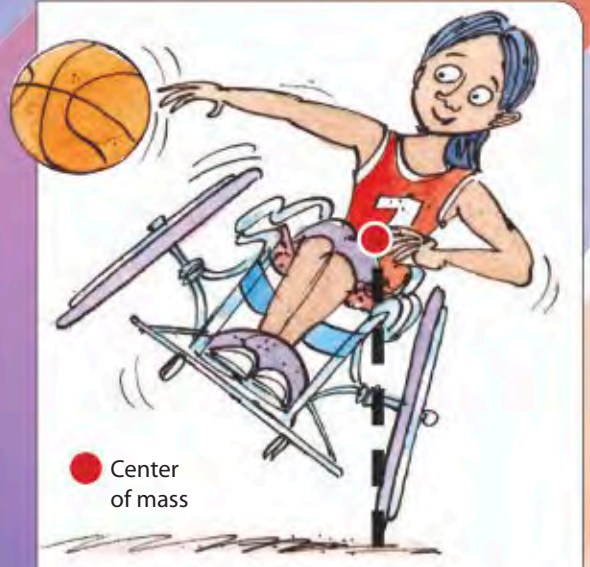
7 So, it's obvious that a lighter wheelchair will let an athlete move faster, stop faster, and change direction easily. The only thing that *isn't* obvious is why no one built a light wheelchair for athletes sooner. It seems this invention had to wait for Marilyn Hamilton: not only did she understand the need, she also had the connection to hang-gliding technology that turned a dream into a reality.

**traditional** Something that is traditional has been made or done in a certain way for a very long time.

8 The lightness of the Quickie was the biggest innovation. But Hamilton and her friends didn't stop there. They worked hard to figure out what else an athlete would need. In the end, the Quickie was made more stable by giving it a lower center of mass and a wider wheelbase than a traditional wheelchair. An object will tip over when the center of mass is directly over the point of tipping. The diagram above shows that with a lower center of mass and a wider wheelbase, the sports wheelchair must be pushed to a much greater angle before it tips.

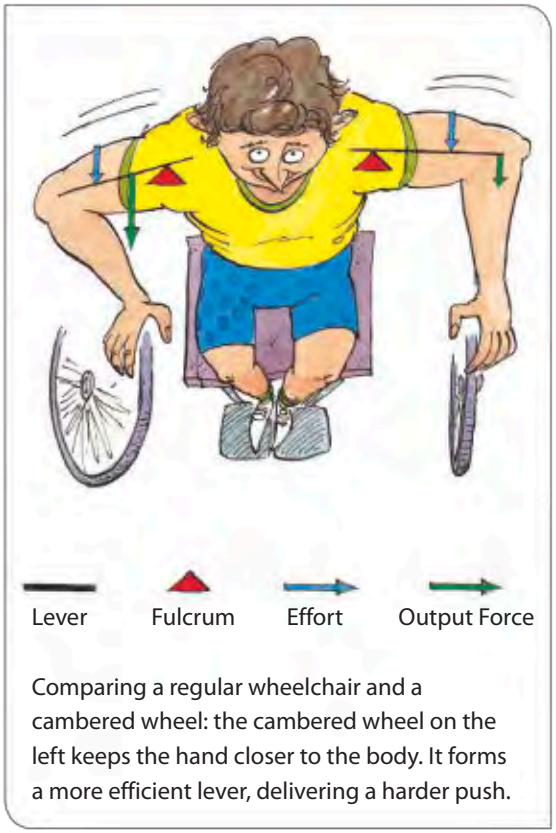


The wide wheelbase on a sports wheelchair makes it very stable and hard to tip over.




9 With a wheelchair, the center of mass is made lower by setting the seat lower. The Quickie also lets athletes adjust the height themselves. The wheelbase is made wider by using negative cambered wheels. This means that the wheels aren't vertical. Instead, they're angled so that the tops of the wheels are closer together than the bottoms.

10 Another advantage of the negative cambered wheels is that the athlete can reach the wheel more easily. The top part of the wheel is close to the athlete's body, so the hands push almost in line with the athlete's shoulders and not out to the side. This lets you push harder. The diagram shows how this works. The shoulder is the fulcrum, and the muscles in the upper arm provide the effort. The output force is delivered through the hand. The farther away your hand is from your shoulder when you push, the less output force you have.




Comparing a regular wheelchair and a cambered wheel: the cambered wheel on the left keeps the hand closer to the body. It forms a more efficient lever, delivering a harder push.

myNotes

## Tipping Points and Center of Mass

**If you want to feel how the center of mass/tipping point principle works, grab a can of vegetables from the kitchen cupboard. Now mark the middle of the label with a dot. The center of mass is in the middle of the can, right behind that mark. With the mark facing you, hold the can on its edge just where it's balanced but about to tip over. Notice where the dot is? Right above the edge of the can. Now do the same thing with a shorter can, like the kind tuna comes in. There's no doubt which is more stable.**


## Guttmann's Great Idea

11 Dr. Ludwig Guttmann was a German brain surgeon who fled to England before the Second World War. During the war, he was in charge of Stoke Mandeville Hospital, a place that treated soldiers with spinal cord injuries. Before Guttmann, these patients were left to lie in bed, doing nothing. They would get painful bedsores, bladder and kidney infections, and would often die after several miserable months. No one expected them to become active again.

12 Guttmann refused to accept this. He believed he could use sports as a way to get patients active and out of bed. He got a sergeant assigned to the hospital to play catch with patients in bed, using a heavy medicine ball. (They needed to build up enough arm strength to lift themselves into a wheelchair.) Then the games really began. Activity wasn't optional; it was prescribed medicine. Patients had archery and darts, pool and table tennis. They invented wheelchair polo and wheelchair basketball. Amazingly, patients were soon being discharged from the hospital to go home and live active lives.

13 In 1948, Guttmann held the first annual wheelchair competition at the hospital. In 1952, Dutch competitors made these games international. Eight years later, they were held parallel to the Olympics. The Paralympics are now held immediately following the Olympics, in the same cities. In 1960, Guttmann watched 300 athletes enter Rome's Olympic stadium for the first Paralympics Games. That number's now increased to over four thousand athletes.

Respond to the Text


# Collaborative Discussion

Look back at what you wrote on page 46. Tell a partner two things you learned from the text. Then work with a group to discuss the questions below. Use details and examples from *Wheelchair Sports: Hang Glider to Wheeler-Dealer* to support your answers. Help keep your group's conversation focused on just one question at a time.

