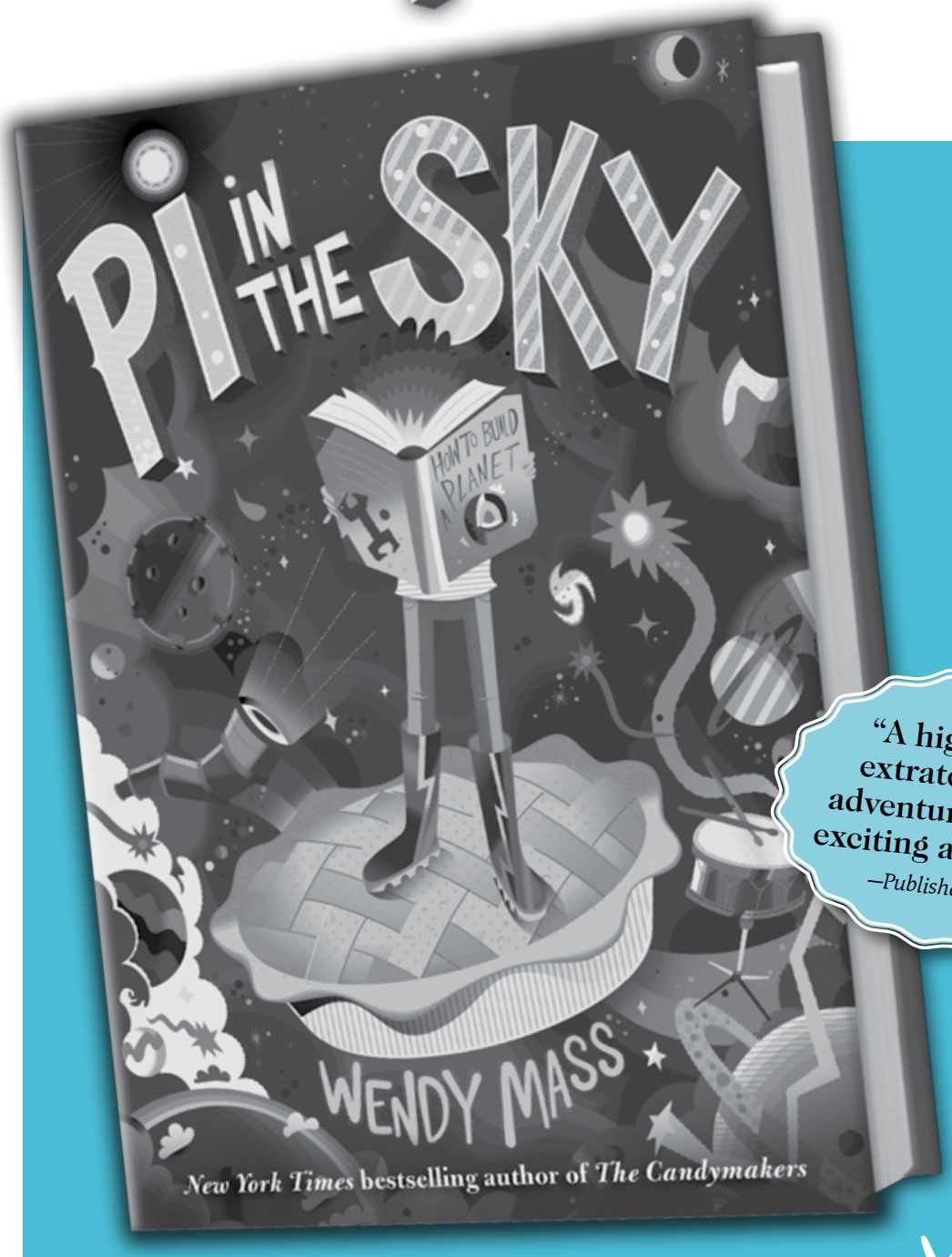
educator's guide

PI IN THE SKY



curriculum connections

- Adventure
- Science Fiction
- Family

Ages 8 to 12

"A high-stakes extraterrestrial adventure that's as exciting as it is fun."
—*Publishers Weekly*

by WENDY MASS

DISCUSSION GUIDE

Chapters 1, 2, and 3

What job does Joss have? How is this different from the jobs of his brothers? How does Joss feel about his role?

Joss and Kal are friends. What is Kal like? How does Joss describe their friendship?

What happens if someone from another planet observes The Realms? What do the PTB usually do when a planet is destroyed?

What is the relationship like between Joss and his father? Use evidence from the text to support your thinking.

