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

rhcbooks.com
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 chef, is struggling to maintain the household, and she and Mikaya, 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 SCIENCES WITH A TOUCHY TOPIC.” —The Bulletin, starred

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: EXPERIMENT • STEP 6: DATA • STEP 7: RESULTS • STEP 8: ANALYZE YOUR RESULTS

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

“Make a long story short” “Every cloud has a silver lining”

• Five scientists that started their work as teenagers are Isaac Newton, Albert Einstein, Galileo

• Natalie’s father is a therapist. Research the skills a good therapist needs: goodtherapy.org/become-a

Grades 3-7 • F&P: V • Lexile: 840L

ABOUT THE AUTHOR

TAE KELLER grew up in Honolulu, Hawaii, where she wrote stories, ate spam musubi, and participated in her school’s egg drop competition. (She didn’t win.) After graduating from BYU Mazer College, she moved to New York City to work in publishing, and now has a very stubborn Ninja and a multitude of books as roommates. Visit her at TaeKeller.com, follow her on Twitter at @TaeKeller, and be sure to sign up for her newsletter at bt.ly/taeKellernews.

CURRICULUM CONNECTIONS

• “Assignment 4: Plants Are People, Too” reveals that Natalie’s mom is a botanist. She has always
told Natalie that plants are 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

• 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)

• Students should be encouraged to jot down unfamiliar words and try to define them, taking clues from
their context. Such words may include:

  • assignment
  • betrayed
  • compromised
  • misled
  • sniped

• 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?

• Natalie’s father is a therapist. Research the skills a good therapist needs: goodtherapy.org/become-a
therapist/skills-needed.html. Cite evidence from both book and research discussion where you think Natalie’s father is a good therapist. What challenges might a therapist face when counseling his own family?

• Five scientists that started their work as teenagers are Isaac Newton, Albert Einstein, Galileo
Gallilei, 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.

• 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). 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.

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), amissly (p. 20), conflicted (p. 41),
velocity (p. 74), illusion (p. 95), indecipherable (p. 95), intimidating (p. 99), siphon (p. 113), initiate (p. 123), oblivious (p. 146), overfit (p. 157), morphed (p. 225), amused (p. 290), and confiscated (p. 273).

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, Mikaya 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 Mikaya had been good friends when they
were younger. What were 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?

• 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
my family. It was like analyzing 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 answers.” (p. 292)

• Explain the title of the book. What is the unexpected thing?

RELATEd NOVELS WITH STEM CONNECTIONS

• 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
different colors? Does more food coloring create darker colors? How long does the process take?
Record the process and results in a science journal.

• Related novels with STEM connections:

- The Fourteenth Goldfish by Jennifer L. Holm
- The City of Ember by Gennifer Choldenko
- The Great Hotel Fire by Christopher Edge
- How to Grow a Miracle by Louis Sachar
- The Great Trouble by Deborah Hopkinson
- The Toughest Dog in Town by G. M. Berenice
- The Many Worlds of Jerry Hopkins by Timothy Zahn
- The Cats of the Missing Mountain by Max Brunsdon

- The animation of gardening from the book to support their reasoning.

- STEM! A guide to using non-fiction books to相连 correspondence: Key Ideas & Details RST. 6-8.3; Text Types & Purposes W. 5-7.2;

- Research to Build & Present Knowledge W. 5-7.7, 5-7.9.

- Science & Technical Subjects: Integration of Knowledge & Ideas RST. 6-8.7.

- English L. 5-7.1, 5-7.2; Knowledge of Language L. 5-7.3.

- Vocabulary Acquisition & Use L. 5-7.5.
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 chemist, 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.

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FOR FANS OF THE THING ABOUT JELLYFISH COMES A CLEVER DEBUT CONTINuing SCIENCES WITH A TOUCH MORE." —Booklist, starred

THE SCIENCE OF BREAKABLE THINGS
Educators’ Guide

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 extra types of package materials. Have the groups record information about their results, and each type of package used.

STEP 1: OBSERVE

Record the process and results in a science journal.

