Thanks for using *Fallout: J. Robert Oppenheimer, Leo Szilard, and the Political Science of the Atomic Bomb* in your classroom. The following are some ideas for generating discussion, critical thinking, and further learning based on what your students just read.

Content questions

Prologue

Have you seen *Dr. Strangelove*? The main character was indeed based on Edward Teller (with some Werner von Braun thrown in, if you ask me). Teller has suffered for his views and actions in the scientific community, but has also had considerable influence on nuclear weapons policy—esp. the "star wars" missile defense. What do you think of the trade-off he made between respect of (most of) his peers for political power?

Birth

The book starts with Leo Szilard reading a book. What was he reading, and why do you think that's important?

What is Einstein's responsibility for what happened before, during, and after the Manhattan Project? He said he wished he'd never been involved in any way, but some might say he should get over himself. (In that he had very little power or responsibility, regardless of what he might think. On the other hand, he did sign the letter to FDR...)

A less weighty topic: Have you read any of H.G. Wells' other novels? *The World Set Free* isn't his best by any means, but it has some really good bits (which I snagged for the book, natch). What's your favorite book that deals with atomic bomb issues? If you can't think of any, I'll recommend *A Canticle for Leibowitz* by Walter Miller. I read this every few years...

How would you describe Janine Johnston's artistic style? What is its most striking feature? How do you compare it to Bernie Mireault's style? Steve Lieber's?

School

Robert Oppenheimer is arguably the main character, but he doesn't make his first appearance until page 55. Who's he talking to there, and why do we not see him sooner?

The section called "School" brings both of the main characters together, and adds in Enrico Fermi and General Groves. How would you compare Oppenheimer and Szilard? Fermi and Groves?

Look at all these immigrants! Fermi, Szilard, Einstein, etc. etc. etc. (And even more appear in the next chapter.) We couldn't have made this happen without a bunch of talent from outside the U.S.…or could we? What do you think?

It's always hard to tell where the tipping point in history is. Was the darkest day that day of the first chain reaction as Szilard said, or could we have stopped the process of creating nuclear weapons at this (or any other) point? Or was it already too late?

Work

"Work" tells you how to build an atomic bomb. (Sort of.) But it ends with very different imagery. What imagery was that, and why do you think the writer and artists chose to do it that way.

If you're diligent about checking the references, you'll notice this chapter is structured around the *Los Alamos Primer*. You could get this on the web prior to September 11, 2001. Now you can't…but you can still buy it in book form or borrow it from a library. Does this make sense to you? In your opinion, what kind of information should be available about topics like this, and does freedom of speech ever become more trouble than it's worth?

Death

Parallels between Clinton and Oppenheimer are not too hard to find. But what about their respective guilt? Do you think Oppenheimer was a security risk? Why?

General

Would nuclear power be more acceptable in this country if everybody's to it hadn't been at Hiroshima and Nagasaki?

Did the U.S. have to use the bomb the way it did, or would something else—such as a demonstration on an unpopulated area—have worked? [Hint for "why use it at all?" responses: Using it on Hiroshima and Nagasaki wasn't just about preventing an island-to-island invasion...by the end of the war in Europe the U.S. and Great Britain were almost as worried about Stalin and his huge army as they were about Japan.]

How would you describe the tone of the book? Cite specific pages and/or panels as examples.

Which characters do you find to be the most interesting and engaging? That may be different than the most memorable, and different from the main characters! Why? [Which character would you like to go on a vacation with? Which character(s) would you want to invite over for dinner?]

Do you think Robert Oppenheimer should have been allowed to keep his security clearance?

Choose a page in the book and carefully examine how the writer and artist combine words and pictures in effective ways.

What chapter or story do you find most effective? Why? Be as specific as you can.

Take a look at the main chapters and the interludes. Why do you think they're so different?

Before reading this book, what were your attitudes about these scientists? About the development of the atomic bomb? In what ways has the book changed your mind about these things?

Should comics have as many footnotes as this one? Did you read 'em?

If you could ask the artist(s) any questions, what would they be?

If you could ask the writer any questions, what would they be?

Storytelling questions

Why do you think page 201 was done in that particular way? Why is it completely silent?

Why do you think the story "Work" is done in this particular style? Does it effectively reflect the mood and setting of the characters?

