

## Tackling the Really BIG Questions

By Diane K. Fisher

How does NASA get its ideas for new astronomy and astrophysics missions? It starts with a Decadal Survey by the National Research Council, sponsored by NASA, the National Science Foundation, and the Department of Energy. The last one, *New Worlds, New Horizons in Astronomy and Astrophysics* was completed in 2010. It defines the highest-priority research activities in the next decade for astronomy and astrophysics that will “set the nation firmly on the path to answering profound questions about the cosmos.” It defines space- and ground-based research activities in the large, midsize, and small budget categories.

The recommended activities are meant to advance three science objectives:

1. Deepening understanding of how the first stars, galaxies, and black holes formed,
2. Locating the closest habitable Earth-like planets beyond the solar system for detailed study, and
3. Using astronomical measurements to unravel the mysteries of gravity and probe fundamental physics.

For the 2012-2021 period, the highest-priority large mission recommended is the Wide-field Infrared Survey Telescope (WFIRST). It would orbit the second Lagrange point and perform wide-field imaging and slitless spectroscopic surveys of the near-infrared sky for the community. It would settle essential questions in both exoplanet and dark energy research and would advance topics ranging from galaxy evolution to the study of objects within the galaxy and within the solar system.

Naturally, NASA’s strategic response to the recommendations in the decadal survey must take budget constraints and uncertainties into account.

The goal is to begin building this mission in 2017, after the launch of the James Webb Space Telescope. But this timeframe is not assured. Alternatively, a different, less ambitious mission that also address the Decadal Survey science objectives for WFIRST would remain a high priority.

The Astrophysics Division is also doing studies of moderate-sized missions, including: gravitational wave mission concepts that would advance some or all of the science objectives of the Laser Interferometer Space Antenna (LISA), but at lower cost; X-ray mission concepts to advance the science objectives of the International X-ray Observatory (IXO), but at lower cost; and mission concept studies of probe-class missions to advance the science of a planet characterization and imaging mission.

For a summary of NASA’s plans for seeking answers to the big astrophysics questions and to read the complete Astrophysics Implementation Plan (dated December 2012), see <http://science.nasa.gov/astrophysics/>. For kids, find lots of astrophysics fun facts and games on The Space Place, <http://spaceplace.nasa.gov/menu/space/>.

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**Caption:**

*Clusters of galaxies collide in this composite image of “Pandora's Cluster.” Data (in red) from NASA's Chandra X-ray Observatory show gas with temperatures of millions of degrees. Blue maps the total mass concentration (mostly dark matter) based on data from the Hubble Space Telescope (HST), the European Southern Observatory's Very Large Telescope (VLT), and the Japanese Subaru telescope. Optical data from HST and VLT also show the constituent galaxies of the clusters. Such images begin to reveal the relationship between concentration of dark matter and the overall structure of the universe.*

*Editors: Download this image at <http://spaceplace.nasa.gov/news-images/pandoras-cluster.jpg>*