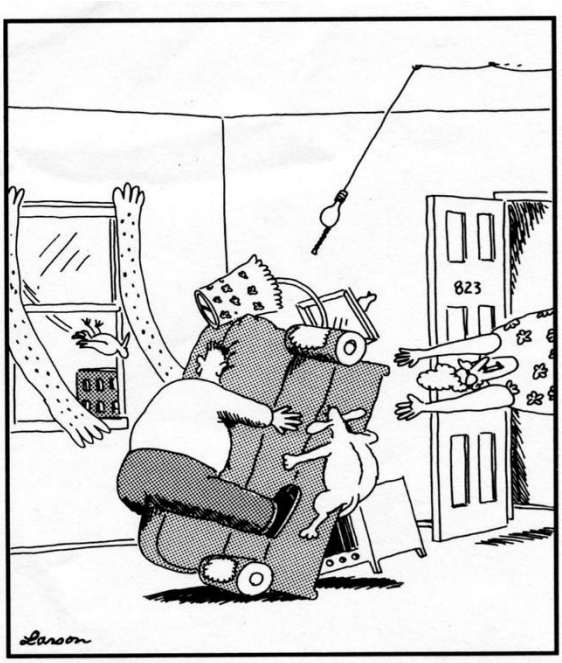
Black Holes: Space Warps, Time Machines, and the Science that Won the 2020 Nobel Prize

With Professor Andrew Fraknoi



Suddenly, through forces not yet fully understood, Darren Belsky's apartment became the center of a new black hole.

In this non-technical course, we'll learn about the theory and experiments behind one of the most remarkable phenomena in science – the gruesome and powerful places in the universe called black holes. Formed through the deaths of huge stars, black holes are places where gravity overwhelms every force in the universe and the behavior of space and time is altered, almost beyond recognition. Designed for non-scientists and presented in everyday language with lots of beautiful illustrations, the class will first describe how black holes emerged from Einstein's work and then show how new instruments on Earth and in space are demonstrating that black holes of various sizes really do exist.

Week by Week Outline (subject to revision):

1. Introduction to the Universe & Einstein

The realms of physics & astronomy; a mini-tour of the universe; science and theories. An introduction to Einstein and his ideas.

2. Einstein's Theory and the Rubber Sheet of Warped Space

What Einstein called "the happiest thought of my life" – General Relativity. Introduction to warped space and the rubber sheet analogy

3. Black Holes in Theory

The rubber sheet leads to ultimate collapse; understanding black holes and their properties. Why jumping into a black hole is a once-in-a-lifetime experience.

4. Black Holes and Time Machines

Black holes and the nature of time; time machines. What it would be like to be near a black hole? Black holes in science fiction stories and novels.

5. Observations of Regular Black Holes

Neutron stars and pulsars as black-hole alternatives. Why black holes are hard to find. Finding black holes produced by single stars (x-ray revelations.) Can black holes merge?

6. Black Holes and Gravitational Waves

Gravity waves and how to measure them. The birth of LIGO. Finding black holes of intermediate size. How big can a black hole get? Galaxies and their monstrous centers. Black hole movies.

7. **Supermassive Black Holes**

The 2020 Nobel Prize: The black hole at the center of the Milky Way. Super-sized Black Holes: Quasars and the centers of galaxies. Black holes and galaxy mergers

8. Stephen Hawking and Quantum Black Holes

Hawking's life and work. Black holes that are not quite black. Where would mini-black holes come from. Black holes and the birth of the cosmos.

[Optional] Reading:

Fraknoi, Morrison, & Wolff: Astronomy (a free, on-line, introductory astronomy textbook) at: http://openstax.org/details/astronomy NOTE: Chapter 1 is an introduction to astronomy & key terms; Chapter 24 is all about black holes; Chapter 27 is about monster black holes

Your Instructor

Andrew Fraknoi retired in 2017 as Chair of the Astronomy Department at Foothill College. He served as Executive Director of the Astronomical Society of the Pacific for 14 years. Fraknoi has appeared on local and national radio, explaining astronomical developments in everyday language, and was the California Professor of the Year in 2007. He is the lead author on a free, open-source astronomy textbook, cleverly entitled *Astronomy,* published by the non-profit OpenStax project, and has written two children's books, including *Disney's Wonderful World of Space*. He now writes science fiction and has had 4 stories published so far. He's Chair of the Board of the Friends of Lick Observatory. The International Astronomical Union named Asteroid 4859 Asteroid Fraknoi to honor his contributions to the public understanding of science.

For more about his work or to read his stories, see: http://www.fraknoi.com