Joss says, "We have been raised to believe that in the grand scheme of things, one planet doesn't matter. *Can't* matter." Why do you think they were taught this in The Realms? Do you agree or disagree with this view?

Chapters 4, 5, and 6

Why, according to Gluck, did Kal disappear?

When Joss first meets Annika, what is his impression of her? Use specific details to support your answer.

Do you think Gluck and the Supreme Overlord (Dad) were sensitive to Joss and his feelings? How did they respond to the disappearance of Kal and the arrival of Annika?

What does Gluck think Joss needs to do in order to save humanity (and fantasy football)? How does Joss feel about this? Explain.

Chapters 7, 8, and 9

How does Joss react to Annika's vision board? How is his view of the future different from hers?

Why do you think Annika's bracelet disappeared? What is Aunt Rae's explanation? What do you predict might happen to Annika?

Why is it important for Annika to continue to believe she is dreaming? What information does Gluck provide that supports this?

Chapters 10, 11, and 12

What is important about the holofilms on the data dots? Why does Aunt Rae take one? What is the consequence of this action?

Why does throwing water on Annika help her breathe?

Do you think Joss has a positive self-image?

How does he describe himself? How does he describe his job? Use specific details from the text to support your answer.

What character traits does Annika have? Use specific examples from the book to support your thinking.

While looking in the mirror outside of the Afterlives, Annika notices that she has cherry pie in her teeth. She says to Joss, "What kind of friend doesn't tell another friend when they have pie in their teeth?" Do you think this is a good way to determine if someone is a friend? Why or why not?

Chapters 13, 14, and 15

What is the relationship like between Joss and his brother, Ty? What does Ty do when Annika is pulled through the wall? What does this reaction show about Ty's personality?

How do the simulations in the Afterlives work? Use details from the text to support your answer.

What is Annika's reaction when Joss refers to humans as primitive? Based on his explanation, in what ways is Earth primitive? In what ways is it advanced? Annika offers several examples to try to convince Joss that humans are not primitive. What examples would you use? What happens when Annika and Joss enter Carl Sagan's simulation? What does Annika do? What is the result of her actions?

Carl Sagan tells Joss that Earth is worth saving. What reasons does he give? Do you think he makes a good argument? How are his reasons different from the ones Annika gave earlier?

Chapters 16, 17, and 18

As Joss leaves Aunt Rae's house, she tells him, "You can do more than you think you can." What do you think she means? How much do you think she knows? What evidence from the story helps you draw this conclusion?

Why does Joss want to discover which chemicals are in Annika's body? What does Ash suggest is the best way to collect these samples? What does Annika think of that idea?

How would you describe Ash's personality? Use evidence from the book to support your answer.

Chapters 19, 20, 21, and 22

Where does Joss find the empty box of data dots? Who does he think took them? Why is this hard for him to accept?

Joss seems to know exactly what to do to form the Sun. What does he learn from Thade that helps explain why he can create the Sun? How does this new knowledge help him understand his mother's earlier comment that he does more than deliver pies? What is his job?

Why did Bren take the data dots and sabotage the formation of the Sun? Do you think Joss will forgive his brother? Why or why not?

Why did Kal's parents give Annika's father the telescope? What reasons do they give for their actions? Do you think they are good reasons? Explain.

Chapters, 23, 24, and 25

In what ways has Annika helped people in The Realms change? How has she helped Joss?

What does Joss have to give up in order to get Kal back and restore Earth and its solar system? How do you think this decision will affect his life?

Chapter 26

Why do you think Joss tries to avoid hearing updates about Annika? Why does he say, "It hurts to think about it?" What does he mean?

How does Annika use the Afterlives for her own purposes? What does she do? Why does she do it?

Looking back, which character do you think showed the most growth and development? Use specific examples from the book to support your opinion. What events or experiences helped this character grow?

ENGLISH LANGUAGE ARTS

BUILDING BACKGROUND

Science or Fiction?

Sometimes science can be stranger than fiction. Within the pages of *Pi in the Sky* are references to some generally accepted scientific principles, mention of some currently theorized, but never observed phenomenon, and a few ideas that would likely only be taught to graduate students in quantum physics. There are real places mentioned that sound like they are straight from a science fiction movie (Sombrero Galaxy, Cygnus Galaxy, Andromeda). Of course, there are also fictitious places, such as The Realms themselves.

