Cosmic Times Questions:

• 1919

What was the estimated age and size of the universe according to astronomers in 1919?

Age:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Size: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

*Sun’s Gravity Bends Starlight*

Both Newton’s and Einstein’s theories of gravitation made predictions about light.

What was the SAME about their predictions?

What was different about their predictions?

Of these two (Newton and Einstein), whose theory was proven to be most accurate?

Why did scientists need a total solar eclipse to detect starlight bending around the Sun? Why did they need to repeat the measurements months later?

*Mt. Wilson Astronomer Estimates Milky Way 10 Times Bigger Than Previously Thought*

Describe the size and shape of the galaxy, according to Shapely.

Where is the Sun located in the Milky Way galaxy?

What special cluster of stars did Shapley study to learn the size and structure of the galaxy?

Why did Shapley believe there could be no other galaxies outside the Milky Way?

*Expanding or Contracting?*

Why did Einstein add the cosmological constant to his equation for General Relativity? What problem did it solve?

• 1929

What was the estimated age and size of the universe according to astronomers in 1929?

Age:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Size: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

*Andromeda Nebula Lies Outside the Milky Way Galaxy*

What is a nebula?

Explain what Dr. Edwin Hubble discovered about spiral nebulae?

What type of stars did Hubble find in the Andromeda Galaxy that allowed him to calculate its distance?

Who was the first person to recognize the importance of Cepheid variable stars?

Explain how a Cepheid variable can be used to determine distance?

What three types (shapes) of galaxies did Hubble identify?

*The Universe is Expanding*

Using the 100-inch Hooker Telescope, Hubble discovered two things that provide definitive evidence that the universe is expanding. Describe those discoveries.

What theory had predicted an expanding universe before Hubble’s observations?

• 1955

What was the estimated age and size of the universe according to astronomers in 1955?

Age:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Size: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Did the size of the Universe double between 1929 and 1955? Explain

*Origin of Everything: Hot Bang or Ageless Universe*

How did the two leading theories of the origin of the Universe in this issue of Cosmic Times explain the expansion of the Universe? What scientists support each theory?

What are the primary features of each of the two leading theories of the origin of the Universe in this issue of Cosmic Times?

What is needed to help determine which theory is more likely correct?

*Yardsticks in Neighbor Galaxy Double Universe’s size*

What did Walter Baade discover about the size of the universe?

Explain how the period of a Cepeid variable can be used to determine distance.

What error did Baade discover in Shapley’s work.

• 1965

What was the estimated age and size of the universe according to astronomers in 1965?

Age:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Size: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

What type of radiation was discovered coming from space in all directions?

If the big bang produced high energy gamma radiation, why is the background radiation in the radiowave portion of the EM-spectrum?

How did the cosmic microwave background discovery help astronomers decide on a leading theory of the origin of the Universe?

Did luck play any role in Penzias and Wilson’s discovery of the cosmic microwave background? Why or why not?

*Quasars: Express Trains to Netherlands*

What do we know about the speed and brightness of quasars?

What do astronomers hope to learn by studying quasars?

*Galaxies Still Misbehaving*

How are galaxies “misbehaving”?

How much of the mass in the Coma cluster appears to be missing?

• 1993

What was the estimated age and size of the universe according to astronomers in 1993?

Age:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Size: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

*Baby Universe’s First Picture*

Fill in the blanks:

The universe began as a dense ball of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ that began to expand, distributing hot \_\_\_\_\_\_\_\_\_\_\_\_\_\_ and space outward in all directions. As the universe expanded and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, it produced \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. The quarks then combined to form \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. Then these combined to form hydrogen and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. This hot gas gave off high energy radiation that was red-shifted into the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ range. This is known as \_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

What is COBE?

Why were the “lumps” in the cosmic microwave background so important?

If dark matter doesn’t emit light, how do astronomers know it is there? What types of objects appear to have dark matter?

*Fool-proofing Galactic “Candles”*

What is the meaning of the term “standard-candle”?

*Dark Matter Hunt Heats Up*

Why was ROSAT’s discovery of a gigantic gas cloud so unexpected?

What was needed to hold the gas there?

What are two ideas that attempt to explain what dark matter is?

• 2006

What was the estimated age and size of the universe according to astronomers in 2006?

Age:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Size: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

*Faster Walk on the Dark Side*

What are two things we currently believe about dark energy?

In 1998, what did two teams of astronomers discover about the rate of expansion of the universe?

*Seeds of the Modern Universe*

What is WMAP?

How did the WMAP data differ from COBE data? What was the significance?

What are the “seeds” of the galaxy clusters we see today?

*Biggest Mystery: What is Dark Energy?*

What is the approximate composition of our universe?

73% \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 4% \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 23% \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

*Sorting out Dark Stuff*

What bad news and good news does the article discuss?