

# THE SCIENTIFIC PROCESS

## STEP 1: OBSERVE

**SHARPEN AND HONE YOUR OBSERVATIONAL SKILLS!**

What is going on in the world around you? Note everything you see and experience!

## STEP 2: QUESTION

**WHAT BAFFLES YOU?** Find something that intrigues you and study it with all your heart!

## STEP 3: INVESTIGATIVE RESEARCH

Grab your magnifying glass and your decoder ring—you're going to be investigating! You'll be researching your questions, and **RESEARCH IS FUN, FUN, FUN!**

## STEP 4: HYPOTHESIS

**A HYPOTHESIS IS AN EDUCATED GUESS!** And since you're all educated and good at guessing, this step is perfect for you!

## STEP 5: PROCEDURE

Time to create a plan of action! How will your experiment work? Take a moment to lay out your steps.  
**REMEMBER: PLANNING MAKES PERFECT!**

## STEP 6: EXPERIMENT

**TIME TO TEST THOSE HYPOTHESES!** Sometimes we learn more when we're open to surprises!

## STEP 7: RESULTS

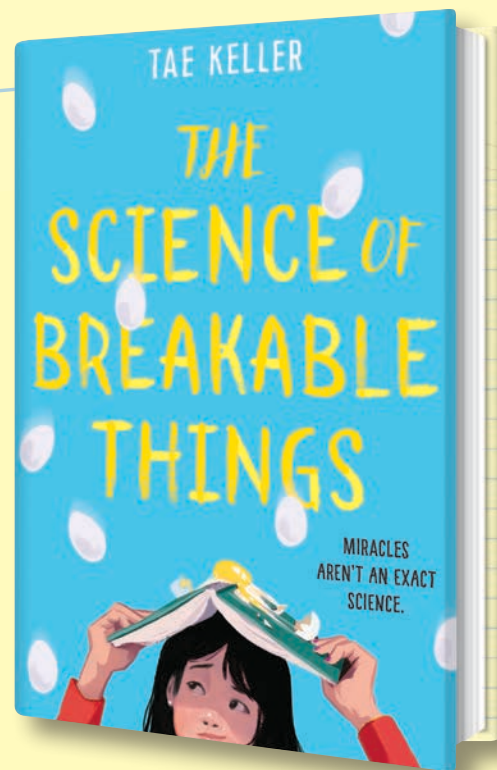
All your hard work has paid off! Now reap your rewards! **RECORD THE RESULTS OF YOUR EXPERIMENTS.**

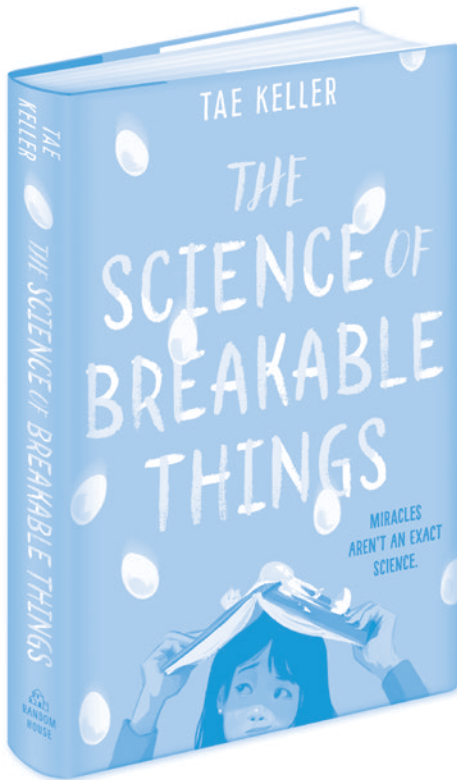
## STEP 8: ANALYZE YOUR RESULTS

**WHAT CAN YOU LEARN FROM YOUR RESULTS?** What would you do differently?  
Your journey exploring, investigating, and experimenting is really just beginning!

