

BUILDING HOMES FOR ALL

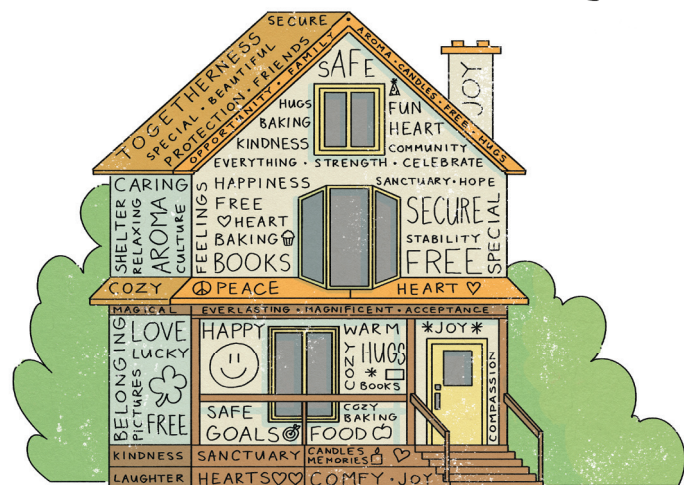
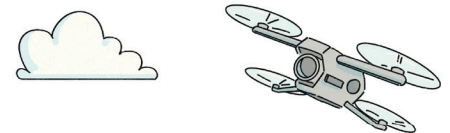
TEACHER GUIDE

Around the world, people urgently need safe, affordable homes—and our planet needs climate solutions now! In *Building Homes for All*, young readers discover why housing matters for our health and well-being. They explore cutting-edge technologies that offer hope and solutions for the housing and climate crises and meet trailblazers who are pioneering a global movement in building automation. They'll learn about the challenges that come with innovation and the importance of teamwork in solving complex problems. This teacher's guide extends the book's learning, sparking classroom discussion and inspiring students to imagine careers in clean, green and smart construction.

PRE-READING DISCUSSION QUESTIONS:

Use these questions to activate background knowledge and excite students about the subjects of housing and health, construction and the environment, construction automation and careers.

1. What do you already know about how housing and homelessness affect our health?
2. What is your reaction to this statement? "All homeless people are drug addicts." Students should think about their response, then chart it on a continuum labeled "strongly agree," "agree," "disagree" and "strongly disagree." Then, students turn to a partner to share their reasoning. The teacher then leads a respectful class discussion to reveal students' opinions. This exercise can be repeated after reading the book to determine if their opinions have changed.
3. How do you think construction affects our environment?
4. What do you imagine when you picture buildings being made in factories?
5. Before reading chapter 3, "Our Tech Powered Partners" examine the illustration on pg. 24. Name three details from the illustration that are interesting to you. How do these details connect to building homes cheaply, safely and sustainably? What questions does this illustration raise about building homes?



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6. What do you know about robots? What are you uncertain about when it comes to robots? What comes to mind when you hear the word exoskeleton? Do you think exoskeletons are robots?
7. Think, Pair, Share: Think about a time you collaborated with someone (or a group of people) to accomplish something you hadn't done before. How did each person contribute to the success of the task? If you used technology to assist you, how did it help you be successful?
8. Before you begin reading this book, write your personal opinion about what it would be like to have a career in construction. Consider the following questions:
 - Did you ever think of construction as a STEAM (science, technology, engineering, art and math) career?
 - Does working with the latest clean, green smart technology make construction a more or less exciting career option? Explain your answer.

POST-READING DISCUSSION QUESTIONS:

Use these questions to summarize the book's key ideas and allow students to reflect on what they learned.

1. Now that you have read this book, revisit your answer to the Pre-Reading Discussion Questions. Has this book changed your understanding? Explain your answer.
2. Has reading this book changed your opinion about working in construction? Explain your answer.
3. Do you feel more or less hopeful that solutions are possible for the housing shortage and climate crisis? Explain your answer.
4. When you read about the inventors in this book, what skills, knowledge and attitudes do you think make them great inventors?

POST-READING ACTIVITIES:

Use these activities to build upon students' knowledge and extend learning.

Get STEAMing

- Go to a nearby school, a library makerspace or a camp to learn about 3D printing.
- 3D-print a robot or drone and enter your design in an engineering challenge. Or search online for Poppy Project, a community-centered robotic project. Anyone can join for free and build a Poppy robot.

