ASTROEDU

Peer-reviewed Astronomy Education Activities

# History of the Universe

## Build a timeline to discover the relative ages of the Universe, the solar system and the appearance of humans, on the scale of a year.

Space Awareness, Leiden Observatory

**AGE**

8 - 10

**LEVEL**

Primary

**TIME**

1h30

**GROUP**

Group

**SUPERVISED**

No

**COST PER STUDENT**

Medium Cost

**LOCATION**

Small Indoor Setting (e.g. classroom)

**CONTENT AREA FOCUS**

Astronomy

**ASTRONOMY CATEGORIES**

Cosmology

**CORE SKILLS**

Asking questions, Developing and using models, Using mathematics and computational thinking, Communicating information

**TYPE(S) OF LEARNING ACTIVITY**

Structured-inquiry learning, Problem-solving

**KEYWORDS**

Universe, Earth, Mathematics, Timeline

## GOALS

During the activity, students create a timeline showing various events from the beginning of the universe to the present day. They learn about the relative ages of the universe, the Earth, and the existence of humans on the planet.

## LEARNING OBJECTIVES

Implementing the activity, students will be able to: * explain that the universe is very old * explain that the Earth was created relatively recently compared to the age of the universe. * discuss that humans have been on the planet for a relatively short time, compared to the age of the Earth * practise maths skills by converting between time units, using scales and division to create their timeline.

## EVALUATION

Ask students to explain the order of important events in the universe and on Earth, and how long ago they occurred. They should be able to explain that the universe is very old, that the Earth came into existence relatively recently and that people have only lived on the planet for a relatively short time. Has the students' concept of 'old' changed?

Optional: Ask students to calculate the difference between two times: e.g. how many years older is the birth of the solar system than the appearance of humans on Earth.

## MATERIALS

For each group of three: * craft paper * calculator or squared paper * scissors * glue * colouring pencils (or other medium of colouring e.g.: water colours, pens, paint)

For each student: * Worksheet in pdf * Pencil or pen

For the class timeline: * 12 A4 paper, plain or coloured * 1 coloured A4 paper for clock

## BACKGROUND INFORMATION

### Earth

Earth is our home and the third planet from the Sun, with a mean distance of about 150 million kilometres. This distance is such that the average surface temperature is above the freezing point of water (0°C) and liquid water can exist freely. This has played a fundamental role in the development of life on our planet, unlike on Venus and Mars, whose surface temperatures are either much warmer or much colder. Earth only has one natural satellite, the Moon, which is thought to have played a major role in stabilising the axis of rotation of the Earth. Once again, this may have been a favourable element in the emergence of life.

One billion years after the Sun and Earth formed, the first known life on Earth, single-celled organisms such as bacteria, emerged around 3.8 billion years ago. One billion years later, multicellular life appeared, though not in forms we would recognise today. Insects and then fish began to evolve around 500 million years ago, and dinosaurs and then mammals around 200 million years ago. 65 million years ago, the extinction of the dinosaurs occurred, and the number of mammals increased. By comparison humans (Homo sapiens) are very recent, emerging only 200,000 years ago.

**Universe**

The universe is the vast expanse of space which contains all of the matter and energy in existence.

The universe contains all the galaxies, stars, and planets. The exact size of the universe is unknown. Scientists postulate that the universe is still expanding outward: the result of a violent, powerful explosion that occurred about 13.7 billion years ago. This explosion is known as the Big Bang. By looking at the change in colour of light (its electromagnetic spectrum) from an object, scientists can determine if an object is moving away from or towards Earth. If the colour of light from an object is shifted towards red, it is moving away from us. The more redshifted the light, the faster it is moving away from us. All of the distant galaxies have tremendous redshifts. Based on these data, scientists postulate that the universe is still expanding outward.

Image: NASA ESA STScI (S. Beckwith) HUDF Team

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## FULL ACTIVITY DESCRIPTION

### Preparation

For the activity you will need a timeline made from 12 sheets of A4 paper. Each sheet of paper represents one month. Divide the month of December into 31 squares. These are the days. Number the days 1 to 31. On a sheet of coloured A4 paper, draw a section of a circle as shown in the drawing. This represents the last 10 minutes of December. Display the timeline, together with the section of the circle, on the wall in the classroom, preferably within reach of the students.

### Activity 1: What is a year?

### Step 1:

The students complete Task 1 on the worksheet.

### Step 2:

Explain briefly what a year is. Ask if every year is the same length of time.

### Step 3:

Discuss the following questions: How old is old? Is a father old? And a grandfather? Father Christmas? An antique chair?

## Step 4:

Discuss with the students how far back in time we know about. Explain that most of what we know about long ago comes from written sources. Everything that we know about the time before people learned to write has been deduced by scientists on the basis of research, such as archaeological digs.

