Video Guide for NOVA - Back to the Beginning

This PBS documentary, narrated by astrophysicist Neil deGrasse Tyson, explores the evidence for the Big Bang. You will meet the scientists who discovered the Cosmic Microwave Background Radiation (CMBR), the first piece of experimental evidence in support of the Big Bang theory. You will also see how the CMBR has been scrutinized in more and more detail since its original discovery, and what implications these details have for our understanding of the evolution of the Universe. As you watch the video, answer the following questions.

1. What was the name of the most recent theory that the Universe is eternal and unchanging?

2. What was Telstar (not the song)?

3. What kind of electromagnetic waves are used for communications satellites?

4. Wilson and Penzias were asked to help figure out what was causing the annoying hiss in Telstar's satellite communications. What did they do to test the antenna they were using? What did they find?

5. While Wilson and Penzias were making their discovery, what was a group of physicists at Princeton University trying to prove?

6. What aspect of the Big Bang did Bob Dicke believe should still be detectable today?

7. In the Big Bang, a “flash” of light initially filled the cosmos. As the Universe expanded, what happened to the wavelength of this light? What is this light like now?
8. If you had an old-fashioned TV set, how could you detect the flash of light produced in the Big Bang?

9. The microwave glow Penzias and Wilson saw was perfectly smooth across the entire sky. Why was this a problem for the Big Bang theory?

10. In order for galaxies to have arisen, what would have to be true about the microwave background glow? What did 30 years of observations of the microwave glow show?

11. What was the COBE satellite designed to find? When was it launched?

12. What did the blotchy picture generated from the COBE data show?

13. What was a limitation of the COBE picture?

14. Why did NASA build the WMAP (Wilkinson Microwave Anisotropy Probe) satellite?

15. The WMAP team started work in 1996, but work was slow. Tony Readhead took advantage of this slow progress to try to scoop NASA. What observations did Tony plan to make?

16. What did Tony's team build to make these observations? Why did they have to place it over 17,000 feet high in the Andes?
17. Five years into the WMAP project, in June 2001, the satellite was launched. But, before WMAP could report back, NASA’s competitor, Tony Readhead, was able to produce a picture with the Cosmic Background Imager. What did this image show?

18. In February 2003, the WMAP team finally produced a picture of the Cosmic Microwave Background. What do the peaks in this picture show? What do the valleys show?

19. According to data from the WMAP satellite, the Universe’s birthday occurred how long ago?

20. Inflation was a period of hyper-fast expansion, which increased the size of the Universe by how much?

21. What filled the Universe after the rapid expansion of inflation ceased? What happened to the light from the Big Bang during this time to “trap” it?

22. What happened that eventually allowed this light to travel freely through space? When did this occur?

23. What elements existed at the time shown in the WMAP picture of the Universe (i.e. 380,000 years after the Big Bang)?

24. What were the first stars like (e.g., what were their masses, lifetimes)?

25. What is a hypernova? (Do you remember hypernovas being discussed in the Gamma Ray Burst video a couple of weeks ago?)
26. Where do elements heavier than hydrogen and helium but lighter than iron come from?

27. Where do elements heavier than iron come from?

28. How is the evolution of the Universe like making a good soup?

29. What is happening in the Eagle Nebula?

30. What method do astronomers use to determine what elements are in far away galaxies? Note, these galaxies are both far away in distance and far back in time.

31. Are the elements essential for life unique to our galaxy, or are they widespread throughout the Universe?