On pages 76-79, what happened between panels and pages? What happened between the panels on page 134?

Pay close attention to backgrounds throughout all these stories. How do the writer and artist establish and treat setting and environment?

Look at the art on pages 135-142. What point do you think is being made with the backgrounds?

Why did the story start with Edward Teller in the hospital, hooked up to machines? Why does the story end with Leo Szilard, also hooked up (for a while) to machines?

Why do you think the art looks the way it does in "Death", with a mixture of typeset prose, illustrations, and comics?

Ask the characters! Ask yourself!

Now that you've read the book, try answering some questions as if you were one of the characters. Then, pretend like you were in the character's situation. How would you answer it for yourself?

"Dr. Oppenheimer, why do you oppose the development of hydrogen bombs?"

"Dr. Szilard, why do you oppose the development of nuclear weapons in general…even though you initially proposed that development?"

"Dr Teller, why do you oppose Oppenheimer's continuing to have a high level of government security clearance and trust?"

"General Groves, why do you support Oppenheimer's continuing to have a high level of government security clearance and trust?"

Vocabulary and ideas to discuss and define

Dr. Strangelove
H.G. Wells
fission
uranium
Los Alamos
Manhattan Project
plutonium
reactor
hydrogen bomb
security clearance
Atomic Energy Committee
House Un-American Activities Committee
McCarthy(-ism)

More to explore

Books

Atoms in the Family, by Laura Fermi (Chicago: University of Chicago Press, 1954).
Fermi's life from his wife's perspective, which added depth to the characterization of him, his colleagues, and the environment in which he worked.

Dawn Over Zero: The Story of the Atomic Bomb, by William L. Laurence (NY: Alfred A. Knopf, 1946).
One of the first books written about the Manhattan Project, by the reporter given exclusive rights to cover the story.

The Day the Sun Rose Twice, by Ferenc Morton Szasz (Albuquerque: University of New Mexico Press, 1985).
An extremely detailed account of the day of the first nuclear explosion. Like many of the other books, a source for impressions this event made on observers.

Genius in the Shadows: A Biography of Leo Szilard, by William Lanouette with Bela Szilard (Chicago: The University of Chicago Press, 1992).
The best of many books I read that focused on Leo Szilard.

Hitler's Uranium Club: The Secret Recordings at Farm Hall, by Jeremy Bernstein (Woodbury, NY: American Institute of Physics, 1996).
Though not directly referenced in the text, this book will give you the background on Germany's wartime efforts in the field of nuclear fission. In many respects, the naiveté (for lack of a better word) of the German scientists is one of the most notable things that come through in the transcripts of the tapes made while Heisenberg and his colleagues were interred in Britain.

In the Matter of J. Robert Oppenheimer: Transcript of Hearing before Personnel Security Board, Washington D.C. April 12, 1954 through May 6, 1954 (Washington: Government Printing Office, 1954).
Almost 1000 pages of small print, at least in the edition I worked from. Excruciating and fascinating in more ways than one.

J. Robert Oppenheimer: Shatterer of Worlds, by Peter Goodchild (Boston: Houghton Mifflin, 1981).
Companion volume to the B.B.C. television series of the same name, this book features illustrations and photographs on almost every page and a thorough overview of Oppenheimer's life.

The Legacy of Hiroshima, by Edward Teller (NY: Macmillan, 1962).
The source for the quote by Niels Bohr about turning the whole country into a factory.

The Making of the Atomic Bomb, by Richard Rhodes (NY: Simon and Schuster, 1986).

If you read no other book about the development of the first atomic bomb, please make it this one.

Men and Decisions, by Lewis L. Strauss (NY: Doubleday & Company, 1962).
Strauss' cold-blooded account of the Oppenheimer hearings are a perfect match with the self-important title of his book.

Now It Can Be Told, by Leslie R. Groves (NY: Harper & Brothers, 1962).
The title says a great deal about the tone of the book, but Groves' point of view is an important one to hear regardless of how he presents it.

Picturing the Bomb: Photographs from the Secret World of the Manhattan Project, by Rachel Fermi and Esther Samra (NY: Harry N. Abrams, 1995).
Hundreds of fascinating pictures that provided reference for what you saw in this book.