Get Building

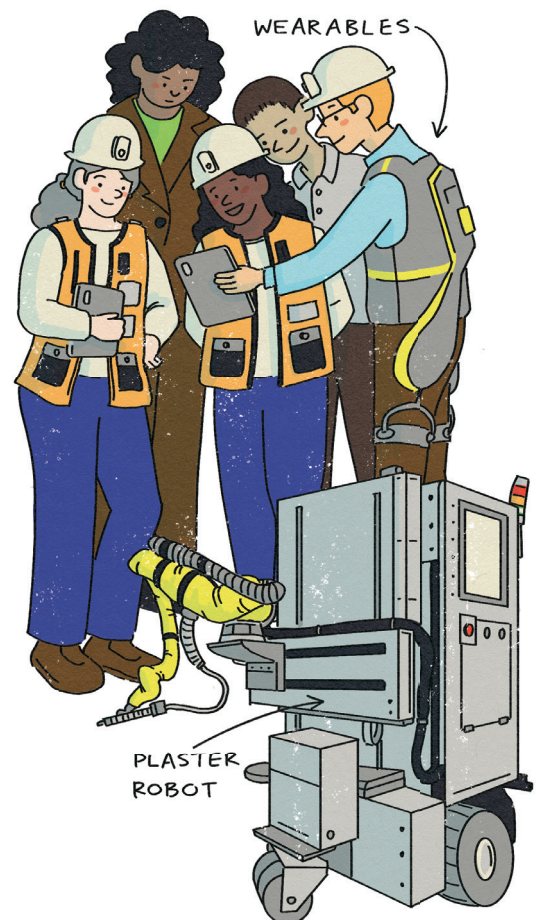
- Ask your teacher if your class can build a tiny home.
- Volunteer with Habitat for Humanity or another organization to help build tiny homes.

Get Writing

- Build a word cloud to capture how tech innovation is shaping the future of housing construction.

Get Careering

- Modern construction uses smart, green technology. Why do experts think automating construction will be a more exciting career option for kids like you? Flip back through this book and think about which jobs and technologies you'd like to know more about. Ask your teacher to invite an expert to your classroom to talk about their jobs and the technologies they use to build homes.



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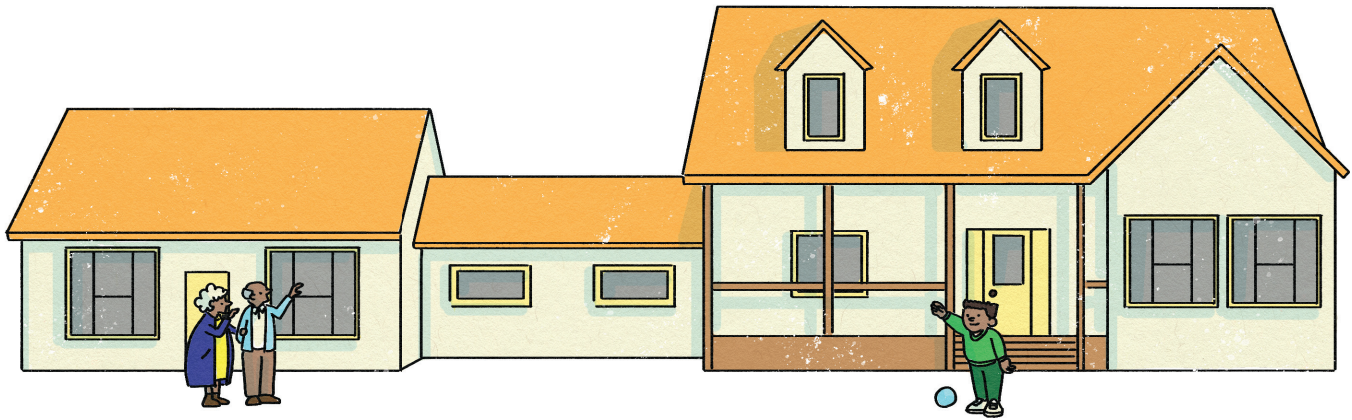
INTRODUCTION

DISCUSSION QUESTIONS:

1. According to the United Nations Human Settlements Program (UN-Habitat), how many new affordable homes need to be built every day until 2030 to meet the world's housing needs?
2. Building and construction pollute the environment. What percentage of the world's carbon dioxide emissions is this sector responsible for?
3. The world is facing a housing shortage and a climate crisis; what needs to happen to fix these problems?

ACTIVITIES:

1. After reading the introduction, what are you most curious to learn more about in the rest of the book? Write a short paragraph explaining why.
2. The author talks about the construction site of the future. Describe or draw an illustration of what you think the construction site of the future might look like.