**"SCIENCE IS ASKING QUESTIONS. AND LIVING IS NOT BEING AFRAID OF THE ANSWER."**

—*The Science of Breakable Things* by Tae Keller





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# THE SCIENCE OF BREAKABLE THINGS

## Educators' Guide

### ABOUT THE BOOK

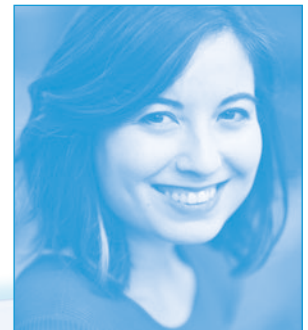
Natalie Napoli is in middle school when things spiral out of control. Her mom, a botanist, is suffering from depression; her dad, a therapist, is struggling to maintain the household; and she and Mikayla, her childhood best friend, have grown apart. When Mr. Neely, her science teacher, introduces the eight steps of the scientific process, Natalie can only concentrate on the mysteries of her own life. Then she enters an egg drop contest with Twig, her new best friend, and Dari, a science enthusiast from India. Natalie has big plans for the prize money, something she believes could help her mom toward recovery. When they fail to win, Natalie launches a new plan that reveals a big surprise and offers an uplifting ray of hope for her family.

★ **“A COMPASSIONATE GLIMPSE OF MENTAL ILLNESS ACCESSIBLE TO A BROAD AUDIENCE.”** —*Kirkus Reviews*, Starred

★ **“FOR FANS OF *THE THING ABOUT JELLYFISH* COMES A CLEVER DEBUT COMBINING SCIENCE WITH A TOUGH TOPIC.”** —*Booklist*, Starred

### ABOUT THE AUTHOR

TAE KELLER grew up in Honolulu, Hawaii, where she wrote stories, ate spam musubis, and participated in her school's egg drop competition. (She did not win.) After graduating from Bryn Mawr College, she moved to New York City to work in publishing, and now has a very stubborn Yorkie and a multitude of books as roommates. Visit her at [TaeKeller.com](http://TaeKeller.com), follow her on Twitter at [@TaeKeller](https://twitter.com/TaeKeller), and be sure to sign up for her newsletter at [bit.ly/taekellernews](http://bit.ly/taekellernews).



Saeveira Photography

### PRE-READING ACTIVITY

Review the eight steps in the scientific process:

STEP 1: OBSERVE • STEP 2: QUESTION • STEP 3: INVESTIGATIVE RESEARCH • STEP 4: HYPOTHESIS  
STEP 5: PROCEDURE • STEP 6: EXPERIMENT • STEP 7: RESULTS • STEP 8: ANALYZE YOUR RESULTS

Divide the class into small groups and ask them to conduct an egg drop experiment. Provide various materials for them to consider for their experiment: cereal, bubble wrap, packing peanuts, and other types of packing materials. Have the groups record information about each step of their experiment.

● Correlates to Common Core State Standards in Science & Technical Subjects: Key Ideas & Details RST.6-8.3; Writing: Text

## CLASSROOM DISCUSSION

- Discuss the structure of the novel. How do the eight steps slowly reveal information about the characters, conflict, and plot? What do the footnotes contribute to the story?
- In Step 1, Mr. Neely asks students to observe. What do readers observe about Natalie from the entries in her lab notebook? (pp. 5–6) Discuss Natalie’s feelings about Mr. Neely, Mikayla Menzer, and Twig. How does she hint about the conflict of the novel?
- Mr. Neely says that Step 2 in the scientific process is to question. He wants his students to investigate something that intrigues them. What questions does Natalie have about family and friendship?
- Define friendship from Natalie’s point of view. She and Mikayla had been good friends when they were younger. What went wrong? How do friendships sometimes change in middle school? Natalie says that friends know which topics to avoid. Which subjects do Natalie and Twig avoid?
- Natalie’s new best friend is Twig. Compare and contrast their families. How do they both feel abandoned? Describe the girls’ relationships with Dari. How do they need him as much as he needs them? Explain why Twig and Dari make Natalie the leader of their team for the egg drop competition.
- A euphemism is a word or phrase used in place of a word that may be harsh or hard to hear. For example, Natalie’s father calls her mother “a situation.” (p. 19) He is a therapist. Why does he feel he must use a euphemism to refer to his wife’s condition? How does Natalie feel about her mother’s depression? How might Natalie benefit from a more straightforward discussion with her father?
- Natalie’s mom is a botanist. How does Natalie compare her mom’s condition to that of plants? Natalie writes in her lab journal, “I want to say to her: Come back.” (p. 26) Where does Natalie think that her mother has gone? Her mom wrote a book titled *How to Grow a Miracle*. Why is Natalie intent on reading her mother’s writing?
- What is the significance of the Cobalt Blue Orchid? How does pursuing the orchid give Natalie hope? Discuss Natalie’s reaction when she learns that the blue plant in their greenhouse was not a Cobalt Blue Orchid but a Bearded Blue Iris. She later questions her mom about why she planted the iris. Explain what her mother means by “we deserve a second chance.” (p. 279)
- Explain why the Korean Fire is the perfect Christmas gift for Natalie’s mom.
- Why does Natalie throw eggs at the plants in the greenhouse? Explain why Natalie’s father calls Twig to come over.
- Natalie says, “For a moment I felt like a scientist, gathering little bits of research about myself and trying to analyze it.” (p. 196) Identify the characters that directly or indirectly help her with the research. At what point in the novel does Natalie really begin to analyze her family situation? What conclusion does she draw?
- Betrayal is a topic that is mentioned throughout the book. Why does Natalie think that Mrs. Menzer betrayed her mother? Cite other examples of betrayal in the novel.
- Natalie’s father is half Korean. Dari is Indian. Contrast the way they view their ethnicities.
- What does Natalie learn about life from Operation Egg? Explain the following quote: “Because science is asking questions. And living is not being afraid of the answer.” (p. 292)
- Explain the title of the book. What is the unbreakable thing?