1. Reread pages 48–49. What led Marilyn Hamilton to invent a new kind of wheelchair?

2. Review page 52. In what way was Dr. Guttmann's idea for helping his patients different from what had been done in the past?

3. What special features make sports wheelchairs better for athletes than traditional wheelchairs?

## Listening Tip

Listen carefully to what each person has to say. Try to add new thoughts or facts about the same question.

## Speaking Tip

Keep the conversation on track by speaking only about the topic your group is discussing at the moment.

Cite Text Evidence

# Write an Encyclopedia Entry

## PROMPT

In *Wheelchair Sports: Hang Glider to Wheeler-Dealer,* you read how Marilyn Hamilton's own injury inspired her to design a new kind of wheelchair for athletes.

Imagine that you and your class are creating an encyclopedia of inventors. Write an entry that tells about Hamilton and her important invention. Begin your entry with a topic sentence that introduces your readers to the central idea and makes them want to know more. Use your understanding of the facts and details in the text to tell readers about Hamilton's life before she was injured, to describe her injury, to explain her invention, and to show how her invention has helped others. Don't forget to use some of the Critical Vocabulary words in your writing.

## PLAN

**Make notes about the central ideas and important details about Hamilton's life and her invention.**


## WRITE

**Now write your encyclopedia entry about Marilyn Hamilton's life and her invention.**

### Make sure your encyclopedia entry

- ☐ introduces the topic with a topic sentence.
- ☐ includes headings and other formatting.
- ☐ includes facts and details about Hamilton's life and her invention.
- ☐ uses informative words about Hamilton's invention.
- ☐ provides a concluding statement.

myNotes

Notice & Note
Again and Again

# Prepare to Read

GENRE STUDY **Fantasies** are imaginative stories that contain characters and events that are not real.

- The plot of a fantasy story usually includes a conflict, or a problem, and its resolution, or how it is solved.
- Fantasy stories often include sensory details and figurative language to develop the setting and the characters.
- Fantasy stories may include illustrations that describe the characters and setting or give clues about the plot.

SET A PURPOSE **Think about** the title and genre of this text. As you read, pay attention to details in the text and illustrations that describe Captain Arsenio's inventions. What do you think Captain Arsenio wants to do? Write your ideas below.

| CRITICAL VOCABULARY |
| --- |
| passionate |
| impulse |
| contribution |
| distinguished |
| eccentric |
| circumstances |
| evidently |
| acceleration |
| prototype |
| conceived |

**Meet the Author/Illustrator: Pablo Bernasconi**

myNotes

# CAPTAIN ARSENIO

## INVENTIONS AND (MIS)ADVENTURES IN FLIGHT


BY PABLO BERNASCONI

myNotes

# THE RESULT OF LOOKING UP

1 Flight, one of the most ancient wishes ever known, has inspired hundreds of fantastic creations. From Icarus to the Wright brothers, history has seen thousands of adventurers who have felt the dangerous urge to soar with the birds. This passionate impulse has resulted in many failures.

2 Scientists, philosophers, doctors, and even crazy people all have been pioneers of aviation, and each has made a different contribution —sometimes right, sometimes wrong—to the pursuit of flight. This is the story of one such man.

**passionate** To have a passionate feeling is to have strong emotions about it.
**impulse** An impulse is the desire to do something.
**contribution** A person who helps to make something has made a contribution to that work.

# THE END AND THE BEGINNING

3 Manuel J. Arsenio was a careless cheese master, blacksmith, scuba diver, and ship captain. Though he was given the easiest of missions in each of these careers, he still couldn't complete any of them successfully. This problem may be the reason he left those jobs behind to enter the distinguished pages of aviation history.

4 One day in 1782, Captain Arsenio decided to build the first in a long series of eccentric projects that would change his life. And although he had little knowledge of physics or mechanics and had access only to useless materials, he demonstrated great patience and determination throughout the course of his flight experiments.

5 *" My days of sailing and scuba-diving are over; I retire with grace to begin a new stage in my life that will undoubtedly go down in history. I'm going to achieve what has been humanity's desire for centuries: I will build a flying machine."*

*—Captain Arsenio, May 1, 1782*

# THE DISCOVERY

6 How do we know about Captain Arsenio? His diary was found by chance just one year ago, under circumstances to be discussed later. In its ninety pages full of doodles, notes, and technical writings, Arsenio developed eighteen different designs for a flying machine, each one original, foolish, and fantastic. Here we explore three of the eighteen most influential projects that have contributed to modern aviation.

7 Captain Arsenio's diary is the oldest and most precious aviation manuscript ever known, second only to Leonardo da Vinci's. Fortunately, the text is still legible and Arsenio's notes, diagrams, and ideas take us back in time to reveal the hidden mystery of the inventor's thoughts.

8 *"Why can birds fly and we humans cannot? What cruel destiny stops all people from seeing the world from above, tasting the clouds, and undoing long distances by air?"*