To help students make sense of which parts are science and which parts are science fiction, have students create a Field Guide to The Realms. Before reading, create a list of places, ideas, and names from the book for students to think about, such as the Sombrero Galaxy, Cygnus Galaxy, quarks, Fangstrich, dark matter, and white holes. Write these on cards. Ask students to tell whether they think each "fact" is science or fiction, by sorting the cards into two piles. Then, ask students to choose one or two to research. If it is fictitious, then students should tell how it relates to *Pi in the Sky* after reading the novel. If it is real, though, they should write a brief report about the place or the concept. All of the research reports can then be bound together to create a Field Guide to The Realms. This can be a reference tool for future students as they read, or a great resource for students to refer to after reading. Discuss how science can be stranger than fiction. How did their ideas change after their research? A sample set of cards is included in this guide. Feel free to use them or design your own.

CAUSE AND EFFECT

Cause and Effect Log

Despite Newton's claim saying for every action there is an equal and opposite reaction, in *Pi in the Sky*, seemingly small actions can have major effects. Since cause and effect play such an important role in *Pi in the Sky*, have students keep a Cause and Effect Log while reading. They should identify the major events, state what caused them, and then reflect on how this led to the next event. Students should try to record as many cause/effect relationships as they can, using evidence from the book to support their ideas. After they have finished their logs, reflect as a class on how one decision can lead to major consequences.

VISUALIZATION

Picture This

The Realms change at the whim of its residents, so there are many opportunities to visualize scenes from the story. Have students choose a particular setting from the story that captured their imagination, and then have them draw what they pictured. Students should be able to support their visualization by pointing to specific evidence in the text.

Powerful Quote Vision Board

Authors are often inspired by the words of others. Wendy Mass, the author of *Pi in the Sky*, shares a number of quotations that helped her frame her thinking as she was writing. Annika created a vision board showing her dreams for the future. Give students the chance to create their own vision board and explore the words of people who inspire them. To do this, they should search for quotations that are meaningful to them. They may already have some in mind, or they can think of people who they admire and look for words they have written or spoken. Then, have them think about their own dreams and hopes for the future, gathering pictures or symbols to represent those dreams. Allow them to use their creativity to make a collage of motivating quotations and pictures. They can use their vision boards to help them maintain their focus on their life goals. Over time, they may want to update their board to reflect their changing interests and plans.

WRITING

Annika's Narrative

When Annika returns to Earth she cannot tell anyone about her time in The Realms, but it is easy to imagine that she might feel the need to write about her adventures. Review the important elements of narrative writing, and then have students pretend they are Annika, writing about one of her experiences in The Realms, focusing on a small moment in time. It could be one of the experiences already mentioned by Joss, but told from Annika's point of view, or it could be something that might have happened, but was not described in *Pi in the Sky*. Students should focus on creating vivid descriptions, but should also make sure their narrative is consistent with the story narrated by Joss.

Persuading the Public

Exploring space was once a national priority, but with budget cuts and other considerations, there are some people who feel it is not necessary to have a space program any longer. Have students research the topic of how the space program is funded and its current goals. Then, have students decide if they think it is important to continue to fund the program. After reviewing opinion writing and public speaking skills, have students share their stance on the issue by writing a persuasive speech designed to convince others of their view. Did everyone have the same opinion? Did everyone have the same reasons to keep or disband the program?

SOCIAL STUDIES

Question Biographies

At the beginning of every chapter there are quotations by famous people (or at least famous in some circles). Working in pairs, have students select one of the quotations and prepare a short "question biography." A question *word* biography consists of telling: *Who* the person is, *What* they are known for, *Where* they are from, *When* they lived, and *Why* they are considered important. As an extension, students may want to include *How* their quote relates to the story. Some of these people are historical figures and some are people alive today. Students may choose from: H. L. Mencken,

Marcus Chown, Paul Davies, Kip Thorne, Charles Darwin, Henry David Thoreau, E.B. White, Euripides, Johann Wolfgang Von Goethe, John Archibald Wheeler, C.S. Lewis, Sean M. Carrol, Eden Phillpotts, Rossiter W. Raymond, Richard Feynman, Carl Sagan, Erwin Schrödinger, Ray Bradbury, Lawrence M. Krauss, Felix Franks, Galileo, Stephen Hawking, Michio Kaku, Pythagoras, Albert Einstein, Neil deGrasse Tyson, Richard Dawkins, and Daniel Dennett.

Time Travel Interview

In *Pi in the Sky*, Joss and Annika meet Carl Sagan and have an opportunity to ask him some questions. Ask students to imagine that they have the chance to interview another famous scientist or historical figure. What questions would they ask? They should pretend they are a journalist and create a list of questions that would help the world understand this historical figure better. As an extension, students may want to pair up and actually conduct the interview, having one student act as the journalist and the other play the role of the historical figure. Students should be sure their answers to the questions are consistent with what is known of the famous person they are impersonating.