● The discussion questions above correlate with Common Core State Standards in Reading Literature: Key Ideas & Details RL. 5-7.1, 5-7.3; Craft & Structure RL. 5-7.4, 4-7.6; Speaking & Listening: Comprehension & Collaboration SL. 5-7.1, 5-7.3; Language: Convention of Standard English L. 5-7.1; Knowledge of Language L. 5-7.3; Vocabulary Acquisition & Use L. 5-7.5.

## CURRICULUM CONNECTIONS

STEM!

- “Assignment 4: Plants Are People, Too” reveals that Natalie’s mom is a botanist. She has always told Natalie that plants are a language. Use books in the library or sites on the Internet to research the symbolism of various plants. **The following site is helpful: [almanac.com/content/flower-meanings-language-flowers](http://almanac.com/content/flower-meanings-language-flowers).** Then select a plant that one character in the novel may give to another. Have students write a paragraph that explains their choices and cite specific scenes or conversations from the book to support their reasoning.

● Correlates to Common Core State Standards in Writing: Text Types & Purposes W. 5-7.2; Research to Build & Present Knowledge W. 5-7.7, 5-7.9; Correlates with Common Core State Standards in Reading Literature: Key Ideas & Details RL. 4-6.1, 4-6.3; Craft & Structure RL. 4-6.4, 4-6.6; Speaking & Listening: Comprehension & Collaboration SL. 4-6.1, 4-6.3; Language: Convention of Standard English L. 4-6.1; Knowledge of Language L. 4-6.3; Vocabulary Acquisition & Use L. 4-6.5.

- Idioms are commonly used phrases in which meaning is garnered not from individual words but from the expression as a whole. Often, that meaning is far removed from any literal definition. What does Natalie’s father mean when he tells her that the family needs to “tighten our belt a notch.” (p. 6) Discuss the meaning of the following common idioms:

“A penny for your thoughts”

“Add insult to injury”

“Back to the drawing board”

“Ball is in your court”

“Barking up the wrong tree”

“In the heat of the moment”

“Make a long story short”

“Every cloud has a silver lining”

- Ask students to pick an idiom and write a paper that discusses where in the book the phrase could be used. Which character is most likely to use it and in what situation?

● Correlates to Common Core State Standards in Language: Vocabulary Acquisition & Use L. 5-7.5; Writing: Production & Distribution of Writing W. 5-7.4.

- Natalie’s father is a therapist. Research the skills a good therapist needs: [goodtherapy.org/become-a-therapist/skills-needed.html](http://goodtherapy.org/become-a-therapist/skills-needed.html). Cite evidence from the book and write a paper discussing whether you think Natalie’s father is a good therapist. What challenges might a therapist face when counseling his own family?