*—Captain Arsenio, June 7, 1783*

**distinguished** A distinguished group is known and respected for its excellence.

**eccentric** Someone who is eccentric is odd.

**circumstances** The way an event happened or the causes of it are its circumstances.

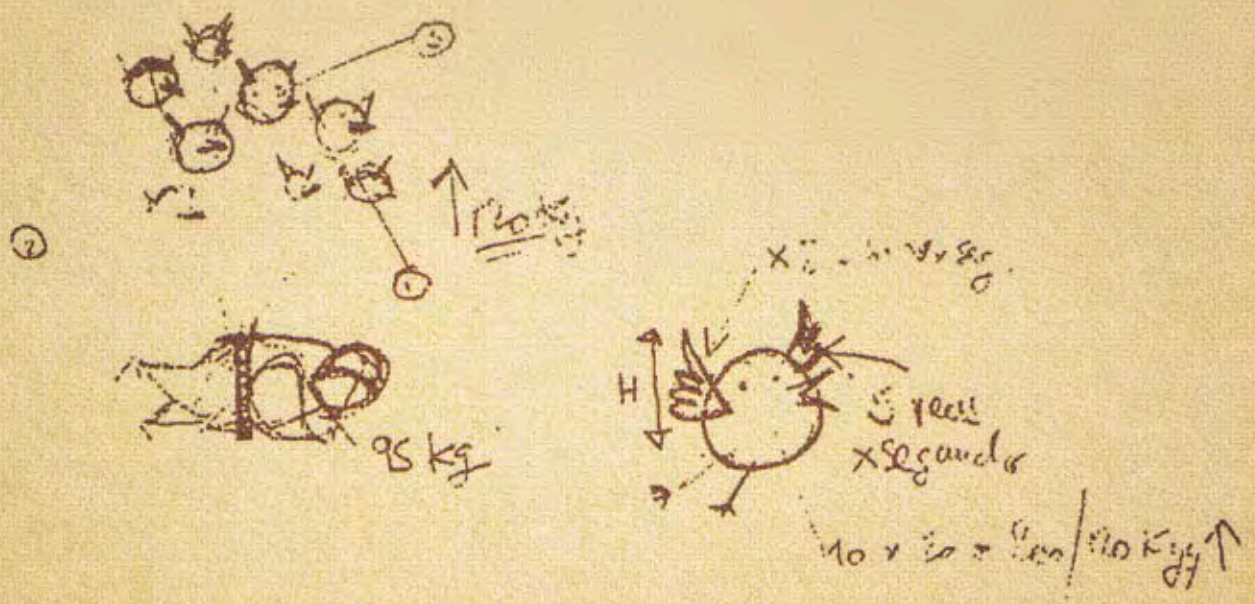
myNotes

## PROJECT NUMBER 1: **MOTOCANARY**

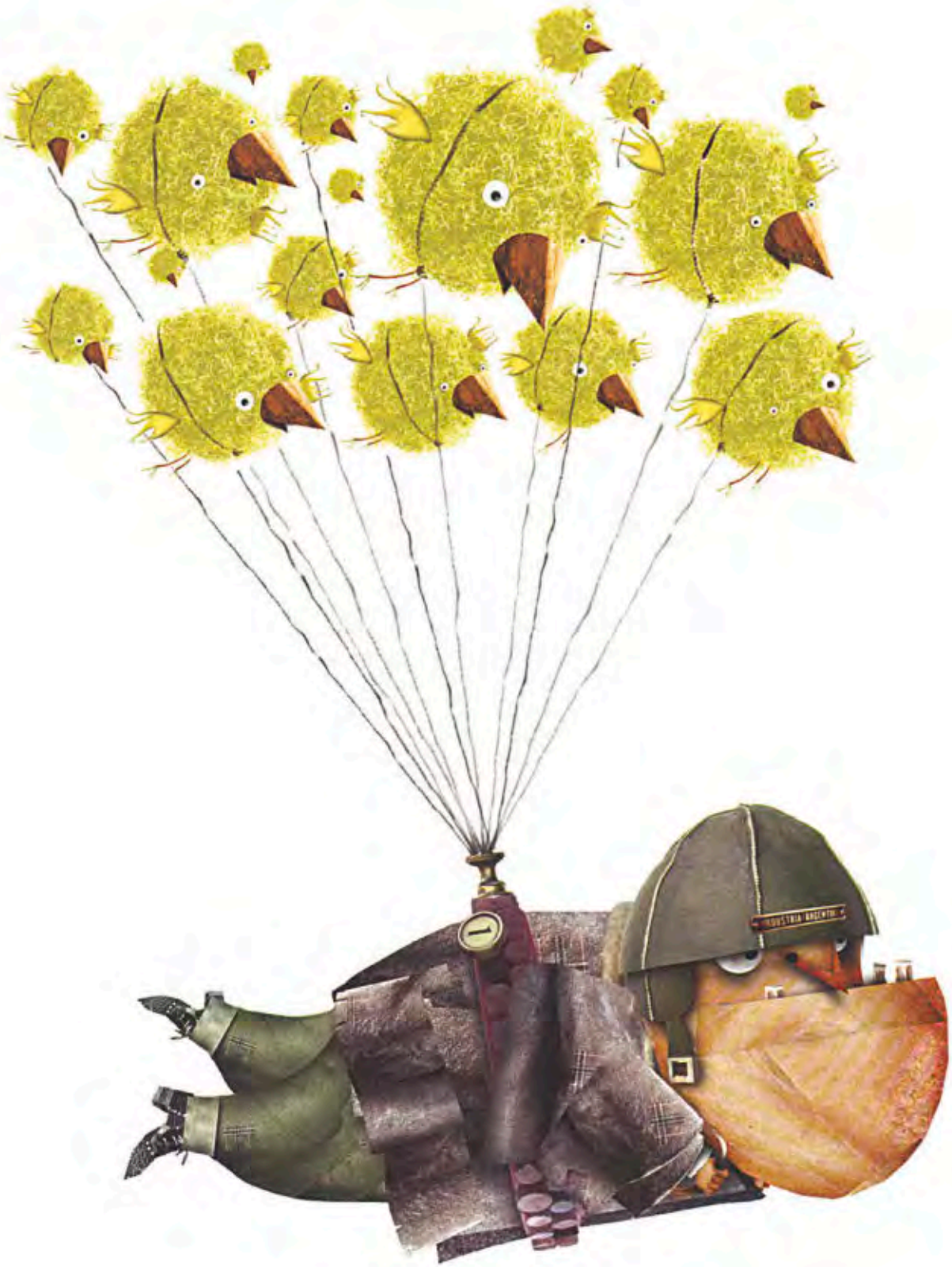
9 The Motocanary was an ingenious experiment that demanded a lot of work. Evidently, it was harder for Captain Arsenio to find enough birds and tie them together with a rope than it was to achieve flight. Although the discovery was revolutionary, it took two days to get the captain down from the tree in which he was stuck.