SCIENCE AND MATH

Observatory Virtual Tour

The problem in *Pi in the Sky* starts with a curious stargazer and her telescope. While the telescope Annika used (and most students are probably familiar with) uses mirrors and lenses to magnify the view of objects in the sky, observatories around the world are using even more advanced technology, including telescopes that look very different from the telescopes students might be imagining. Help students expand their view by taking an observatory world tour. Have them learn about several large observatories such as Kitt Peak National Observatory in Arizona, USA (http://www.noao.edu/outreach/kpvc/), Mauna Kea Observatories in Hawaii (http://www.ifa.hawaii.edu/mko/), and the European Southern Observatory in Chile (www.eso.com). Ask them to compare and contrast the observatories, paying particular attention to the types of telescopes used, the elevation of the observatory, and the geography of the area. After they collect data on each of these sites, ask them to draw some conclusions about what conditions (elevation, climate) are likely best for a large observatory. They might also consider why it is important to have different kinds of telescopes and why it makes sense to have observatories in both the Northern and Southern Hemispheres. Extend the discussion by asking students to research more about the Hubble telescope. In what ways is this different? How does it overcome some of the limitations of a ground-based telescope?

Mock IAU Committee: What's in a Name?

Names of galaxies, planets, and stars are found throughout *Pi in the Sky*. The International Astronomical Union has the responsibility (and privilege) of naming planets, stars, nebulae, galaxies, and other objects in space. Their website http://www.iau.org/public/naming has a detailed explanation of celestial nomenclature. Students may find it fascinating to learn that dwarf planets must have mythological names, and any with the same orbital rhythm as Pluto must have the name of an underworld deity from mythology. Students can read about how objects in the sky are named, and then show their comprehension with a group project. Each group should pretend they have recently discovered either a galaxy, dwarf planet, nebulae, or satellite. They will need to describe their discovery and explain why it should be classified as that particular type of celestial object. Then, they should attempt to name their discovery, paying careful attention to the naming criteria. After all groups have named their celestial objects or planets, the class should form a mock IAU committee and determine if each name will be accepted or not. The IAU does sometimes reject names. For example, the dwarf planet Eris was originally called Xena, but a fictitious warrior princess was not considered to be a mythological figure. The mock committee members should each write an explanation of why they would accept or reject the name. Then, the mock IAU committee will vote and make a final decision. After the mock committee meeting, have students reflect as a class on the experiment. Do they think these naming rules make sense? Why or why not?

Pi in the Pie

Pi and pie play an important role in *Pi in the Sky*. Laz, considered the least intelligent among Joss and his six brothers, fails Planet Building Class because he can't calculate pi. This results in his planets crashing into one another. Since pi is a constant, it is really that Laz can't calculate circumference. As a delicious math activity, have students use pi to calculate the circumference of a pie. Prepare several pies of various sizes. Ask students to measure the diameter of each pie. Then, have them calculate the circumference by multiplying the diameter times pi (3.14). How big is their pie? Have them check their answer by using a string to measure around the pie, and then a ruler or yardstick to measure the string. Did their calculations match the length of the string? If not, what could be the problem? If the diameter is not measured precisely, it will be a chord instead of the diameter. How might this change their calculations? After students have correctly calculated the circumference, perhaps while enjoying a slice of pie, have students explain how knowing this formula could help Laz pass Planet Building Class. Extend the learning by having students calculate the orbital circumference of Earth or other planets.

Astronomical Odds

When Joss first discovers Kal's parents and Earth have been destroyed by the PTB, the green-haired man argues that the odds are astronomical of Kal's parents being on the same planet at the same time someone viewed The Realms. Joss says, "A nice try to deflect blame, but the odds of anything existing in the universe at all are astronomical." To help students understand what Joss means, they will need to have a basic understanding of probability and how to calculate odds. Probability is written as a fraction; the number of possibilities is the denominator and the number of desirable outcomes is the numerator. This can easily be shown with a bag of marbles. If there are 5 marbles, two blue and three red, then the probability of choosing a blue is 2/5ths or 2 divided by 5. The odds are calculated by comparing the number of desirable outcomes to the number of undesirable outcomes. So, in the case of the marbles it would be 2:3. When calculating the probability of something existing in the universe, however, the numerator would be finite (the desired outcome) and the denominator would be infinite (total number of things in the universe). In this case, when the numerator is divided by infinity, the answer is effectively zero. Once students understand the math, have them explain why Joss said the green-haired man's argument "fell short"?

