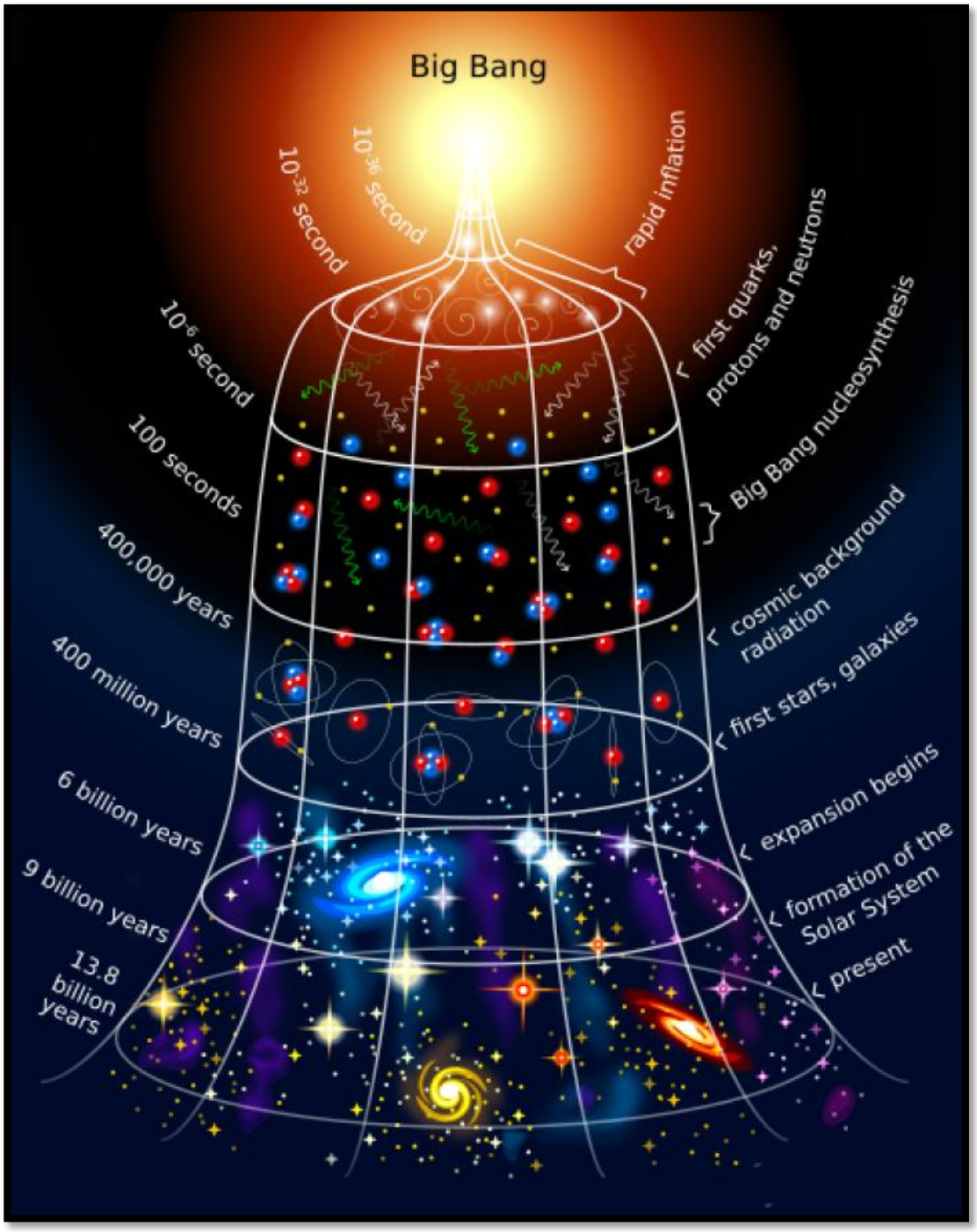
Science: Solar System - What is the Universe? The Scale and Age of the Universe