10 *"Carts are dragged along by horses, sleighs by dogs, and plows by bulls. I think that if I concentrate enough birds together, the sustaining force will help me win the clouds. It cannot fail!"*

*—Captain Arsenio, February 18, 1784*

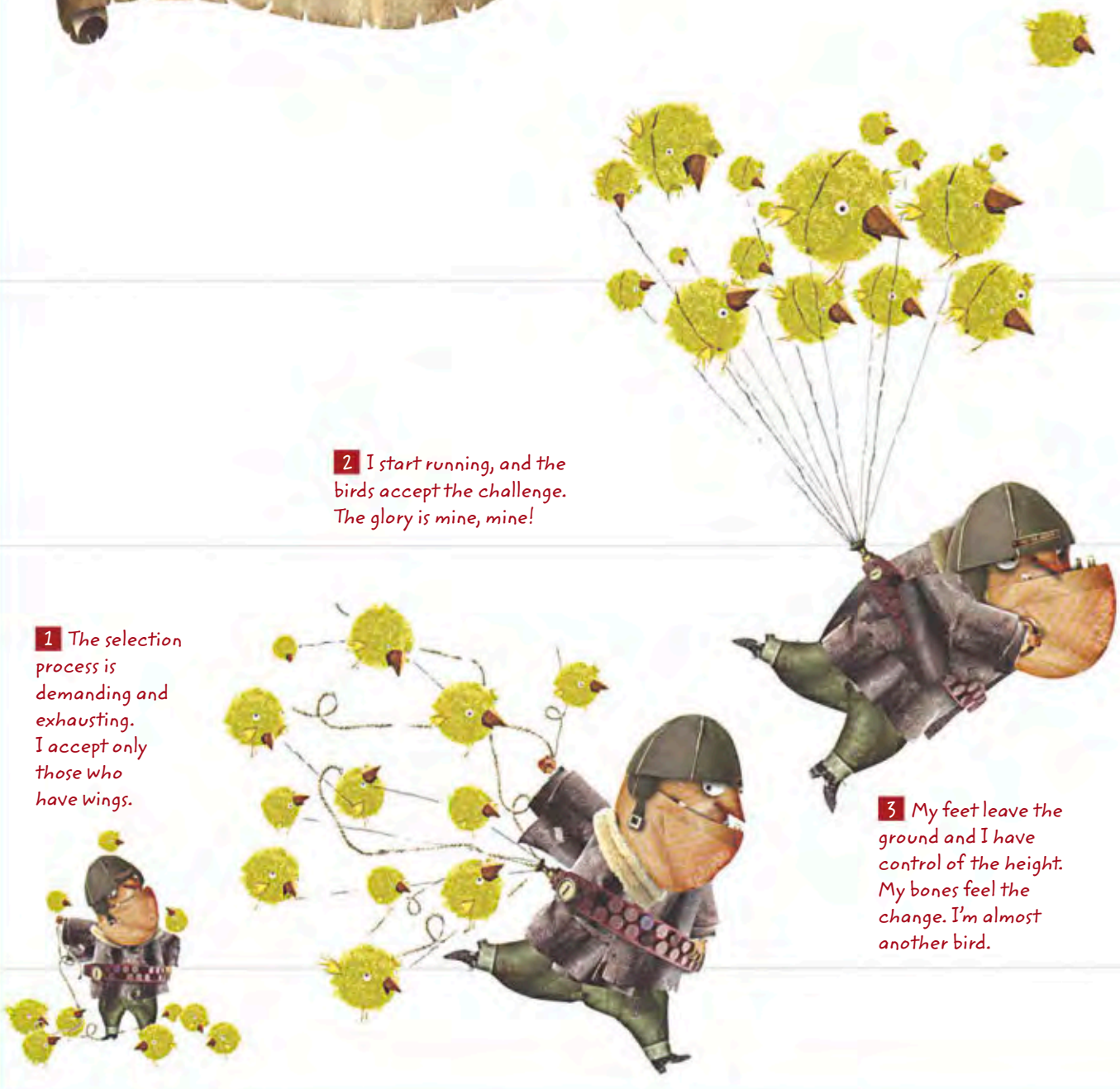



**evidently** If something happened evidently, it happened for an obvious reason.



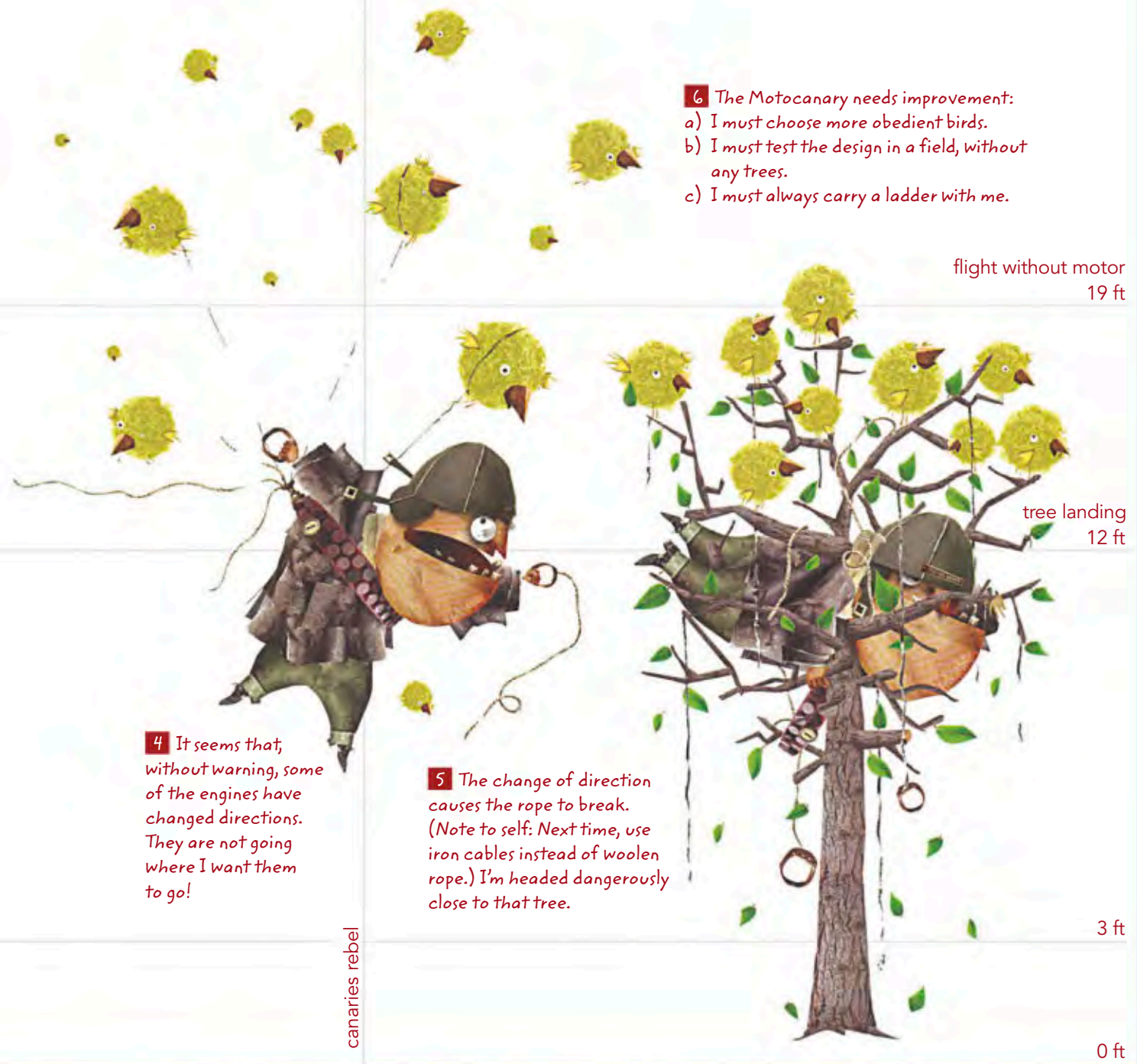
myNotes

# FLIGHT DIARY




**Phase 1:** 14 hrs **Phase 2:** 10 min **Phase 3:** 4.5 sec

**NOTE:** As improbable as it appears, this diary shows us that the Motocanary did fly for a few feet before crashing into a tree. Maybe the failure is due to Captain Arsenio's misplaced trust in the unreliable canaries.




