

### **Title:** *The history of Universe an art-based STEAM activity at school*

Take your students on a journey to the history of the Universe; Photos, videos, goose game and AR-tool will bring us from the big bang to the present system.

### **Student Learning Objectives:**

- Learn about the history of the Universe.
- Reflect on how the need to solve new problems leads to technological advancement.
- Improve propensity for observing celestial phenomena.
- Deepen some notions about planets, stars, and galaxies.
- Understand the concept of space and time.

**Keywords:** *Universe, planets, stars, galaxies, time, space, Art, Exhibition, Creativity*

**Target audience:** *Teachers and students*

**Age range:** *8-13*

**Setting:** *School, museum, and laboratory (onsite or virtually)*

### **Duration:**

*5-6 hours in school/laboratory*

*1.5 hours in the museum*

### **Technical requirements:**

*PC, large monitor/TV, WEB connection, cellular (for AR tool)*

**Author(s)'s background:** *scientist and science communicator.*

## Connection with the curriculum:

This is a multidisciplinary learning tool, the use of which can include elements from several subjects. It represents multidisciplinary elements for STEAM pedagogy. In relation to the Italian school curriculum:

- **Primary school (8–10-year-old students):** This pathway is suitable for the last two grades of primary school as a complement to the subjects of Science and History.
- **Middle school (11–13-year-old students):** In middle school, this pathway is related to the subjects of Science, History, and Art.

## Teacher Support Materials

Useful resources, suitable for the age group of your students, are available at the “Teacher Support Materials” tab.

### Pre-activity materials

- [Il rompi atomi \(seminar\)](#)

### Activity materials

- [The History of the Universe](#) (slide)
- [The elements of the Universe \(AR project\)](#)

### Post-activity materials

- [Spazio Tempo e Universo \(seminar\)](#)
- [La Materia nell'Universo \(seminar\)](#)
- [Big Bang and History of Universe \(seminar\)](#)
- [La gravità \(cartoon\)](#)
- [La Materia \(cartoon\)](#)
- [La spazio \(cartoon\)](#)

## Structure

This educational pathway follows an inquiry-based pedagogical approach, organized into 3 logical stages:

1. Pre-activity
2. Activity:
3. Post-activity

**Guidance for preparation:** *Interested teacher, before launching the activities described in the following sections, must study the material provided (storytelling,*

slides, and cartoon) in order to have a clear understanding of the time needed and the strategy to follow during the narration.

## Pre-activity

### Phase 1: Provoke curiosity.

You can start with an open discussion with students about their concept of the Universe and how do they imagine it.

You can then use the following questions to initiate discussion, placing students in a familiar context suitable for engaging their personal interests and passions, and helping them observe the sky with a critical eye:

- *Has the Universe always existed?*
- *How large is the Universe?*
- *Where is the Earth in the Universe?*

Students should be then left free to respond and share their experiences and opinions. At this stage, your role is that of a facilitator, helping your students reflect on the basic knowledge of the Universe.

At the end of the pre-activity phase, you can also share with your students' useful materials to help them prepare the in person or virtual activity.

## Activity – investigate the Universe

### Phase 2: Front lesson

Activities, normally held in presence at the school/museum, can also be conducted online based on the circumstances.

You can use the Power-Point presentation (available at “Tracher Support Materials” tab) that includes many photos, videos, and cartoons, as main narrative of the activity - [The History of the Universe](#)

The first two questions to be addressed to your students are:

- *What are the main objects of the Universe? (Galaxies, stars, and planets)*
- *What are the constituents of the matter? (Molecules, atoms, nucleus, quarks and electron)*

The first topic of the lesson is to define, with the students, the main visible constituents of the Universe, considering that most of them are well known to the students. This is very well described in this set of slides ([link](#)).



The second topic is to reflect about how many kinds of “matter” eventually there are in the Universe (for example gas, liquid and solid or which?) and if we they know/imagine how matter is made of. The main aim is to understand that ALL the kind of “matter” are made by smaller and smaller components in a way like the matryoshka.

Let's the students make examples about what can be considered big or huge and what small or very small in the Universe and how matter is made of.

From the infinitely large, like a star, to the infinitely small, like to electron and quark, will be the main narrative of the lesson.

You can then proceed with a second group of questions that are very difficult to be answered but help students in imagining about the Universe.

- *How much a star or a galaxy are large?*
- *How many galaxies and stars are there in the Universe?*

Here it is important to introduce how we can measure quantities that are not usual to us. Dimension of a galaxy or of an atom, speed of speed and Light-year. Some very useful examples like why thunder and lightning do not come together, or why the light of a star that we see now is indeed left millions of years before.



### **Phase 3: The elements of the Universe (AR project)**

Augmented Reality (AR) has revolutionized the way we learn and understand science. It allows learners to experience and interact with virtual objects in a real-world environment, bringing abstract concepts to life. AR provides a highly engaging and interactive learning experience that can captivate learners' attention and inspire curiosity. By enhancing visualization, AR enables learners to grasp complex ideas more quickly, and it can provide a safe and cost-effective alternative to traditional laboratory experiments.

The AR project "The Universe (link)" will let the students explore the Universe and learn about the main elements like galaxies, planets, stars, and black hole.

For each of the three scenarios we have a QR code, to upload it with the AR platform, and the tow markers to run it.

Using an Android cellular or tablet the students will have the possibility to explore the Universe and interact with some of the main elements and learn about their dimension, distance, and compositions.