● Correlates to Common Core State Standards in Writing: Text Types & Purposes W. 5-7.2; Research to Build & Present Knowledge W. 5-7.7, 5-7.9.

- Five scientists that started their work as teenagers are Isaac Newton, Albert Einstein, Galileo Galilei, Aristotle, and Blaise Pascal. Ask students to research one of these scientists and write a biographical entry for a book called *Teenage Scientists*. Include a discussion of the scientific investigation that made them famous.

● Correlates to Common Core Standards in Writing: Text Types & Purposes W. 5-7.2; Research to Build & Present Knowledge W. 5-7.7; Language: Convention of Standard English L. 5-7.1, 5-7.2; Knowledge of Language L. 5-7.3.

STEM!

- Marie Curie and her husband won the Nobel Prize in Physics in 1903. And in 1911, she won the Nobel Prize in Chemistry. Ask students to research the number of women and men who have won the Nobel Prize in various areas of science from 1901 to 2017 ([nobelprize.org](http://nobelprize.org)). Then have them construct a bar graph that compares the figures by year. What is the ratio of female to male prizewinners? Discuss the findings, and whether or not this is surprising to students.

● Correlates to Common Core Standards in Writing: Research to Build & Present Knowledge W. 5-7.7; Science & Technical Subjects: Integration of Knowledge & Ideas RST 6-8.7.

## CURRICULUM CONNECTIONS (CONTINUED)

STEM!

- Natalie is upset when she learns that she and her mother never had a Cobalt Blue Orchid in their greenhouse. Have students research blue orchids in the library and online. How are they cultivated? Ask students to conduct their own plant or flower experiment. Bring in some type of white flower. Provide various food colorings. Follow the eight steps of the scientific process, and discover the effect of food coloring on your flowers. How much dye does it take to turn a white flower a different color? Does more food coloring create darker colors? How long does the process take? Record the process and results in a science journal.

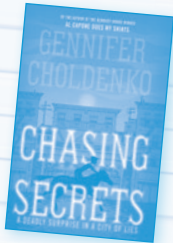
● Correlates to Common Core State Standards in Science & Technical Subjects: Key Ideas & Details RST 6-8.3; Writing: Text Types & Purposes W. 5-7.2.

## VOCABULARY/USE OF LANGUAGE

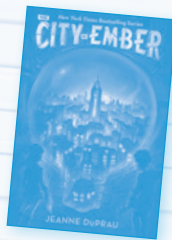
- Students should be encouraged to jot down unfamiliar words and try to define them, taking clues from context. Such words may include: *optimistic* (p. 4), *pretense* (p. 17), *amicably* (p. 20), *conflicted* (p. 41), *velocity* (p. 74), *illusion* (p. 95), *indecipherable* (p. 95), *intimidating* (p. 99), *siphon* (p. 113), *initiative* (p. 123), *oblivious* (p. 146), *averted* (p. 157), *morphed* (p. 225), *anomaly* (p. 260), and *confiscated* (p. 273).

● Correlates to Common Core State Standards in Language: Vocabulary Acquisition & Use L. 4-7.4.

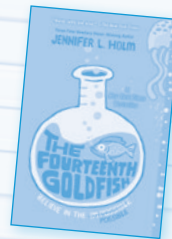
## RELATED NOVELS WITH STEM CONNECTIONS



**CHASING SECRETS**  
Gennifer Choldenko  
PB: 978-0-385-74254-2



**THE CITY OF EMBER**  
Jeanne DuPrau  
PB: 978-0-375-82274-2



**THE FOURTEENTH GOLDFISH**  
Jennifer L. Holm  
PB: 978-0-375-87114-6



**FUZZY MUD**  
Louis Sachar  
PB: 978-0-385-37022-6



**THE GREAT TROUBLE**  
Deborah Hopkinson  
PB: 978-0-375-84308-2



**HOOT**  
Carl Hiaasen  
PB: 978-0-440-41939-6



**THE MANY WORLDS OF ALBIE BRIGHT**  
Christopher Edge  
HC: 978-1-5247-1357-7



**THE CASE OF THE MISSING MOONSTONE**  
(The Wollstonecraft Detective Agency, Book 1)  
Jordan Stratford;  
illustrated by Kelly Murphy  
PB: 978-0-385-75443-9

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