**Phase 4:** 2 sec

**Phase 5:** 1 sec

**Phase 6:** total elapsed time: 2 days, 14 hrs, 10 min, 7.5 sec

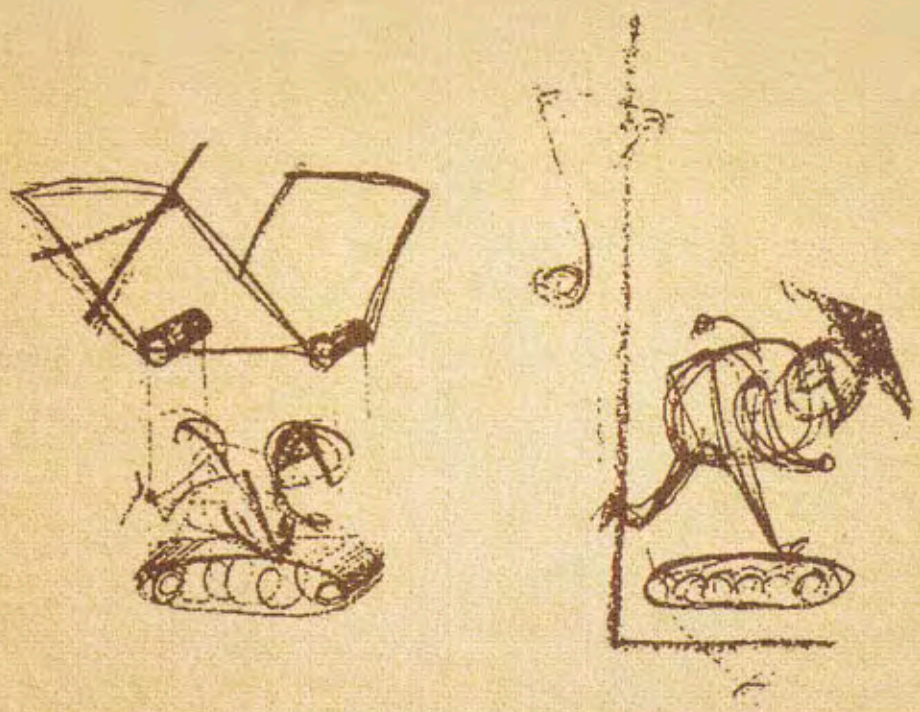
myNotes

## PROJECT NUMBER 2: **FLYING RUNNER**

11 Good cardiovascular health would become a determining factor in Captain Arsenio's second ambition. The acceleration of the runner would allow—according to his plans—the wings to beat up and down in imitation of a bird's flight and lift the machine off the ground. The direction control is unknown.

12 *"I can leave the ground by the effort of an energetic run, transferred to the little wings and multiplied thirty times by the transfer pulleys. Running + wings = access to heaven. It cannot fail!"*