Name: _____

Science: Solar System – What is the Universe? The Scale and Age of the Universe

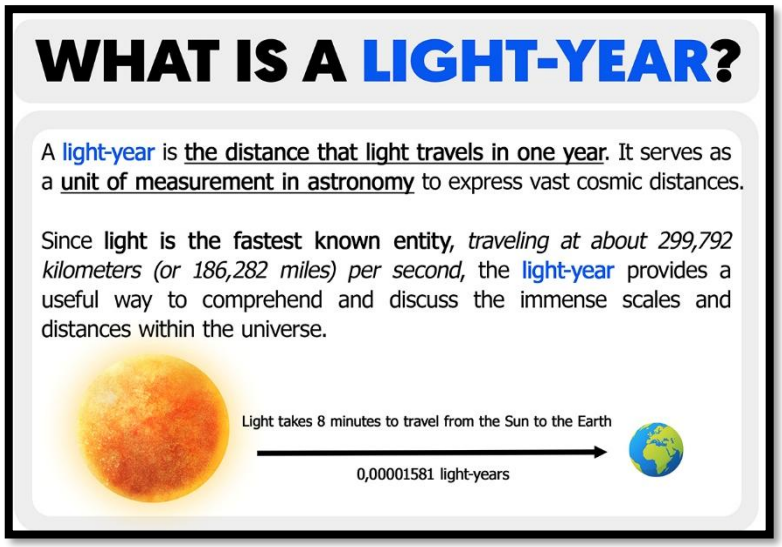
Big Idea (6): The solar system is part of the Milky Way, which is one of billions of galaxies.
Content (6): The overall scale, structure, and age of the universe
Content (6): The position, motion, and components of our solar system in our galaxy
Curricular Competency (6): Questioning and Predicting: Make predictions about the findings of their inquiry
Curricular Competency (6): Questioning and Predicting: Make observations in familiar or unfamiliar contexts
Curricular Competency (6): Planning and Conducting: Observe, measure, and record data, using appropriate tools, including digital technologies
Curricular Competency (6): Planning and Conducting: Use equipment and materials safely, identifying potential risks
Curricular Competency (6): Processing and Analyzing Data and Information: Compare data with predictions and develop explanations for results
Curricular Competency (5): Evaluating: Identify possible sources of error
Curricular Competency (5): Evaluating: Suggest improvements to their investigation methods
Curricular Competency (5): Applying and Innovating: Generate and introduce new or refined ideas when problem solving
Curricular Competency (5): Communicating: Communicate ideas, explanations, and processes in a variety of ways
First Peoples Principles of Learning: Learning is experiential

Background Information

Scientists estimate the universe is about **13.8 billion years old.** The universe is so vast that ordinary units (kilometers) become useless. Astronomers use: Astronomical Unit (AU): distance from Earth to Sun (~150 million km), and Light-year (ly): distance light travels in a year (~9.46 trillion km).

Examples of Scale:

- Earth to Moon: 384,000 km (~1.3 light-seconds).
- Earth to Sun: 1 AU = 8 light-minutes.
- Sun to nearest star (Proxima Centauri): 4.2 light-years.
- Milky Way galaxy diameter: ~100,000 light-years.
- Distance to Andromeda galaxy (nearest big galaxy): ~2.5 million light-years.
- Observable universe: about 93 billion light-years across.



Analogy for Scale:

If the Sun were the size of a grain of sand:

- Earth would be a speck of dust orbiting a few centimeters away.
- The nearest star would be another grain of sand several kilometers away.
- The Milky Way would be the size of North America filled with sand.

This shows how empty space really is.

Goal

To better understand how old the universe is, and how big it is.