STEP 2: QUESTION

Back to the drawing board

STEP 3: INVESTIGATIVE RESEARCH

Add insult to injury

STEP 4: HYPOTHESIS

Ball is in your court

STEP 5: PROCEDURE

A penny for your thoughts

STEP 6: EXPERIMENT

Add insult to injury

STEP 7: RESULTS

Add insult to injury

STEP 8: ANALYZE YOUR RESULTS

Add insult to injury

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 Monrez, and Twig. How does he 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? 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 mom has gone? Her mom wrote a book titled How to Grow a Mime. 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 the experiment a success. (p. 156)

• What does Natalie learn about life from Operation Egg? Explain the following quote: “Life is a mystery.” (p. 195) 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 says, “For a moment I felt like a scientist, gathering little bits of research about myself and ruminating analysis.” (p. 196) Identify the characters that directly or indirectly help her with her 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 answers.” (p. 292)

• Explain the title of the book. What is the unbelievable thing?

Students should be encouraged to jot down unfamiliar words and try to define them, taking clues from context. Such words may include: amicably (p. 4), pretexts (p. 17), amissly (p. 20), conflicted (p. 41), velocity (p. 74), illusion (p. 95), indecipherable (p. 95), intimidating (p. 99), siphon (p. 113), initiative (p. 125), oblivious (p. 146), overwrought (p. 157), merited (p. 225), anomaly (p. 290), and confounded (p. 273).

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VOCABULARY/USE OF LANGUAGE

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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 chef, 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.

*FOR FANS OF THE THINGS ABOUT JELLYFISH COMES A CLEVER DEBUT COMBINING SCIENCES WITH A TOUCHY TOPIC.*

ABOUT THE AUTHOR

TAE KELLER grew up in Honolulu, Hawaii, where she wrote stories, ate spam musubi, and participated in her school's egg drop competition. (She did not win.) After graduating from Beyn Maser College, she moved to New York City to work in publishing, and now has a very stubborn irishie and a multitude of books as roommates. Visit her at Taekeller.com, follow her on Twitter at @Taekeller, and be sure to sign up for her newsletter at t.ly/taekellynews.

CLASSROOM DISCUSSION

• Discuss the structure of the novel. How do the eight steps slowly reveal information about the characters, conflict, and plot? What does 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, Monkey, 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. See 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? Discuss 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.

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• 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 mom has gone? Her mom wrote a book titled How to Grow a Mumtaz. Why does Natalie interest 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 really analyzing 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 answers.” (p. 292)

• Explain the title of the book. What is the unbelievable thing?

PRE-READING ACTIVITY

Review the eight steps in the scientific process.

1. Observe.
2. Ask questions.
3. Investigate research.
4. Hypothesize.
5. Create materials.
6. Experiment.
7. Record results.
8. Analyze 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 extra types of packaging materials. Have the groups record information about their experiment and conclusions.

VOCABULARY/USE OF LANGUAGE

• 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
  • Back to the drawing board
  • Ball is in your court
  • Ball is in your court
  • Ball is in your court
  • Backing the wrong horse
  • Make a long story short
  • Every cloud has a silver lining

  • “Penny for your thoughts”
  • “Ball is in your court”

  • “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?

• Natalie’s father is a therapist. Research the skills a good therapist needs: goodtherapy.org/become-a-therapist. 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.

VOCABULARY/Acquisition & 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), ostensibly (p. 20), conflicted (p. 41), velocity (p. 74), illusion (p. 95), indecipherable (p. 95), intimidating (p. 99), cipher (p. 113), initiative (p. 128), oblivious (p. 146), avert (p. 157), mesmerized (p. 225), anonymity (p. 260), and confiscated (p. 279).

CURRICULUM CONNECTIONS

• 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 symbiosis of various plants. The following sites are helpful: almanac.com/content/flower-meaning-flower-names, flowers.com, and about.com. Then select a plant that one character in the novel might 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.

CURRICULUM CONNECTIONS (CONTINUED)

• 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 flower. 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.


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 Mikyala, 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* ~ William Arens, Sr.

FOR FANS OF THE THINGS ABOUT JELLYFISH COMES A CLEVER DEBUT COMBINING SCIENCES WITH A TOUGH TOPIC.* ~ Andrew, Senior

PRE-READING ACTIVITY

Review the eight steps in the scientific process: 1. Observe, 2. Question, 3. Hypothesize, 4. Research, 5. Predict, 6. Experiment, 7. Results, 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 (eggshells, bubble wrap, packing peanuts, and extra types of packaging material). Have the groups record their data about each group's egg drop; then compare results.

VOCABULARY/USE OF LANGUAGE

- 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”
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