*—Captain Arsenio, March 23, 1785*



**acceleration** Acceleration is the act of moving faster.

myNotes

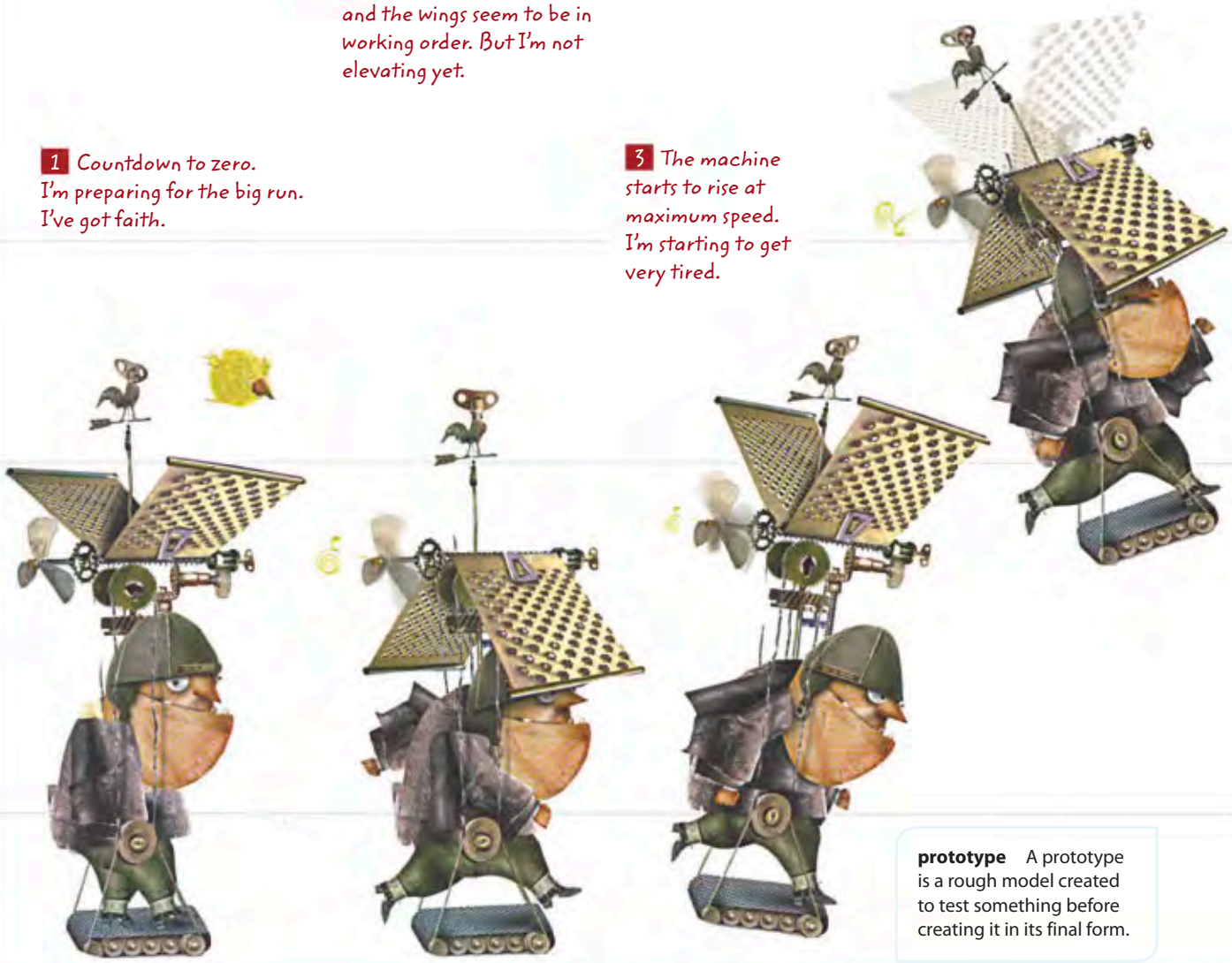
# FLIGHT DIARY

4 All systems go, the balance is controlled —the prototype is a success . . . up until this point.

2 I start the acceleration, and the wings seem to be in working order. But I'm not elevating yet.

1 Countdown to zero. I'm preparing for the big run. I've got faith.

3 The machine starts to rise at maximum speed. I'm starting to get very tired.



**prototype** A prototype is a rough model created to test something before creating it in its final form.

**Phase 1:** at rest **Phase 2:** 21 min **Phase 3:** 47 sec **Phase 4:** 1 min

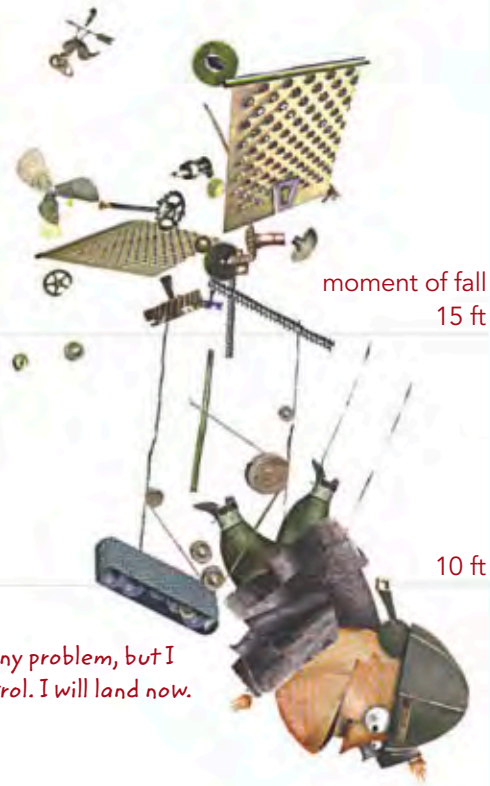
**NOTE:** The reader may notice that there are significant differences between what is written and what actually happened. This may be due to Captain Arsenio's unflagging optimism (or the many bumps on the head that he suffered from his experiments).

