

Einstein and Relativity Class: Suggestions for Further Exploration by Andrew Fraknoi [2018]

1. About Einstein's Life and Work

Friedman, Alan & Donley, Carol *Einstein as Myth and Muse*. 1985, Cambridge U. Press. Out of print; worth searching out. Fine introduction to the influence of Einstein's science on culture.

Hoffmann, Banesh & Dukas, Helen *Albert Einstein: Creator and Rebel*. 1972, Viking. A good primer by a physicist and Einstein's secretary; paints a somewhat unblemished picture.

Isaacson, Walter *Einstein: His Life and Universe*. 2008, Simon & Schuster paperback. Widely praised biography, not so much about the science, but about his life and passions.

Overbye, Dennis *Einstein in Love: A Scientific Romance*. 2000, Viking. A biography by a science writer.

White, Michael & Gribbin, John *Einstein: A Life in Science*. 1993, Penguin Plume. A clear, brief overview.

Albert Einstein On-Line (a collection of links to many Einstein sites): <http://www.westegg.com/einstein/>

Einstein Time Line (Princeton U. Press & Einstein Archives): <http://press.princeton.edu/einstein/life.html>

Official Einstein Site by company that licenses his image (sigh): <http://einstein.biz/>

2. About the Special Theory of Relativity

Gardner, Martin *The Relativity Explosion*. 1976, Vintage. An entertaining introduction by a puzzle popularizer.

Mermin, N. David *Space and Time in Special Relativity*. 1968, McGraw Hill. A careful, step-by-step working out of all the aspects of relativity, without advanced math.

Wolfson, R. *Simply Einstein: Relativity Demystified*. 2002, Norton. A readable modern introduction.

Astronomy Magazine: Relativity Turns 100: Special Issue, Feb. 2005.

Gale, T. "Chasing Light Speed" in *Sky & Telescope*, Feb. 2012, p. 34. On how speed of light was measured.

Overview of Special Relativity (David Harrison, U. of Toronto) (slightly mathematical):
<https://faraday.physics.utoronto.ca/GeneralInterest/Harrison/SpecRel/SpecRel.html>

3. Selected Fiction Influenced by the Special Theory of Relativity

Benford, Gregory "Relativistic Effects" in *In Alien Flesh*. 1986, TOR. A spaceship accelerates very close to the speed of light & flies between two galaxies about to collide, removing some matter.

Durrell, Lawrence: The Alexandria Quartet: *Justine, Balthazar, Mountolive, and Clea*. 1957-1960, Dutton. Four novels whose structure and approach were influenced by Durrell's understanding of relativity; there are three novels of "space" and one of "time," all telling the same story.

Haldeman, Joe *The Forever War*. 1974, Ballantine. Award-winning novel of an interstellar war involving concepts from both special and general relativity.

Haldeman, Joe "Tricentennial" in *Infinite Dreams*. 1978, St. Martin's. Traveling near c and time dilation.

Masson, David "Traveler's Rest" in Silverberg, Robert, ed. *Voyagers in Time*. 1967, Tempo. Intricate story in which relativistic time dilation becomes a function of latitude.

Stith, John *Redshift Rendezvous*. 1990, Ace. Voyage in a "hyperspace" where speed of light is 30 m/sec.

Varley, John "The Pusher" in *Blue Champagne*. 1986, Berkley. Poignant story on the loneliness of relativistic space travel; time dilation makes it difficult to have a family on Earth.

4. Readings on the General Theory of Relativity

Fraknoi, A., et al. *Astronomy*. 2017, OpenStax. Chapter 24 of this FREE on-line introductory textbook explains general relativity and black holes: <http://openstax.org/details/astronomy>

Begelman, M. & Rees, M. *Gravity's Fatal Attraction: Black Holes in the Universe*, 2nd ed. 2010, Cambridge U. Press. Nice book on the astronomical aspects of black holes.

Crelinsten, Jeffrey *Einstein's Jury: The Race to Test Relativity*. 2006, Princeton U. Press. A very detailed history of how physicists and astronomers tested the predictions (especially of general relativity).

Gefter, A. "Putting Einstein to the Test" in *Sky & Telescope*, July 2005, p. 32. Review of experimental tests.

Jayawardhana, Ray "Beyond Black" in *Astronomy*, June 2002, p. 28. On finding evidence of the existence of event horizons and thus black holes.

Kaufmann, William *Cosmic Frontiers of General Relativity*. 1977, Little Brown. Out of print, this very clear, helpful intro (with its focus on black holes) is well worth searching for.

