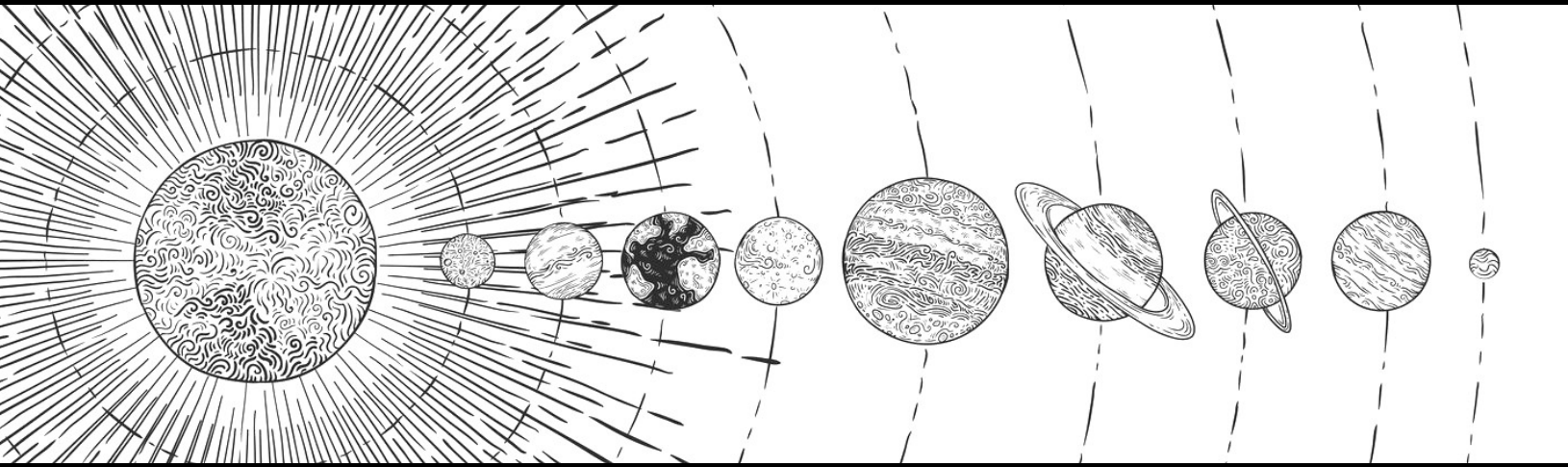


# THE EXPANDING UNIVERSE

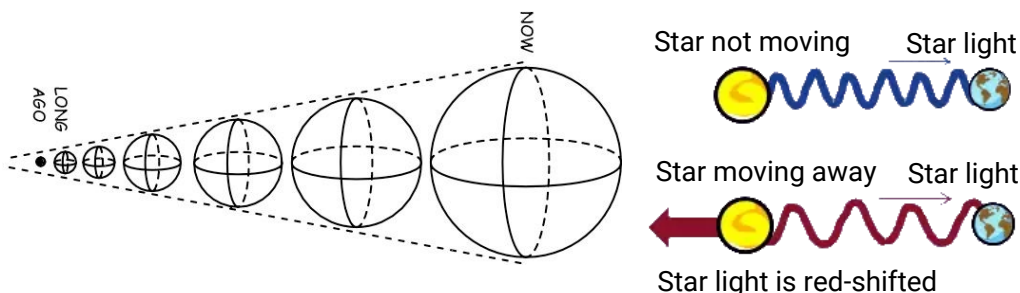
## LaCuKnoS Language Booster



### DESCRIPTION

Cosmology is the study of origins. Cosmologists attempt to answer questions such as how the Universe began. One explanation is the *Big Bang Theory* – a theory that **resulted** from several important observations made by the *astronomer*, Edwin Hubble. In 1927, Hubble first observed that light from distant stars is “red shifted.” This means that the light appears to be more red than it should be. *Red shift occurs* when an object you are observing is moving away from you at a high speed. This is similar to the Doppler shift that changes the sound you hear whenever something fast and loud, like a fire truck or a race car, moves past you quickly. When it is moving away from you, the pitch of the sound you hear gets lower.

The red shift that Hubble observed meant that the galaxies in every direction were moving farther and farther away from us. Second, Hubble determined that the farther away a galaxy is from us, the faster it is moving away. If the *Universe* is **expanding**, then it must be the case that the galaxies of our Universe were once closer together than they are now. By measuring how far apart galaxies are and how fast they are moving, Hubble calculated that it probably took about 15 billion years for the Universe to grow to its present size. From these observations, Hubble **theorized** that the Universe must have begun its expansion at a time when all the matter of the Universe was together in one place. This awesome event is what astronomers call the Big Bang. In this investigation you will model the expanding Universe and make observations similar to those that Edwin Hubble made.



**Talk with your partner about these questions, then write your answers...**

- 1 What characteristics of a balloon do you think will make it a useful model of the early universe?
- 2 What information do you think Hubble used to calculate that the age of the universe is 15 billion years old?