Materials

- A pen or pencil
- Meter stick, or tape measure, or piece of paper that is measured out to 1 m
- A long working space, such as a hallway, or an outdoor space
- A spare piece of paper
- 10 random objects to represent the planets

Curricular Competency: Questioning and Predicting: Make **predictions** about the findings of their inquiry

You are asked to make some predictions. Write down your thoughts:

1) When do you think humans appeared on the calendar, if the age of the universe were squished into one calendar year? _____

_____

Why is that? _____

_____

_____

2) You will be asked to space out how far various planets/dwarf planets are from the sun. How many meters will the planets be from Earth, if 1 meter = 10 million km

Planet / star	How many meters from Earth
Mercury	
Venus	
Earth	
Mars	
Jupiter	
Saturn	
Uranus	
Neptune	
Pluto	

How did you come up with those numbers? _____

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Curricular Competency (6): Planning and Conducting: Use equipment and materials safely, identifying potential risks owing information

How will you ensure safety during this lab? Read through the rest of this lab, and discuss all of the ways that you can keep yourself safe, others safe, and the learning environment safe:

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Curricular Competency: Planning and Conducting: Observe, measure, and record data, using appropriate tools, including digital technologies

Below is your **COSMIC CALENDAR** – a calendar that shows when events occurred, if all of time were compressed into a calendar. Use lines to help you add events to the calendar. Use the white space around the calendar to add more details. Consult the list on the next page.

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	1	1	1	1	1	1	1	1	1	1	1
2	2	2	2	2	2	2	2	2	2	2	2
3	3	3	3	3	3	3	3	3	3	3	3
4	4	4	4	4	4	4	4	4	4	4	4
5	5	5	5	5	5	5	5	5	5	5	5
6	6	6	6	6	6	6	6	6	6	6	6
7	7	7	7	7	7	7	7	7	7	7	7
8	8	8	8	8	8	8	8	8	8	8	8
9	9	9	9	9	9	9	9	9	9	9	9
10	10	10	10	10	10	10	10	10	10	10	10
11	11	11	11	11	11	11	11	11	11	11	11
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14	14	14	14	14	14	14	14	14	14	14	14
15	15	15	15	15	15	15	15	15	15	15	15
16	16	16	16	16	16	16	16	16	16	16	16
17	17	17	17	17	17	17	17	17	17	17	17
18	18	18	18	18	18	18	18	18	18	18	18
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27	27	27	27	27	27	27	27	27	27	27	27
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29	29	29	29	29	29	29	29	29	29	29	29
30		30	30	30	30	30	30	30	30	30	30
31		31		31		31	31		31		31

Cosmic Events

January

- **Jan 1:** Big Bang — universe begins.
- **Jan 10–13:** First stars form.
- **Jan 13:** First galaxies begin forming.

March

- **March 15:** Formation of the Milky Way Galaxy.

August

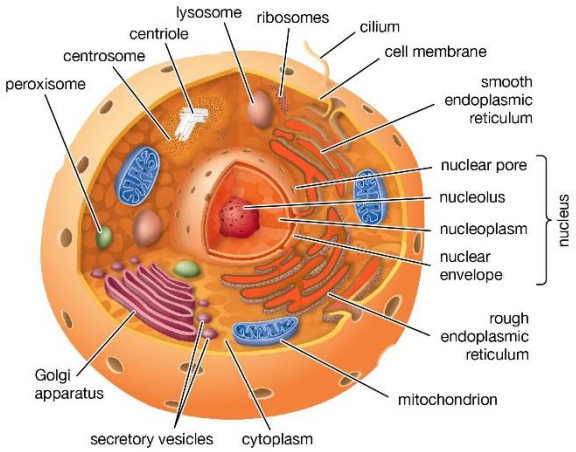
- **Aug 31:** Our Sun forms (4.6 billion years ago).
- **Sep 2:** Planets of the solar system form.

September

- **Sep 14:** Earth forms.
- **Sep 21:** Oldest rocks on Earth.
- **Sep 30:** First life (simple single-celled organisms).

October

- **Oct 9:** Oldest known microfossils (bacteria-like).
- **Oct 25:** Photosynthesis begins (oxygen starts to build in atmosphere).



November

- **Nov 12:** First eukaryotes (complex cells with nuclei).
- **Nov 15:** Reproduction evolves.
- **Nov 20:** First multicellular organisms.
- **Nov 26:** Simple animals (sponges, jellyfish).