Melia, Fulvio *Cracking the Einstein Code: Relativity and the Birth of Black Hole Physics*. 2009, U. of Chicago Press. History of study of black holes & biography of Roy Kerr, who worked on BH rotation.

Nadis, Steve "Here, There, and Everywhere" in *Astronomy*, Feb. 2001, p. 34. On Hubble observations showing how common supermassive black holes are in galaxies.

Thorne, Kip *Black Holes & Time Warps: Einstein's Outrageous Legacy*. 1994, Norton. Long, detailed, but nontechnical introduction by one of the world's experts in the field.

Thorne, Kip *The Science of Interstellar*. 2014, W. W. Norton. Explains the movie and the science in it.

Will, C. *Was Einstein Right? -- Putting General Relativity to the Test*. 1986, Basic Books. Clear discussions.

Zee, A. *An Old Man's Toy: Gravity in Einstein's Universe*. 1989, Macmillan. Basic introduction.

Frequently Asked Questions about Black Holes: <http://cosmology.berkeley.edu/Education/BHfaq.html>

Hubble Space Telescope Black Hole Encyclopedia (a good introduction for beginners): http://hubblesite.org/explore_astronomy/black_holes/home.html

Black holes resource guide (by your instructor.): <http://www.astrosociety.org/education/astronomy-resource-guides/black-holes-an-introductory-resource-list/>

5. About Gravity Waves and Their Discovery

Levin, Janna *Black Hole Blues*. 2016, Knopf. Popular introduction to gravity wave observations by physicist.

Schilling, Govert *Ripples in Spacetime*. 2017, Harvard U. Press. By a noted science writer.

LIGO website and news: <https://www.ligo.caltech.edu/>

From *Scientific American*: <https://www.scientificamerican.com/report/the-discovery-of-gravitational-waves/>

6. Fiction Influenced by the General Theory of Relativity

Asimov, Isaac "The Billiard Ball" in *Asimov's Mysteries*. 1968, Dell. Murder using general relativity.

Baxter, Stephen "Gravity Mine:" <http://www.infinityplus.co.uk/stories/gravitymine.htm> (in distant future the energy of giant black holes is needed for survival)

Benford, Gregory *Eater*. 2000, Eos. An ancient, intelligent black hole visits our solar system.

Benford, Gregory *Great Sky River*. (1987, Bantam) *Tides of Light*. (1989, Bantam) *Furious Gulf*. (1994, Bantam) *Sailing Bright Eternity*. (1995, Bantam). Books take place in far future, around a super-massive black hole at the center of Galaxy; humanity hunted by complex machine intelligences.

Johnson, Bill "Meet Me at Apogee" in Carr, T., ed. *The Best Science Fiction of the Year 12*. 1983, Pocket Books. Future levels of descent near a black hole; the 2-month level is where 1 day of time for the traveler is 2 months outside. Prospectors & people with diseases hire pilots to take them down.

Landis, Geoffrey "Impact Parameter" in *Impact Parameter*. 2001, Golden Gryphon. On gravitational lenses and wormholes.

Landis, Geoffrey "Approaching Perimelasma" in *Impact Parameter*. 2001, Golden Gryphon. Virtual human is dropped into a black hole to explore space and time. Author is a NASA astronomer.

McDevitt, Jack & Shara, Michael "Lighthouse" in *Cryptic: The Best Short Fiction of Jack McDevitt*. (2009, Subterranean Press) [https://www.baen.com/Chapters/1596061958/1596061958_8.htm] An alien race decides to mark the location of unaccompanied black holes in the Galaxy by putting very strange brown dwarfs around them that could not exist in nature. Shara is an astronomer.

Niven, Larry *World Out of Time*. 1976, Ballantine. Using supermassive black hole to travel into the future.

Oates, J. "Passions and Meditations" in *The Seduction and Other Stories*. 1975, Black Sparrow Press. Allegory using black holes as a symbol of being cut off from communication.

Pohl, Fred *Gateway*. 1977, Ballantine. Enjoyable novel with event horizons, and "black-hole guilt".

Sagan, Carl *Contact*. 1985, Simon & Schuster. The protagonists use a kind of black-hole/worm-hole "subway" system for interstellar travel. (Made into a film with Jodie Foster).

Willis, Connie "Schwarzschild Radius" in Preiss, Byron & Fraknoi, Andrew, eds. *The Universe*. 1987, Bantam. Haunting story combining episodes from Schwarzschild life and black hole images.

For an annotated guide to science fiction with good physics and astronomy (by your instructor), see: <http://www.astrosociety.org/scifi>

To find all the places the science fiction stories listed above have appeared, see: <http://www.isfdb.org/>