

## Pre-Show

### Discovering the Universe

- 1) 13.8 billion years ago a sudden expansion of space marked the origin of the universe. This event is known as the Big Bang.
- 2) In its hot dense state, the observable universe inflated from smaller than an atom to bigger than a galaxy in less than a second.
- 3A) Today, light from the Big Bang is still spreading out.
- 3B) You can see it as television static.
- 4) You can hear it as radio hiss.
- 5A) Gravity shapes the universe.
- 5B) Gravity causes masses to attract each other.
- 6) Stars form when gravity causes dense regions of matter to collapse in on themselves.
- 7) A galaxy is a system of millions to trillions of stars, gas and dust, held together by gravitational attraction.
- 8) Our solar system lies halfway out from the center of the Milky Way Galaxy.

9) The Sun is one of a hundred billion stars in the Milky Way Galaxy.

10) The Earth formed within a disk of gas and dust left over from the Sun's formation.

11) Since the earliest human life on earth, we've been fascinated by the study of our origins and the eventual fate of our universe. (\*This was reviewed and confirmed as accurate and an acceptable statement per David Hurst Thomas, Ph.D., D.Sci, RPA, Curator of North American Archaeology Division of Anthropology American Museum of Natural History)

12) As long as there have been humans, we have searched for our place in the cosmos.

13A) Astronomy is the oldest science.

13B) It has been used to predict the seasons, navigate ships and help foster the birth of human civilization.

14) The first astronomical observations were made using the naked eye.

15) Visible light only occupies a small part of the electromagnetic spectrum.

16) There are many types of light that our eyes cannot detect.

17) In the 17th century, astronomers developed the optical telescope as an extension of human vision.

18) Optical telescopes enable us to observe light that our eyes aren't sensitive enough to see.

19) Telescopes are used for the observation of distant stars, planets, and galaxies.

20) By studying the wavelengths of light emitted by distant galaxies, astronomers can measure their motions through the cosmos.

21) A moving object emits light waves.

22) When stationary, an object emits light waves in perfect circles.

23) When an object moves, the light waves spreading out ahead of it get shorter as they are squashed together.

24) The light waves spreading out behind it get longer as they are stretched apart.

25A) Shorter light waves are bluer—they are blueshifted.

25B) Longer light waves are redder—they are redshifted.

26) Astronomers find a redshift in almost every distant galaxy they observe.

27) A redshift means the galaxy is moving away from us.

28) If all distant galaxies are moving away from us, then is the universe itself expanding?

29) A new age of discovery has begun. We invite you to travel with us far beyond the reaches of our Milky Way Galaxy ... into the distant reaches of space...