CHAPTER 1

DISCUSSION QUESTIONS:

1. What does the phrase “social determinants of health” mean? Why is housing a “social determinant of health”?
2. What is Finland doing to reduce homelessness? Why is this country's work important?
3. “Affordable housing” and “housing affordability” sound almost the same, but they mean different things. What do they each mean? Compare and contrast these terms.
4. The United Nations says, “Housing is a human right.” What does this mean?
5. On page 6, three students write about what home means to them. In just a few words, what is the main idea of each of their poems? What do they each think home represents? Who has similar ideas about home? Whose ideas differ?
6. Having a good home is critical for a person's health—their physical, social and mental well-being. What examples does the author provide? Can you think of other ways that health is impacted by housing?
7. On page 7, the author uses a metaphor to compare life without a clean, safe home to swimming upstream. How is trying to swim against a strong current like living without a comfortable home? What figurative language (similes or metaphors) can you use to illustrate the impacts of inadequate housing or homelessness?
8. Examine the picture on page 10. What details do you see in this picture? What does this picture make you wonder about how kids are impacted by their housing situations?



ACTIVITIES:

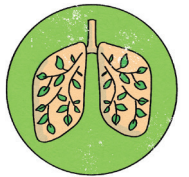
1. A common proverb states, “Home is where the heart is.” It means the concept of home is not a physical place, but a place where one feels emotions like love, comfort and caring. How would you define the meaning of home? Create a poem or proverb to express your ideas about what makes a house a home.
2. On page 8, have a look at how the illustrator shows the connections between the social determinants of health. Create your own illustration to show how you think the social determinants of health are connected.



CHAPTER 2

DISCUSSION QUESTIONS:

1. Use evidence from the text to explain how old building methods contributed to the affordable housing and climate crises.
2. How are old ideas a barrier to solving homelessness and housing problems? What are the three main reasons construction is behind other industries when it comes to automation?
3. What are common myths about why people are homeless? How are these myths a barrier to solving the problem? Explain three reasons why people might become homeless.
4. What is zoning? Why are zoning rules a barrier to building affordable housing?
5. Examine the picture and caption on page 17. Floods are one kind of natural disaster that could contribute to homelessness. What are some others? How does climate change impact affordable housing and the issue of homelessness?
6. Zoning laws and building codes can contribute to housing issues, but they also provide important regulations. What benefits do zoning laws and building codes provide for a community? What are their drawbacks?
7. On page 19, the author gives examples of middle housing. In your own words, define the term “middle housing.” Why is building middle housing so important for addressing the affordable housing crisis?
8. Review pages 20-21 and summarize three ways that governments have contributed to homelessness and a lack of affordable housing. Then explain five ways that governments could help to build more affordable housing if they did things differently. Thinking about where you live, use additional resources to learn about how federal, state or provincial and local governments worked together to solve a housing problem.
9. The author suggests eight changes that need to occur to fix the housing crisis. In your opinion, which change would be the most difficult to accomplish? Why do you think that? Which might be the easiest to achieve? Why?



ACTIVITIES:

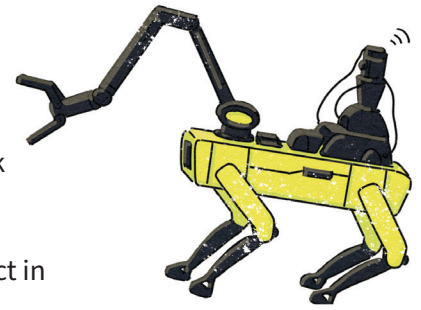
1. Write a letter to a leader in your government explaining some of the reasons that contribute to the affordable housing crisis and three things that you think they should do to fix the problem.
2. Collaboration between governments and organizations is one way of preventing the affordable housing crisis. Think about a problem that is important to you in your community. Research this issue and interview experts to understand the problem. Use upstream thinking to suggest prevention strategies. Then create an infographic to teach others about the issue and how it might be prevented through collaboration and innovation. Get fundraising! Consider raising money and awareness to help address this problem.
3. Look at page 22. Imagine it is members of your own family who could not move in because of NIMBYism. How would you convince that neighbor to say YIMBY—“yes, in my back yard”? Draft a friendly letter explaining how building additional housing is important to your family and the community using facts from the text and other sources. Be persuasive