## Step 5:

The students will investigate how old the universe is and when important events took place in the universe and on Earth.

## Activity 2: Timeline of the universe

## Step 1:

Draw the students' attention to the timeline. Ask students if they know what the universe is. Explain that this timeline shows time from the beginning of the universe to the present day. Now look at the section of the circle and explain that this shows the last ten minutes in the year.

## Step 2:

Organise the students into groups of three. Give each group a calculator or a sheet of squared paper.

## Step 3:

The students complete Tasks 2a to c. Help them to complete the table. Explain how to calculate how long a month on the timeline is in reality (15 billion years divided by 12 months = each month on the timeline is 1.25 billion years in reality). You can find the answers in the list below. The students will need this information for the next task.

| Time on timeline | Time in reality |
|---|---|
| 1 year | 15 billion years |
| 1 month | 1.25 billion (1250 million) years |
| 1 week | 300 million years |
| 1 day | 43 billion years |
| 1 hour | 1.8 million (1,800,000) years |
| 1 minute | 30,000 years |
| 1 second | 500 years |

*Good to know:*
According to the Big Bang theory, the universe was "born" around 13.7 billion years ago (however, in the remainder of this exercise we will say that it was born 15 billion years ago, for ease of calculation). After this, the universe developed, the galaxies (including our own, the Milky Way) were formed, the Sun was born, and the Earth took shape. The various geological eras passed, and life as we know it today evolved from the first living organisms. On the timeline the students will be making, the Big Bang took place at 00.00 on 1 January. Earth was born in September, and the first humans appeared on 31 December at 23.57.

| Time on timeline | Time in reality | Event |
|---|---|---|
| 1 January | 15 billion years ago | beginning of the universe |

| Time on timeline | Time in reality | Event |
|---|---|---|
| early January – mid-March | 12 – 14.7 billion years ago | birth of solar systems |
| early September | 5 billion years ago | birth of Sun and planets |
| end of September | 3.8 billion years ago | emergence of first life forms |
| 25 December | 225 million years | mammals appear on Earth |
| 29 December | 65 million years ago | extinction of dinosaurs, more mammals appear |
| 30 December | 5 million years ago | first ancestors of man appear |
| 31 December 23.53.00 | 195,000 years ago | Homo Sapiens appears |
| 31 December 23.59.52 | 4300 years ago | building of Stonehenge |
| 31 December 23.59.59 | around 400 years ago | invention of the telescope |

### Step 4:

Give each group a specific event to investigate. The third column of the above table shows eleven events that can be shared among the groups.

### Step 5:

The groups complete Task 2d to j. The students calculate the point on the timeline on which their event took place. Before they begin, discuss the example on the worksheet.

### Step 6:

For Task 2k hand out craft paper, colouring pencils, glue and scissors. Encourage the students to make something associated with the event they have just investigated and paste it in the correct place on the timeline.

## Activity 3: How old is old?

### Step 1:

The students complete Task 3 on the worksheet.

### Step 2:

Discuss the answers and the timeline. Explain that the entire timeline covers a span of 15 billion years. So one second on the timeline actually represents 500 years! Come to the conclusion that the universe is very old, that the Earth came into existence relatively recently and that people have only lived on the planet for a really short time.

**CURRICULUM**

| Country | Level | Subject | Exam Board | Section |
|---|---|---|---|---|
| UK | KS1 | History | - | Events beyond living memory that are significant nationally or globally. |
| UK | KS1 | Art and Design | - | To use drawing, painting and sculpture to develop and share their ideas, experiences and imagination. |
| UK | KS2 | History | - | Pupils should continue to develop a chronologically secure knowledge and understanding of British, local and world history. |
| UK | KS2: Year 5 | Maths | - | Number – number and place value: count forwards or backwards in steps of powers of 10 for any given number up to 1 000 000. |
| UK | KS2: Year 6 | Maths | - | Number – number and place value: read, write, order and compare numbers up to 10 000 000 and determine the value of each digit. |
| UK | KS2: Year 6 | Maths | - | Ratio and proportion: solve problems involving the relative sizes of two quantities where missing values can be found by using integer multiplication and division facts. |
| UK | KS2: Year 6 | Science | - | Evolution and inheritance: recognise that living things have changed over time and that fossils provide information about living things that inhabited the Earth millions of years ago. |

## ADDITIONAL INFORMATION

## CONCLUSION

During the activity, students build a timeline showing various events from the beginning of the universe to the present day. Students learn that the universe is very old and that the Earth and humans appeared relatively recently.

### ATTACHMENTS

- Worksheet PDF

### CITATION

Space Awareness, 2016, *History of the Universe*, astroEDU, , doi:10.14586/astroedu/1612

### ACKNOWLEDGEMENT