Robert Oppenheimer: Letters and Recollections, edited by Alice Kimball Smith and Charles Weiner (Cambridge, MA: Harvard University Press, 1980).
Letters to and from Oppenheimer, with the majority of the correspondence pre-dating the Los Alamos period.

Science and the Common Understanding and *The Open Mind*, by J. Robert Oppenheimer (NY: Simon and Schuster, 1954 and 1955, respectively).
Philosophical writings by Oppenheimer, touching on the role of science and politics. Copyright dates notwithstanding, all were written before Oppenheimer's political downfall.

"Surely You're Joking, Mr. Feynman!", by Richard P. Feynman (as told to Ralph Leighton (NY: W.W. Norton & Company, 1985).
The "Dragon's Tail" experiment is described here, as are the incidents with the censors and an excellent example of Feynman's capacity for mischief regarding the strict security that we've alluded to in the story—see "Los Alamos From Below" for all this and more.

Their Day in the Sun: Women of the Manhattan Project, by Ruth H. Howes and Caroline L. Herzenberg (Philadelphia: Temple University Press, 1999).
Most important to the story you just read for the outsider view of the Trinity bomb and the excellent image of Hinton and Woods hopping on a motorcycle to crash the party.

The Uranium People, by Leona Marshall Libby (NY: Crane, Russak & Company, 1979).
You know her in this story as Dr. Woods, but she married fellow scientist John Marshall soon after the CP-1 experiment. This book was an excellent source for details about the first atomic pile and the people who worked on it.

What Little I Remember, by Otto Frisch (London: Cambridge University Press, 1979).

The source for Frisch's "I can still hear it." quote, along with the a more accurate account of the Dragon's Tail experiment than you read here.

The World Set Free, by H.G. Wells (1914, accessible from Project Gutenberg at *ftp://sailor.gutenberg.org/pub/gutenberg/etext97/twsfr10.txt*).

The inspiration for Szilard, and though not Wells' best by far, it still contains many prescient details and some vivid writing.

Articles

"Infamy and Honor at the Atomic Café," by Gary Stix in *Scientific American*, vol. 281, no. 4, October 1999, 42-44.

The source of the "infamous" Teller quote, and a superb portrait of Teller in his later years.

"J. Robert Oppenheimer: Before the War," by John S. Rigden in *Scientific American*, vol. 273, no. 1, 76-81.

A quick overview of Oppenheimer's achievements in building an "American School" of physics that would rival the great European schools that dominated the world scene until World War II.

"The Odd Couple of the Bomb," by William Lanouette in *Scientific American*, vol. 283, no. 5, November 2000, 104-109.

Like his book on Szilard, you'll find Lanouette's article provides an excellent portrait of Fermi and Szilard and their uneasy liaison.

"Physicists in Wartime Japan," by Laurie M. Brown and Yochiro Nambu in *Scientific American*, vol. 279, no. 6, December 1998, 96-103.

Nothing about bomb development, since there was none in Japan, but this article points out some of the excellent science done during the war despite difficult conditions and almost complete isolation.

"A Reporter at Large: The Contemporaneous Memoranda of Dr. Sachs," by Geoffrey T. Hellman in *The New Yorker*, vol. 21, no. 32: December 1, 1945, 73-81.

The tortured syntax of Alexander Sachs comes through loud, clear, and quotable in this hot-from-today's-headlines article.

Sites and CD-ROMs

Critical Mass: America's Race to Build the Atomic Bomb produced and directed by Lisa C. Anderson (Seattle: Corbis, 1996, www.corbis.com).

This multimedia CD-ROM gives an overview of the Manhattan Project and more in-depth looks at Bohr, Fermi, Feynman, and Oppenheimer.

The Day After Trinity: J. Robert Oppenheimer and the Atomic Bomb, a film by Jon Else (1980, CD-ROM version by NY: Voyager, 1995, ISBN 1-5594068-5-2).

Worth seeking out as a film, but even more so in the CD-ROM version, which includes a wealth of elegantly presented supplementary material.

"Historical Nuclear Weapons Test Films",
http://www.nv.doe.gov/news%26pubs/photos%26films/testfilms.htm .

I don't have any direct experience myself, but I doubt these will give you much of a sense of what an actual explosion is like. Thank goodness we currently have no live alternative to them, though.