ART AND MUSIC

Music of the Spheres

Thade, the oldest brother of Joss, was able to hear "the music of the spheres," while Joss was stuck listening to Kal's drums. While the phrase "music of the spheres" is an ancient philosophical concept referring to mathematical relationships (often associated with Pythagoras), in *Pi in the Sky* it is applied in a literal sense. Students can try to take over Thade's role by "composing" their own music of the spheres. In small groups or with a partner, have students compose or find music that they think might help someone visualize the planets or the sky. Ask students to carefully consider what they want the listener to visualize. They may need to experiment with many instruments or listen to many types of music before they find something that is a good fit for their vision. For inspiration, students may want to watch some of the videos or live web feeds from observatories. There are some excellent resources for this purpose at www.nasa.gov.

Celestial Art Show

Thade is the brother who inspires the artists of the Universe. Throughout time, there have been many artists who have created works of art with a celestial theme. Ask students to look for examples of famous paintings, sculptures, musical compositions, poetry, dances, or other forms of art with this theme. Then, have them share their examples by creating a display or presentation. In what ways are the exhibits similar? How are they different? As an extension, students may want to create their own works of art that are inspired by The Realms or the night sky.

Science?	Fiction?
Cygnus Galaxy	Sombrero Galaxy
dark energy	white holes
Andromeda	gravitons
Borga 3	The Realms
Higgs boson	quarks
dark matter	Fangstrich

Cambrian explosion	Agamos
holograph	supernovas
Milky Way	Niffum
magnesium	wormhole
Cartwheel Galaxy	amino acids
globular cluster	nebula
gamma rays	Magellanic Clouds

about the book

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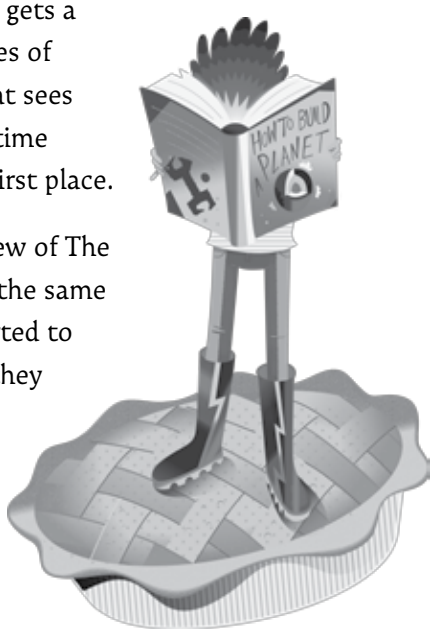
If you think it's tough being the Supreme Overlord of the Universe, try being his son. Better yet, try being his seventh son, like Joss is. All Joss's older brothers have awesome jobs: they create new species, or choreograph sunrises and sunsets, or inspire artists! All Joss gets to do is deliver pies. That's right: pies.

Of course these pies actually hold all the secrets of the universe between their buttery crusts, and Joss has to cart them all over the Upper Realms—home to everyone who controls the universe. Normally, The Realms are hidden from human eyes, but every once in awhile, someone accidentally gets a forbidden peek. No one knows the consequences of discovering The Realms, because any planet that sees them gets immediately taken out of the space-time continuum, so that it has never existed in the first place.

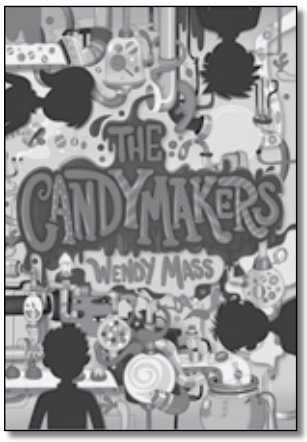


One day, the planet that gets the accidental view of The Realms is Earth. And while the consequence is the same as always, one human girl is somehow transported to the Realms—and now she and Joss must see if they can save Earth from...never existing.

about the author

Wendy Mass is the *New York Times* bestselling author of *The Candymakers*, the ALA Schneider Family Award-winner *A Mango-Shaped Space*, *Leap Day*, *Jeremy Fink and the Meaning of Life*, *Heaven Looks a Lot Like the Mall*, and *Every Soul a Star*. Wendy lives in New Jersey with her husband and their twins. Her website is www.wendymass.com.

also by Wendy Mass



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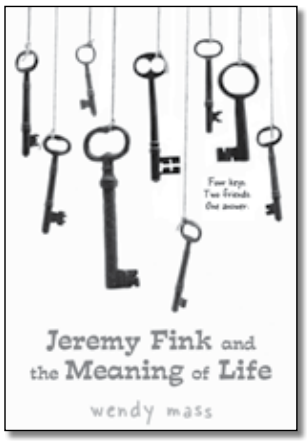

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