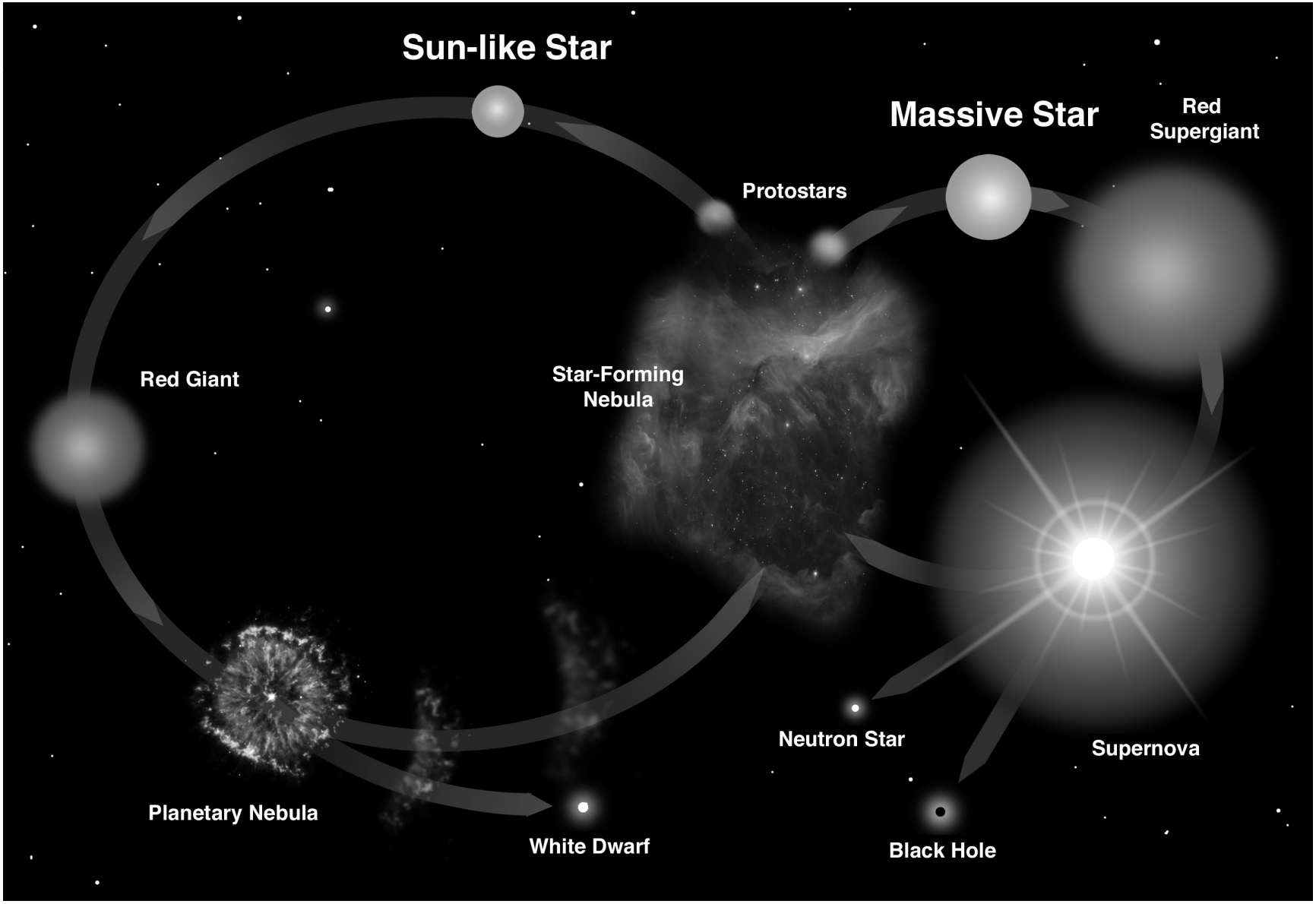
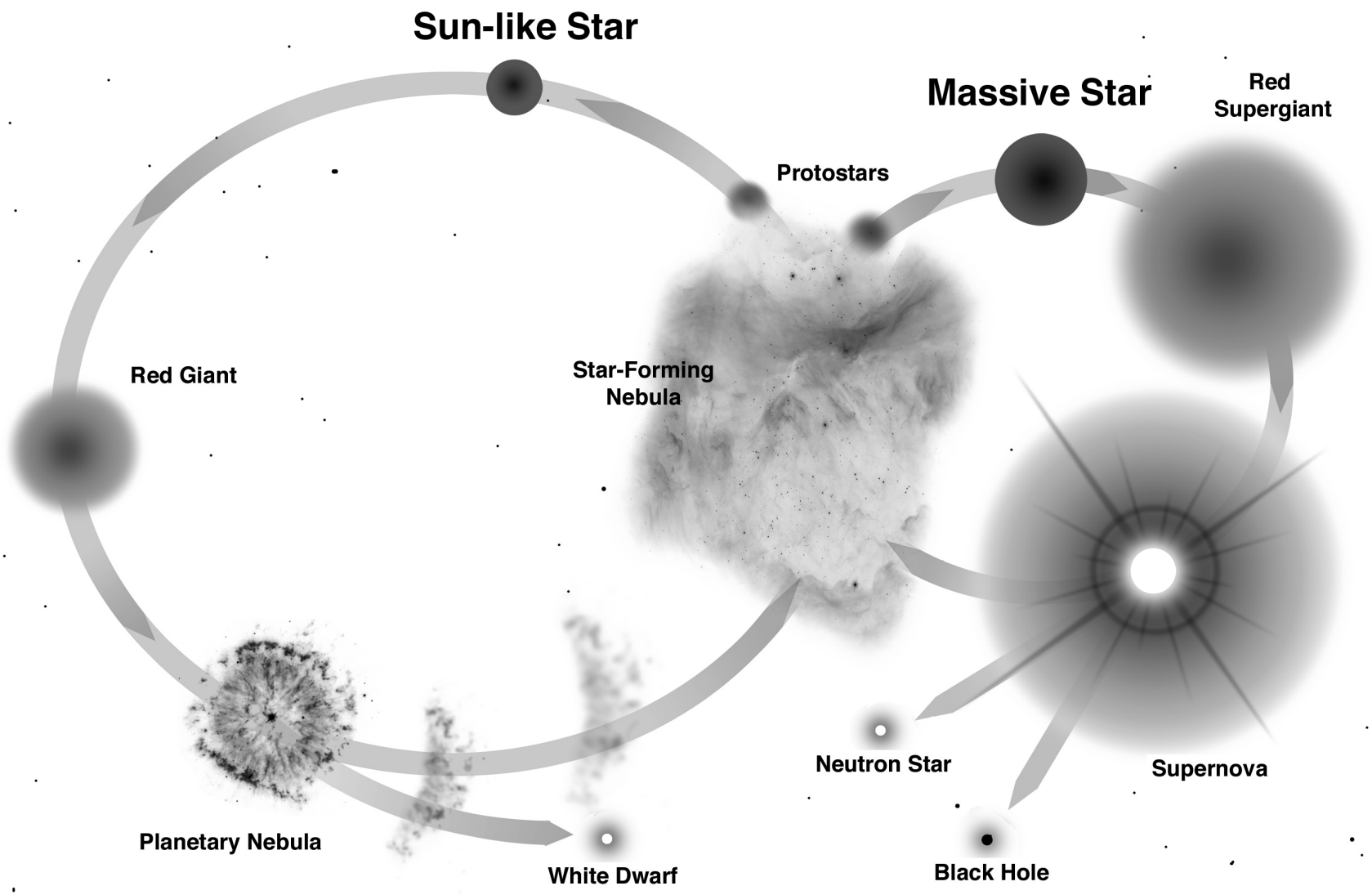