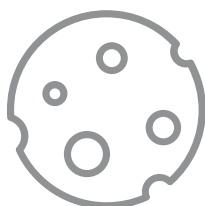
# BIG BANG AND EXPANDING UNIVERSE

## LaCuKnoS Science Investigation



### Materials

- Large round balloon
- Sharpie marker or pen
- 40-50 cm piece of string
- Ruler
- Paperclip



### DESCRIPTION

In this investigation you will be measuring the changes in a model over time to better understand the **concept** of the **expanding universe**. By constructing a balloon and dot model of the universe, you will be able to see how each star is moving further and further apart from one another, and think about how the model of the expanding universe was first constructed. This will also help you understand how simple modeling can help address complex science problems.



### PROCEDURE

1. Use the ruler and marker to mark off 1 cm measurements on the piece of string.
2. Inflate the balloon just a little bit (1 breath) and then use the marker to make 10 - 15 dots on the balloon, spread randomly around the balloon. Number 10 of the dots from 1 to 10.
3. Measure the distance between dot number one and each of the other numbered dots using the string and record your data in the first column of the table below.
4. Inflate the balloon part way (about 4 breaths). Twist the end of the balloon and secure with the paper clip so no air escapes (but don't tie the balloon).
5. Measure the distance again between dot number one and each of the other numbered dots and record your data in the second column of the table below.
6. Calculate the difference for each dot between column 1 (slightly inflated) and column 2 (half inflated) and record the differences in the third column.
7. Now, blow up the balloon to about double the size it was before and tie the balloon.



### Distance between Dots on Expanded Balloon

Dot	Initial Distance from Dot #1 after step 3 (cm)	Distance from Dot #1 after step 5 (cm)	Difference between 1st and 2nd distance (cm)	Final distance from Dot #1 after step 7 (cm)	Difference between 2nd and 3rd distance (cm)
2					
3					
4					
5					
6					
7					
8					
9					
10					



**With your group, discuss and then write an answer to the following questions.**

**Describe the patterns that you see in your data table.**

**How are the patterns in your data table relevant to the question of how the Universe expands?**

**If an object moving quickly away appears more red than normal (red shift), what do you think happens when an object is moving quickly towards you?**



# **BIG BANG AND EXPANDING UNIVERSE**

## **LaCuKnoS Investigation Summary**

### **Practice: Using Models to Construct Explanations**

Describe the concept that the Expanding Universe model can help you to explain.

Describe the relationships that the Expanding Universe model shows.

Describe a strength and a weakness of the Expanding Universe model for explaining the concept

Use your own words to describe how the Expanding Universe model helps you explain the movement of the universe.

Use scientific language to describe how the Expanding Universe model helps you explain the movement of the universe.