CHAPTER 3

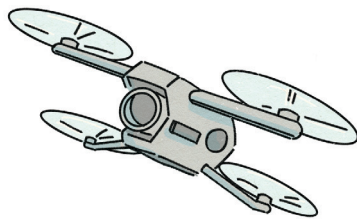
DISCUSSION QUESTIONS:

1. Robots are similar to humans because they are autonomous—they can sense, compute and act! How do humans and robots sense, compute and act in different ways? Include specific body parts and mechanical parts that do the work of sensing, computing and acting.
2. Pick two of your favorite robots from the book and explain why you chose these examples. Create a chart to demonstrate how these robots sense, compute and act in order to build houses better.
3. Explain why the sense, compute, act process continues in a circle instead of ending at a point.
4. Compare and contrast virtual reality (VR), mixed reality (MR) and augmented reality (AR). How are they similar? How are they different?
5. What are the two main types of exoskeletons? How are they similar? How are they different?
6. Are active exos like Apogee and Cray X robots? How do you know? What facts prove your position?
7. What is Building Information Modeling? How does it help construction teams?
8. What are the benefits of various technologies being used together? What concerns should we keep in mind as we adopt new technologies?
9. What is the National Zoning Atlas? Why is this tool important?



ACTIVITIES:

1. Imagine you were working with Atlas on a construction site. Write a story about the pros and cons of working with a humanlike robot like Atlas.
2. If you were designing an exoskeleton what are some questions that you would ask the user to make sure that it's comfortable? How might the Caplex robotic system make your job easier?
3. Think about a job or task that you have to do that is either difficult (e.g., carrying your backpack), repetitive (e.g., writing your name on papers), dangerous (e.g., playing goalie) or boring (e.g., cleaning your room). Design a robot that will sense, compute and act to make the task easier or safer for you. Create an advertisement to convince other kids this technology will improve their lives.
4. Create awards for robots in the book. Which robot would win an award for building the fastest? Which one makes building the safest? Which one is best at reducing the cost of building affordable homes? Which one would win for being the most environmentally sustainable? Be sure to use at least one amazing fact as proof of each robot's greatness!



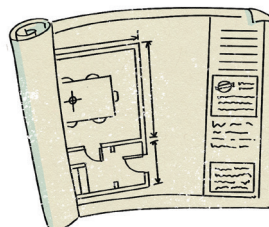
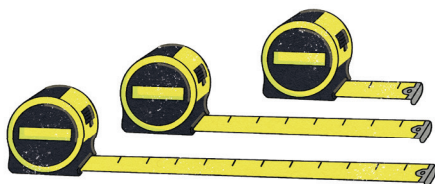
CHAPTER 4

DISCUSSION QUESTIONS:

1. How does mass timber differ from traditional wood? What are the benefits of mass timber over traditional lumber?
2. Pages 44 and 45 outline the process wood undergoes to first become mass timber, then become a home. Both technology and humans are needed for this process. Create a t-chart to name how technology and humans contribute to building homes with mass timber.
3. How does building with mass timber benefit humans economically, environmentally and in their health and well-being?
4. Biophilia can be broken into two parts: the prefix bio meaning “life or living things” and philia meaning “love of,” “fondness for” or “tendency toward.” How does this enhance or support your understanding of the term?
5. What must be done to ensure building with wood, especially mass timber, is a sustainable process?
6. Explain the carbon loop cycle and discuss why mass timber is part of this cycle. Use the glossary to help explain the terms.
7. Debate: On page 50, in the section titled “Hype or Help?” the author asks the question, “Are the promises of mass timber too good to be true?” Students should choose a perspective: “Yes, mass timber is a sustainable building material” or “No, mass timber is not a sustainable building material.” Using this book and other resources students should collect facts to explain their choice. Then, students can brainstorm in small groups to come up with reasons to support their point of view. Afterwards, host an informal debate where students share their ideas. After hearing the different sides, ask if any students would like to change their opinion. If yes, what was the most compelling reason for changing their point of view?
8. Rank the following building materials in terms of safety and sustainability from safest to least safe and greenest to least green: traditional wood, mass timber, steel and concrete. Be sure to justify your ranking.
9. What is the tallest mass timber building in the world so far? How much CO₂ does this building store?

ACTIVITIES:

1. In order for mass timber to be used more widely for building affordable and sustainable homes, the cost, environmental footprint and training must be improved. What technologies could help? How can they be used to make this work easier, safer and greener? Review the robots, exoskeletons and other innovations that you learned about in chapter 3 to get your ideas flowing! Write a paragraph to share your thoughts.
2. How do you think mass timber could address a housing need in your community? Create a presentation that teaches others in your class about mass timber and how it could add to affordable, sustainable housing in your community.