December

- **Dec 5:** Cambrian Explosion (sudden burst of animal diversity).
- **Dec 14:** First land plants.
- **Dec 17:** First land animals (amphibians).
- **Dec 20:** Forests spread; insects flourish.
- **Dec 21:** Reptiles appear.
- **Dec 25:** Dinosaurs appear.
- **Dec 26:** Mammals appear.
- **Dec 27:** Birds appear.
- **Dec 28:** Flowers evolve.
- **Dec 30 (morning):** Dinosaurs go extinct.
- **Dec 30 (evening):** Mammals diversify.

December 31 — New Year's Eve

- **10:24 p.m.:** First humans (genus *Homo*).
- **11:52 p.m.:** Modern humans (*Homo sapiens*).
- **11:59:46 p.m.:** Humans invent agriculture.
- **11:59:55 p.m.:** First cities/civilizations.
- **11:59:59 p.m.:** Industrial Revolution, space exploration, modern science.

Curricular Competency (6): Questioning and Predicting: Make observations in familiar or unfamiliar contexts

Based on what you saw on the COSMIC CALENDAR, what did you notice about the age of the universe?

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Curricular Competency: Questioning and Predicting: Make predictions about the findings of their inquiry

How did your predictions compare with your findings, with the COSMIC CALENDAR?

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Curricular Competency: Planning and Conducting: Observe, measure, and record data, using appropriate tools, including digital technologies

We will now look at the **Scale of our Solar System.**

- Write down the names of your planets on a separate piece of paper. These will be the labels for your planets.

Planet / star
Mercury
Venus
Earth
Mars
Jupiter
Saturn
Uranus
Neptune
Pluto

- At the end of the hallway (or outside), place 'the Sun' (any object to represent the sun). Place your label next to it.
- Use your meter stick (or tape measure) to measure out the distances for the other planets. Place and label them.

Distances at 1:10 Billion Scale

(Round to nearest half-meter for convenience)

- Sun: at the starting point.
- Mercury ⟶ **0.6 m**
- Venus ⟶ **1.1 m**
- Earth ⟶ **1.5 m**
- Mars ⟶ **2.3 m**
- Jupiter ⟶ **7.8 m**
- Saturn ⟶ **14.3 m**
- Uranus ⟶ **28.7 m**
- Neptune ⟶ **45 m**

👉 Pluto (dwarf planet) would be **~59 m** away.

Curricular Competency (6): Questioning and Predicting: Make observations in familiar or unfamiliar contexts

Based on what you saw on the SCALE OF THE UNIVERSE, what did you notice about far everything is from each other?

Curricular Competency (5): Communicating: Communicate ideas, explanations, and processes in a variety of ways

Use the space below to create a diagram, that shows how THE SCALE of our solar system – you are trying to create a drawing that shows how far apart the planets are from each other:

Curricular Competency: Questioning and Predicting: Make predictions about the findings of their inquiry

How did your predictions compare with your findings, with the SCALE OF THE SOLAR SYSTEM?

Curricular Competency (5): Applying and Innovating: Generate and introduce new or refined ideas when problem solving

Now that you have learned about the AGE of our universe, and the SCALE of our solar system, how could someone use this knowledge to come up with a new idea, or to solve a problem?

Curricular Competency (5): Evaluating: Identify possible sources of error

Every lab has potential flaws in it. What are some of the ways that the lab itself (not you), could lead people to different results?

Curricular Competency (5): Evaluating: Suggest improvements to their investigation methods

How could you have improved your investigation methods?

Rubric:

Emerging	Developing	Proficient	Extending
Some sections are completed. Decipherable answers show initial understanding of the concepts, and sometimes incorporate specific vocabulary terms and reasoning.	All sections are completed. Answers show a growing understanding of the concepts, with some correct use of vocabulary and reasoning. Students are beginning to make connections and explain ideas with increasing clarity.	All sections are completed. Answers are reasonable, show clear understanding of the concepts, and include appropriate vocabulary and logical reasoning.	All sections are completed thoroughly. Answers are reasonable, insightful, and demonstrate clear connections to bigger ideas, with precise vocabulary, effective reasoning, and reflect awareness of multiple perspectives or broader implications of the concept.