



## Quasar Variability Study

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Student Name: \_\_\_\_\_ Period/Subject: \_\_\_\_\_

### HOW DID IT HAPPEN?

#### The Cosmic Timeline - From the Big Bang to Today

##### Background

Everything has a beginning, including the universe, but how did it happen? To help with this question, we have to go back billions of years in time and imagine all of the matter and energy in our present universe was packed together in a small, dense, fireball. Then POW! a giant explosion takes place sending matter and energy out in all directions.

Most astronomers agree this giant explosion is what happened to form the universe. This explosion took place approximately 15 billion years ago and is called the Big Bang. The Big Bang marks the instant that time, space, matter and energy came into existence.

Major evidence that supports the Big Bang theory includes: observations that the universe is expanding outward, cosmic microwave background radiation, and the abundance of light elements such as Hydrogen and Helium. Using the Hooker telescope at Mount Wilson Observatory, Edwin Hubble discovered that the galaxies farthest away from us were moving away at a faster speed. This is called "Hubble's Law". It explains that the universe, which was once compacted, is expanding outward. In 1964, two radio astronomers confirmed that cosmic microwave background radiation was detectable throughout the universe. If the universe was originally very hot, this showed remains of that heat and energy, still present today. Using spectrometers (instruments showing identity of gas elements using light), astronomers have found clouds of gas formed in the first few minutes of the Big Bang, which show high amounts of hydrogen and helium, still abundantly present throughout the universe today.

##### Materials

Roll of white cash register receipt paper (for an individual timeline) - OR  
Long sheet of butcher paper (entire class timeline)  
Colored markers or pencils

## Procedure

Using a length of cash receipt paper (or butcher paper if working as a group), illustrate the list of astronomical events that took place from the Big Bang up to today. Write the date and a brief description of the event at the bottom of the paper and draw a picture of your interpretation above that. Be sure to allow for proper scaled spacing between the events. For example, if the events happened close together, place them near each other on the paper. If they happened farther apart in time, place them farther apart on the paper.

<b>Date (Time)</b>	<b>Event</b>
15 billion years ago	Big Bang! Violent explosion which marks the instant at which the universe began. All the matter and energy spread throughout space.
After 3 minutes	Protons and neutrons combine to form the atomic nuclei of the lightest elements: hydrogen and helium.
14 billion years ago	Stars and galaxies begin to form from giant gas nebulae.
8 billion years ago	Our Milky Way galaxy forms.
4.6 billion years ago	The birth of our Solar System happens, beginning with our sun and later the planets.
3 billion years ago	The basic building blocks of life form, beginning with microbes developing photosynthesis to produce food and oxygen.
1.5 billion years ago	Modern multicellular organisms emerge, eventually to present producing all forms of plant and animal life.
1929	Edwin Hubble discovers that the galaxies farthest away from us are moving away at a faster speed, known as "Hubble's Law".
1964	Discovery and confirmation of Cosmic Microwave Background Radiation (remaining heat and energy from the Big Bang explosion).
1992	COBE (Cosmic Background Explorer Satellite) maps the sky taking "baby pictures" of the early universe. This evidence shows the hot and cold spots in cosmic background radiation from the energy of the Big Bang.
2011	HIRES spectrometer finds evidence of Hydrogen and Helium in clouds of gas formed minutes after the Big Bang, still abundant in the universe today.
Today	NASA spacecraft, such as the Hubble Space Telescope and Spitzer Space Telescope, continue to measure the expansion of the universe occurring since the Big Bang.

## **Conclusion/Assessment**

Student or group timelines should illustrate all 12 dates/events listed. Each event should accurately portray a picture, date and text, which shows their understanding of the astronomical event. Have students contribute to a discussion of the Big Bang and the evidence that supports this theory.

## **Pre-Lesson Demonstration**

To develop student interest as you introduce the Big Bang timeline, you can perform a brief demonstration as follows:

### **Materials**

Baseball size whiffle ball  
Box cutter  
Party Poppers (small bag of 4-6)

### **How to Demonstrate**

Prepare for the demo by using the box cutter to enlarge one hole in the whiffle ball. Attempt to make the hole the width of the party popper, so it goes into the ball snugly. Put the popper in stem/neck end first, with the bottom of the popper facing open end out. Be sure to guide the string out one of the holes in the opposite end of the whiffle ball. Explain that 15 billion years ago, the universe was once a concentrated ball of matter and energy, which then exploded. Then explode your popper!