CHAPTER 5

DISCUSSION QUESTIONS:

1. In 1997, Behrokh Khoshnevis invented the first modern example of mega-scale 3D printing for construction. How might previous innovators like Charles Hull and William E. Urschel have influenced him?
2. What are the two main types of 3D construction printers? What is a well-known example of each one? Briefly explain each one, including how they differ.
3. 3D printing houses is efficient and fast. Name three ways innovators are working to ensure it is sustainable.
4. Massimo Moretti, the founder of WASP, wants to build “homes that coexist with the environment, not destroy it.” Is he achieving his goal? What facts can you use as support?
5. What makes NASA’s role in 3D construction printing so important?
6. Morten Bove, the CEO at WOHN Homes, thinks we should “change our view of housing.” What is Morten’s view of housing? Summarize his opinion in a sentence or two. (Hint: Try using this sentence starter, “Morten Bove believes houses should be...”)
7. Look at the section called “Help or Hype?” What examples are given to prove 3D-printed buildings are helping those in need?
8. Government minister, Ina Scharrenbach, and Fabian Meyer-Brötz, PERI 3D’s managing director, are very excited about using the BOD2 to 3D-print Europe’s first social housing apartment. Why are they so excited?
9. The author provides some examples of projects that are using sustainable 3D-printing materials including low-carbon concrete, bio-based materials, raw earth, clay and upcycled plastics. Briefly explain why these projects are so exciting.
10. 3D construction printing is a promising solution for building affordable, sustainable housing. Explain why. In your answer be sure to discuss five factors that experts are working on to make sure 3D construction printing continues to have a promising future.

ACTIVITIES:

1. Review the images of 3D-printed houses and the texts that describe them. Then visit the companies’ websites to see more interior and exterior images. Which building would you prefer to live in? Why? What improvements would you consider making to the original design? Sketch out a design that highlights the benefits of your choice over other 3D printed or traditionally built houses.
2. How do you think 3D printing could address a housing need in your community? Create a presentation that teaches others in your class about 3D printing and how it could add to affordable, sustainable housing in your community.
3. If you were given a million dollars to invest in either mass timber or 3D-printed building technology, which would you choose to have the greatest positive impact on people and the environment? Why? Write an essay and give at least two reasons for your choice. Support each reason with facts from chapters 4 and 5.
4. Have you ever 3D printed something? What steps did you take to create your finished product? What challenges did you face?



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CHAPTER 6

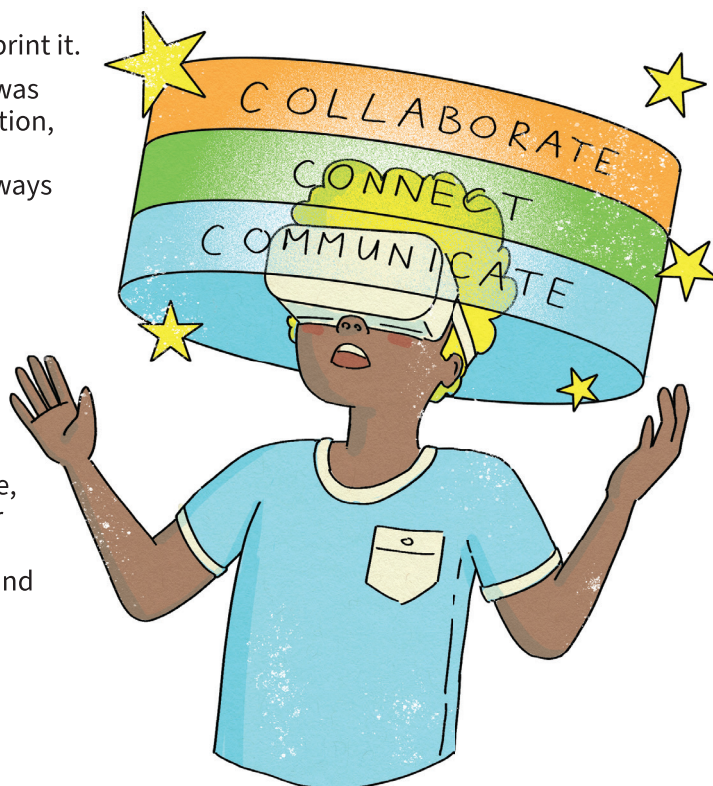
DISCUSSION QUESTIONS:

The author provides examples of how innovation happens when you have teamwork, technology and innovators using many technologies and building materials.