5 I hear some strange noises. They come from the pulleys.

maximum height
26 ft

6 There seems to be a small problem.

moment of fall
15 ft



7 Yes, there's a tiny problem, but I have it under control. I will land now.

10 ft

3 ft

danger moment

8 I need to call a doctor.

0 ft

**Phase 5:** 2 sec **Phase 6:** 17 sec **Phase 7:** 30 sec **Phase 8:** total elapsed time: 23 min, 36 sec

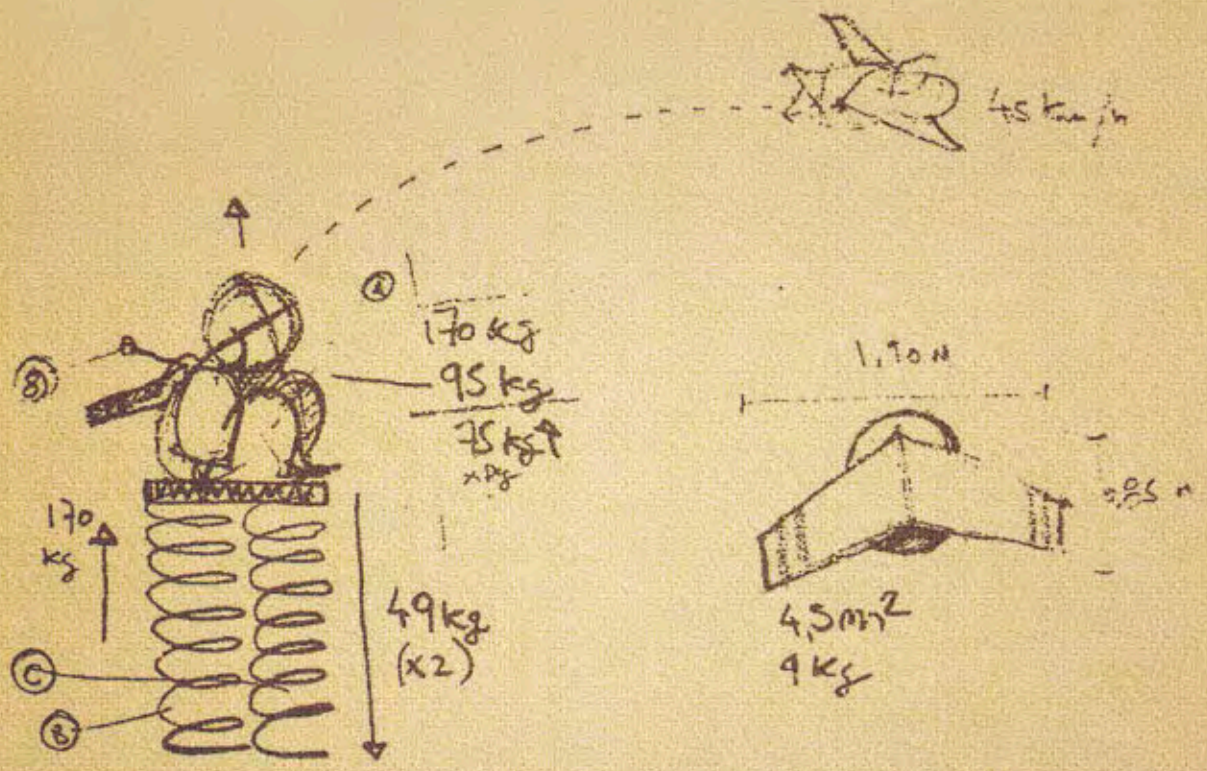
myNotes

## PROJECT NUMBER 3: **CORKSCREWPTERUS**

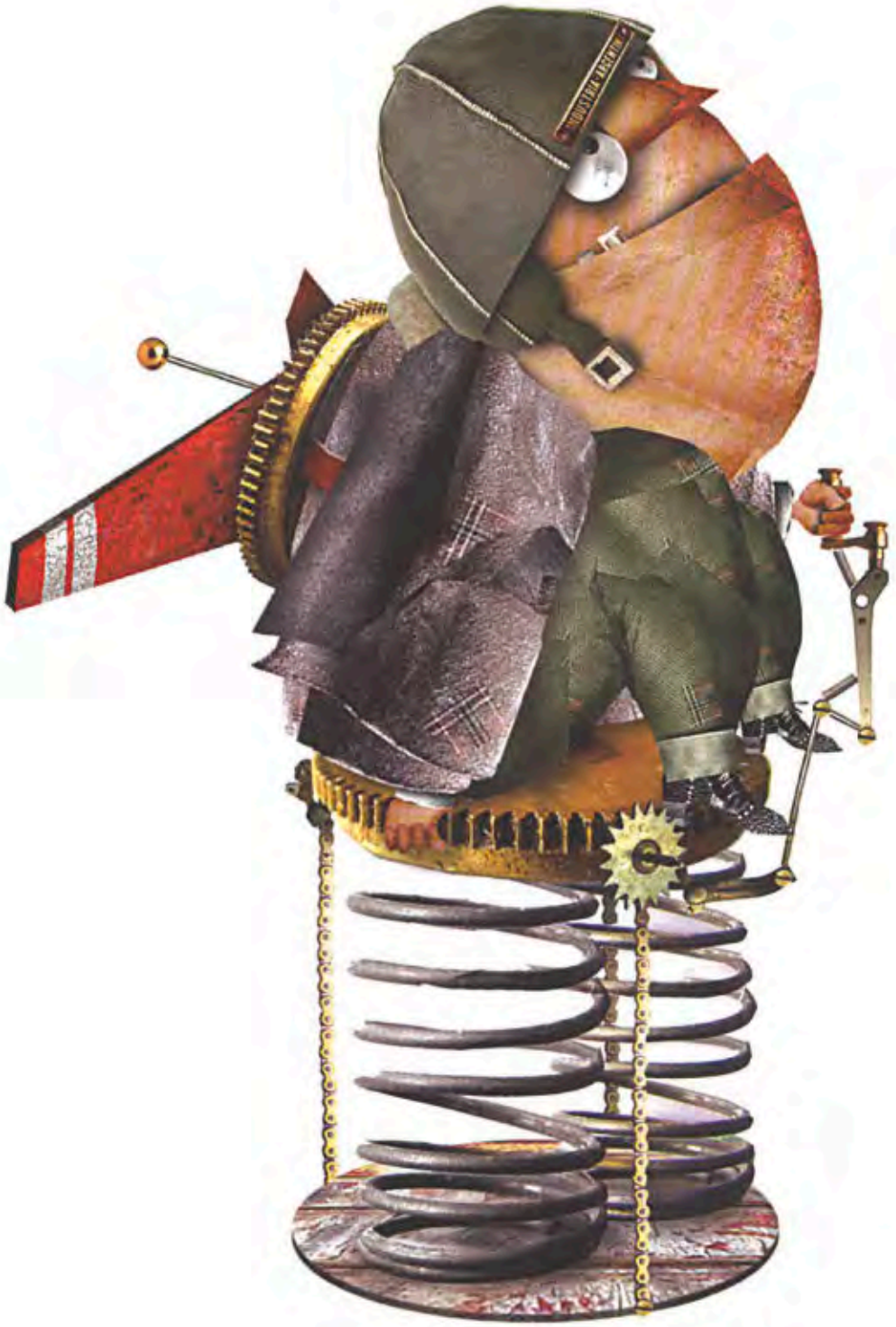
13 No one knows what was going through Captain Arsenio's mind when he conceived of this contraption. What we do know is that he placed so much emphasis on getting off the ground that he forgot a substantial part of the matter: how to keep himself in the air. Obvious results.

14 *"All past propelling mechanisms were wrong. I need to find a way to beat gravity, despite my generous weight. The compression of two metal springs should do the trick; I anticipate a big leap. But I will put little wings on my back, just in case. It cannot fail!"*

*—Captain Arsenio, November 15, 1785*




**conceived** If you thought of the idea to create something, you conceived it.



myNotes

# FLIGHT DIARY

1 Everything is ready for takeoff. The jump is possible.

2 I start the countdown: 10, 9, 8, 7, 6, 5, 4, 3, 2, 1.

3 Oh!!!! The acceleration is violent, and I've conquered gravity without any problems.

**Phase 1:** at rest

**Phase 2:** 10 sec

**Phase 3:** 3.5 sec

**NOTE:** This document is the only one of its kind; there is no other recorded data of a person surviving such a fall, either before or since.

maximum height unknown

myNotes

4 I've already passed through the clouds; I start the controlled descent.

5 Now it is time for the wings.

maximum *measured* height
208 ft

99 ft

6 Descent is completely under control, although the wings do not respond as I had expected.

50 ft

panic point

7 The doctor is not at home. I will call the veterinarian.

3 ft

0 ft

**Phase 4:** 1 min **Phase 5:** 1 sec **Phase 6:** 7.25 sec **Phase 7:** total elapsed time: 1 min, 21.75 sec

myNotes

# GOODBYE FROM BELOW

15 As it happens with almost all legends, multiple versions contradict one another, proof disappears, and word of mouth constructs stories that differ greatly from the reality. No one knows for certain exactly what happened to Captain Arsenio and his flying machines; all that is left is his diary—ninety pages of consecutive failures—and one big question: Did he eventually succeed?