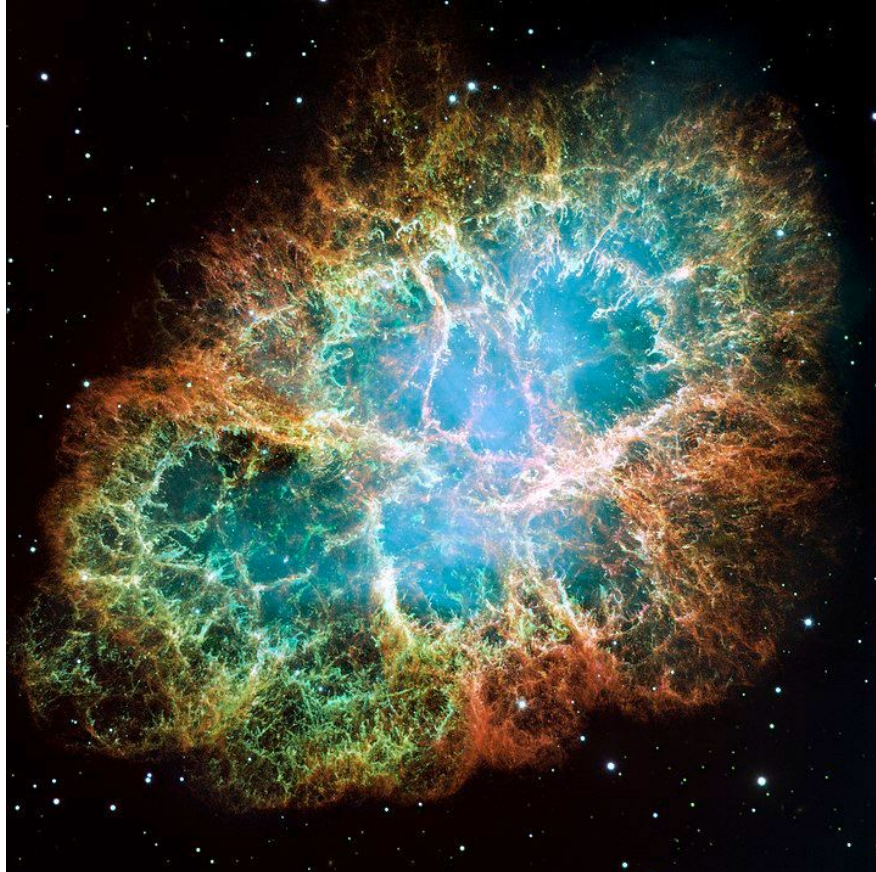
## **BIG BANG AND EXPANDING UNIVERSE**

### **LaCuKnoS Concept Cards**

# **Universe/Universo**

**All of space and everything in it including stars, planets and galaxies.**

**Todo el espacio y todo lo que incluye estrellas, planetas y galaxias.**







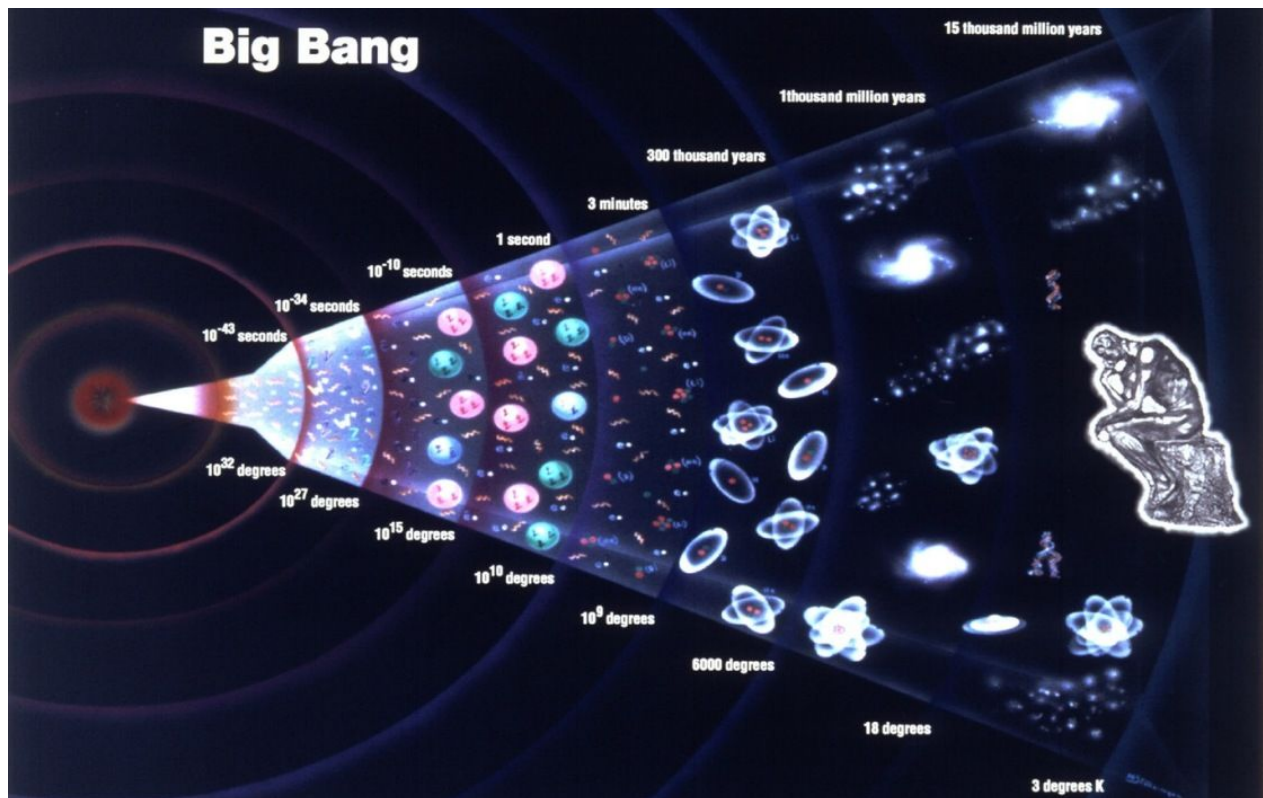
## BIG BANG AND EXPANDING UNIVERSE

### LaCuKnoS Concept Cards

# Big Bang Theory/ Teoría del Big Bang

The theory that the universe may have been created in a huge explosion at least 12 billion years ago.

La teoría de que el universo pudo haber sido creado en una gran explosión hace al menos 12 mil millones de años.





## **BIG BANG AND EXPANDING UNIVERSE**

### **LaCuKnoS Concept Cards**

# **Astronomer/Astrónomo**

**An expert in astronomy; a scientific observer of the celestial bodies.**

**Un experto en astronomía; un observador científico de los cuerpos celestes.**







## BIG BANG AND EXPANDING UNIVERSE

### LaCuKnoS Concept Cards

# Red Shift/ Desplazamiento al Rojo

When light or other electromagnetic radiation from an object is increased in wavelength, or shifted to the red end of the spectrum.

Cuando la luz u otra radiación electromagnética de un objeto se incrementa en longitud de onda, o se desplaza al extremo rojo del espectro.

