

Reading Guide for November 19

from Gribbin and Gribbin, *From Here to Infinity*

Chapter 6. Stars

pp. 146–148. *The Life of a Star*. This describes the evolution of stars in general and our Sun in particular. The effects of these changes on the planets in our solar system are also described.

- Regardless of their masses, what do all main sequence stars do in common?
- What happens to make a star “leave” the main sequence?
- What new process occurs in the core of a star after it leaves the main sequence?
- What happens to the size of a star after this new process begins?
- If a star is massive enough, what process occurs after that?

pp. 148–150. *Stardeath*. How a star “dies,” and what is left of it afterwards, depends on its mass.

- What is a **white dwarf**?
- What is a **planetary nebula**?
- What is a **neutron star**?
- What is a **pulsar**?

Fig. 90. Although the discussion of planetary nebulas refers you to Fig. 90, this object, the Veil Nebula, is a supernova remnant, not a planetary nebula. The Cat’s Eye Nebula, in Fig. 87 (p. 141), is a planetary nebula. The Eskimo Nebula, in Fig. 92 (p. 151), is also a planetary nebula.

pp. 151–153. *Black Holes and Supernovae*. Giant stars, white dwarfs, and pulsars are certainly bizarre objects, difficult to imagine. This section describes objects that are even more extreme.

- What process creates a **Type 1a supernova**?
- What is a **black hole**?
- Why are some x-ray sources thought to contain black holes?
- What is a **Type 2 supernova**?

pp. 154–157. *Seeding the Universe*. This section goes into more detail about the death process of really big stars. Although these stars are rare, we personally would not exist if it were not for them!

In Fig. 94, the structure of a very massive star near the end of its life is shown schematically. The “burning” referred to in the diagram is nuclear fusion, not the chemical combustion reaction we ordinarily call “burning.” Larger atomic nuclei are more difficult to fuse than smaller nuclei do, because their greater positive charges repel each other more strongly. This means that they require a higher temperature to fuse. The star’s temperature increases from its surface to its core. Closer to the core, heavier nuclei fuse because that’s where the necessary high temperatures are, and because the lighter nuclei there already fused in the past, when the temperature was lower. No fusion is occurring in the iron core, because energy is absorbed rather than released by fusing nuclei as heavy as or heavier than iron.

- What causes the core collapse at the end of a large star’s life?
- When the star’s core collapses, what happens to the outer portions of the star?
- Under what conditions are the elements heavier than iron produced?
- What fraction of the Universe’s total mass is made of elements heavier than iron?