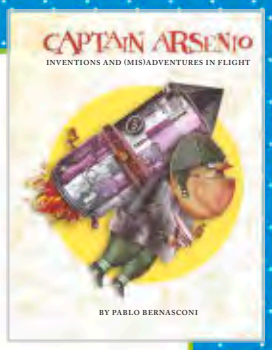
16 Some say that Arsenio's book was buried near Cairo, Egypt—7,508 miles away from where he lived in Patagonia, Argentina. Others disagree and tell us it was in a chest at the bottom of the sea, buried under a pile of rusty metal junk. But most people insist with determination that Captain Arsenio's diary was found on the surface of the moon on July 20, 1969.

17 *"Many years have passed since that first Motocanary.*
*Although I have failed many times, I have learned so much. And today, for the first time,*
*I am sure that this new machine I have developed is going to work.*
*I deserve a piece of heaven, and I am going for it!"*

*—Captain Arsenio, December 6, 1789*

Respond to the Text

# Collaborative Discussion




Look back at what you wrote on page 56. Tell a partner two things you learned during reading. Then work with a group to discuss the questions below. Support your answers with details from *Captain Arsenio*. Connect your ideas to what other group members say.

1. Reread pages 58–59. How has the narrator come to know so much about Captain Arsenio? What does the author seem to think of him?

2. What details might make readers think Captain Arsenio was a real person? What details show that he was not?

3. Review page 72. What hint does the narrator give that Captain Arsenio may have succeeded in his efforts to fly?

## Listening Tip

Listen carefully to the speakers, noting how they use text evidence to support their thoughts.

## Speaking Tip

Restate a speaker's idea, and then share information that builds on that idea.

Cite Text Evidence

# Write a Blog Post

## PROMPT

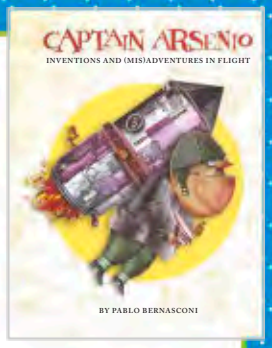
In *Captain Arsenio*, you read the story of a man who created inventions that he believed would allow him to fly.

Imagine that you witnessed one of Captain Arsenio's attempts to fly. Write an account of it for a web site blog called "Strange Things I've Seen" in which you tell about what you saw that day. Start by introducing Captain Arsenio with a topic sentence that tells who he is and what he does. Use details from the text to tell about the experiment you witnessed. Then write a conclusion that explains how the experiment ended up. Include descriptive words and phrases to help your readers picture your experience. Don't forget to use some of the Critical Vocabulary words in your writing.

## PLAN

**Make notes about Captain Arsenio's actions and other events that took place during his attempt to fly, including how it ended.**

## WRITE




Now write your blog post about Captain Arsenio's attempt to fly.

### Make sure your blog post

- ☐ includes a topic sentence that explains the situation.
- ☐ uses detailed evidence from the text.
- ☐ describes events in an order that makes sense.
- ☐ uses descriptive words.
- ☐ includes a conclusion.

Performance Task

Essential Question

# What kinds of circumstances push people to create new inventions?

## Write a Personal Narrative

**PROMPT** Think about how each inventor in this module used curiosity and determination to solve a problem.

Imagine that your class is putting together a collection of personal narratives called *Class Inventors at Work*. Write a personal narrative about a time when you found a creative way to solve a problem. Use the inventors in the texts as inspiration.

**I will write about the time when I** _____.

**Make sure your personal narrative**

- ☐ establishes that you are the narrator.
- ☐ draws inspiration from the selections in *Inventors at Work*.
- ☐ has an introduction that presents the setting and the problem.
- ☐ explains steps toward your solution in a clear sequence.
- ☐ uses concrete words and sensory details.
- ☐ has a conclusion that shows how the problem was solved.

## PLAN ..... Map your ideas.

Think about the problem you solved. What steps did you take? What challenges did you have to overcome? Look back at your notes and revisit the texts to help you brainstorm ideas for your narrative.

Use the story map below to plan your narrative. Identify your problem and the obstacles you faced. List in order the steps you took and how you overcame each obstacle. Then explain your solution and why it worked. Use Critical Vocabulary Words where appropriate.

**My Topic:** _____

| **Problem** | **Setting** |
| --- | --- |
| **Events/Steps** | |
| **Solution** | |

Performance Task

DRAFT ..... Write your narrative.

Write an **introduction** that clearly states your problem. Get readers interested in learning how you solved it!

Write **body paragraphs** that explain how you used creativity to solve your problem. Tell the steps in order and use a new paragraph for each one.

Write a satisfying **conclusion** that explains your solution.

## REVISE AND EDIT ..... Review your draft.

Now it's time to review your draft and make changes to improve it. Read your narrative to a partner. Ask your partner for suggestions to make it clearer and more interesting. Use these questions to help you evaluate and improve your narrative.

| PURPOSE/ FOCUS | ORGANIZATION | EVIDENCE | LANGUAGE/ VOCABULARY | CONVENTIONS |
|---|---|---|---|---|
| ☐ Does my narrative show how I used creativity to solve a problem?<br>☐ Does every paragraph tell about how the problem was solved? | ☐ Are the steps or events told in a clear sequence?<br>☐ Does the conclusion explain the solution to the problem? | ☐ Did I include examples and inspiration from the texts I've read about inventors? | ☐ Did I use concrete words and sensory details?<br>☐ Did I use transition words to connect my ideas? | ☐ Have I spelled all words correctly?<br>☐ Have I used commas and other punctuation marks correctly? |

## PUBLISH ..... Share your work.

**Create a Finished Copy.** Make a final copy of your personal narrative. You can include a photo or drawing of your solution. Consider these options for sharing your narrative:

1. Bind your narrative together with those of your classmates to create a *Class Inventors at Work* collection.
2. Hold an inventors' conference at which you and other students read aloud your narratives and respond to questions from the audience.
3. Create an audio recording of your narrative. Read with expression to keep your listeners engaged. Make the recording available on a school website or media blog for others to listen and respond to.