1. The first example is titled, “Warm and Cozy.” Why do you think the author chose this title?
2. The first-ever mass-timber affordable-housing project was built in Ontario to house 41 previously homeless women. How did the architects adjust their designs to meet the needs and wants of the women who would live there?
3. In the Model for Others example on page 72, what does the BC government hope to achieve with the MTDP?
4. The building project in Vancouver, at the corner of Main and Cordova Streets will house Indigenous Peoples as well as Chinese and Japanese Canadians, among others. What approach did the team use to guide the building’s design? Why did the team use this approach? How did this approach affect the design?
5. In the 3D-Printed Homes for Youth example, the team worked patiently through a lot of trial and error. In the end, they were successful. Explain why you think they were successful.
6. On pages 77–78, there are two examples of how 3D printing is providing humanitarian aid—one in Africa (Malawi and Kenya) and one in Ukraine. What do these projects have in common? How are they different?
7. What does Kakatoosoyiists mean in Siksikáí’powahsin? What is the cultural significance of the word, according to the text? Is this a good name for a housing project that assists members of the community who are at risk of homelessness? Why or why not?
8. On page 79 is a section titled “Just the Beginning.” What is the purpose of this part? How does it fit into the overall organization of this book?

ACTIVITIES:

1. Imagine your dream home. Create a design in CAD and 3D-print it.
2. In the example 3D-Printed Homes for Youth, collaboration was key to the success of the project. Create a visual representation, possibly a flow-chart or idea web, to show the various collaborators, their reasons for joining the project and the ways they contributed to the success of the project.
3. The author shows how the needs and wants of various groups shape the designs of each building project. Identify a specific group in your community (like the elderly, young families, people with physical or sensory impairments or people living in poverty) that would benefit from safe, affordable housing. Please make a list of what you think someone would want or need in their home. Then do some research to understand this community better—for example, interview people in the group or those who support it. After learning more, revise your original list to reflect what you learned through your research. Design a prototype in CAD and 3D print.



ABOUT THE CREATORS OF THIS GUIDE:

Andrea Jarr Gordon, MA Ed, middle school teacher, is passionate about literacy and inspiring learners worldwide. With over 25 years of education experience in public and private schools across North America, Asia, Europe and the Caribbean, her diverse teaching background reflects a commitment to fostering a new generation of empathy-driven and globally-minded critical thinkers.

Karoline Jarr, Ph.D, STEM Educational Consultant, consults with forward-thinking organizations in the areas of learning, assessment and STEM. She has had an exciting career in education and helped found Broomfield STEM, a volunteer-driven Colorado nonprofit that offers community-based STEM programming.

STANDARDS ALIGNMENT

COMMON CORE STATE STANDARDS

Grade 4: ELA.RI.4.1-3,7-9; W.4.1-2,7-10; SL.4.1-4; L.4.4,5

Grade 5: ELA.RI.5.1-3,7-9; W.5.1-2,7-10; SL.5.1-4; L.5.4,5

Grade 6: ELA.RI.6.1-4,6-9; W.6.1,2,4,7-9; SL.6.1; L.6.4,5; RST 6-8.1,2,4,5,7

Grade 7: ELA.RI.7.1-4,6-9; W.7.1,2,4,7-9; SL.7.1; L.7.4,5; RST 6-8.1,2,4,5,7

NEXT GENERATION SCIENCE STANDARDS

Grade 4 and 5: 3-5 ETS 1-1, 3-5 ETS 1-2, 3-5 ETS 1-3,

Grade 6 and 7: MS ETS 1-1, MS ETS 1-2, MS ETS 1-3, MS ETS 1-4, 5-ESS3-1



ABOUT THE AUTHOR:

Elaine Kachala is the award-winning author of *Superpower? The Wearable-Tech Revolution*. With over 20 years as a health policy writer and advisor, degrees in psychology and sociology (University of Toronto), and a master's degree in environmental studies (York University), Elaine brings a unique perspective to STEAM topics. She hopes to write books that inspire young readers to learn about real-life inventors who are unafraid to dream big while thinking critically about health, social and ethical issues. Housing for health and well-being is her passion, both personally and professionally. She lives with her family in Toronto.



ABOUT THE ILLUSTRATOR:

Catherine Chan is a Toronto-based illustrator with a previous life in project management and technology. Her work explores her relationships as an immigrant, a mother and a lifelong learner, and acts as both self-exploration and self-declaration. She is excited about telling unique and inspiring stories through her illustrations.



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