the lives of stars

National Aeronautics and Space Administration



the lives of stars

THE LIVES OF STARS

What is a red giant, a white dwarf, or a supernova? Where do these fit into the lives of stars? Follow the arrows on the diagram and discover the stages in the life of a small Sun-like star compared to the stages in the life of a massive star (a star more than 8 to 10 times the mass of our Sun).

Stars of all sizes are born as *Protostars* from a cloud of gas and dust in our galaxy (a *Star-Forming Nebula*). When the protostar compresses under the force of gravity and its core becomes hot enough, the star begins fusing hydrogen into heavier elements in its core.

Stages in the life of a sun-like star (A life of BILLIONS of years):

Sun-like Star: For billions of years, the star remains stable, fusing hydrogen in its core.

Red Giant: After several billion years, the star uses up the hydrogen in its core, and it turns into a red giant, now mostly fusing helium.

Planetary Nebula: At this point the star goes through an unsettled stage where it starts losing its outer atmosphere in a planetary nebula which forms around the star.

On the diagram, the cycle continues from the planetary nebula back into the cloud of gas and dust. This represents the recycling of the elements created in the star back into the interstellar medium to provide material to make new stars.

White Dwarf: The leftover core of the star cools down and shrinks to a white dwarf. After billions of years, the white dwarf cools off so much that it no longer glows and becomes the dark, cold remains of the star.

Stages in the life of a massive star (A life of MILLIONS of years):

Massive Star: For millions of years, the star remains stable, fusing hydrogen in its core.

Red Supergiant: After several million years, the star uses up the hydrogen in its core and it turns into a red supergiant. The star continues to fuse atoms in its core into heavier and heavier elements until the core starts filling up with iron. Because the fusion process stops at iron, the core collapses under its own weight, no longer held up by the heat generated during fusion.

Supernova: An explosive shock wave and the energy generated from the core collapse starts moving outward, heating the surrounding layers of the star, and BOOM. Most of the star is blasted into space in a supernova explosion. On the diagram, the cycle continues from the supernova back into the cloud of gas and dust. This represents the recycling of the heavy elements created in the star and during the supernova explosion into the interstellar medium to provide the material to make new stars — and planets.

Neutron Star or Black Hole: After the explosion, the remaining core of the star turns into a neutron star or, if the core is more than three times the mass of the Sun, it turns into a black hole.

Which NASA missions study supernovae, black holes, and high-energy radiation from space?

Some of the NASA missions are:

GLAST: http://www.nasa.gov/glast

Swift: http://swift.gsfc.nasa.gov

Chandra: http://chandra.harvard.edu/

In collaboration with European Space Agency (ESA)
XMM-Newton: http://xmm.sonoma.edu

In collaboration with Japanese Aerospace Exploration Agency (JAXA)
Suzaku: http://suzaku-epo.gsfc.nasa.gov/