**First Scenario:** It will describe the earth and the moon. When the markers are separated, they show their own 3D models. When we put the Earth and Moon markers together, it changes to a 3D animation of the Moon revolving around the Earth. Text and audio will help the students in understanding the relative dimension and the distance between the two (fig. 2)

**Second Scenario:** Three different planets will be described and compared: Mars, Venus, and Earth. When we put the three markers together the planets will

be compared for what concern the relative dimension and distance from the sun (fig. 3)

**Third Scenario:** In this scenario we will study the main characteristics of the sun and other stars in the universe. Binary star and the sun are the markers and when put together they will be compared (fig. 4)



Figure 2: first scenario markers and QR code



Figure 3: second scenario markers and QR code

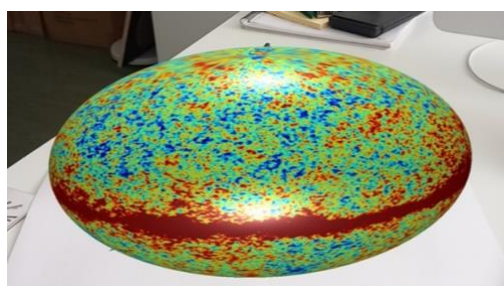
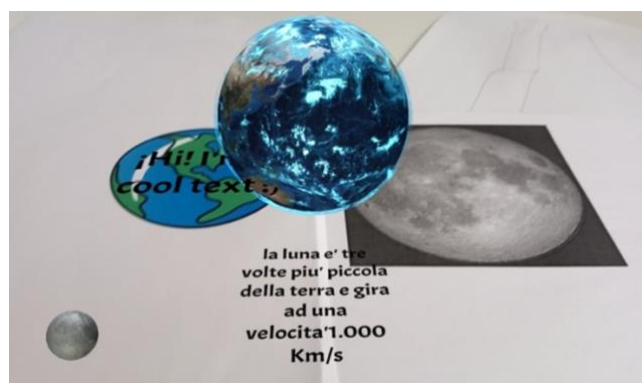


Figure 4: third scenario markers and QR code

This project is used while explaining about the universe and, more specifically, about the Earth and Moon, the planet, and the stars.

Children can visualize the 3D models separately and then mix them to understand the relationship between them.

It is also used to help them understand concepts such as gravity between bodies. This project can be used in combination with other activities described in the following section.



*Figure 5: The example of what students will see in the three scenarios (from top to bottom; Earth-Moon, Earth-Mars-Venus and The Universe)*

#### **Phase 4: Goose game “The History of the Universe”**

After having discussed the Universe and Matter it is time to play a game all together.

This activity is aimed at helping children discover the history of the universe by playing with the different physical objects present in it during the timeline: particles, atoms, stars, galaxies, black holes, etc.

**Background: tell them about the history of the Universe**

You can use the slides and the video about the History of the Universe available at “Teacher Support Materials” section.

Before starting the game, you can group all the students around you and tell them a history, the history of the Universe. The full text is available at “Teacher Support Materials” according to the age of your students.

### Here the History of the Universe (to be moved in the Teacher support Materials)

Before the birth of the Universe (about 14 billion years ago), everything was clustered together in a very little space, imagining it as an orange in which everything was concentrated. Everything was very hot, still, and motionless. Neither space nor time existed. Quite unexpectedly, for no apparent reason, there was an incredible event that started the Universe. Do you know how it is called? With the Big Bang everything that was previously clustered together in a space like an orange begins to recede and cool down. Let's try to draw dots all close together on a deflated balloon: if we start to inflate the balloon, those dots that used to be close together will get farther and farther apart. And that's more or less what has happened in the Universe since the Big Bang. And the Universe continues to expand and cool today.

In the beginning, even less than a second after the Big Bang, there was a phase where the Universe expanded very fast, in a moment it became 60 times bigger than it was! This phase in the history of the Universe is called inflation. As the Universe got bigger and bigger and a little less hot, what we call particles began to form, which are the smallest bricks in everything we know, a bit like Lego. And some particles join with others and form protons and neutrons, which, after about 1 minute, join to form nuclei. And this is a good thing because nuclei are a fundamental part of atoms, the smallest parts of matter. But at this point, the electrons are still unable to bond to the nuclei, to form atoms.

To get to the formation of atoms and thus of matter, we have to time jump: the first atoms are formed 370 thousand years after the Big Bang! And about 10 thousand years later, 380 thousand years after the birth of the Universe, something extraordinary happens. You must know that, until that moment, there was no light in the Universe! Everything was completely dark! And just 380 thousand years after the Big Bang, light is released. And that light still reaches us, so much so that we can reconstruct the first photograph of the Universe!

Not much happens from here for a long time, until the first stars begin to form, and then galaxies, some 700 million years after the Big Bang. And then the first planets, and some 9 billion years after the Big Bang, the Earth, and the Solar System.

### **Preparation of the game**



After setting up the board, the teacher tells the story of the universe by following the boxes on the board and, when encountering special boxes, explains what they represent and what the effect will be on the game. During the story, students are encouraged to ask questions or make observations on the story: discussion among students must be fostered as much as possible.

The class must be split up into 4 or 6 groups. Each group, in turn, walks around the board to understand what the route looks like.



### Rules of the game

The game follows the rules of the traditional goose game, but it traces the history of the Universe from the Big Bang to the present day, and the special squares have an effect related to some element in the history of the Universe (wormhole, inflation, dark Universe, black hole, galaxies, big crunch, etc.).

The children play in groups and take turns rolling the dice and walking on the board. Children are encouraged to organize their team turns by themselves. When the children land on a special square, helped by the teacher, they have to try to remember what it represents and when the square causes them to lose a turn they can try small tests and games to get free.



### Follow-up

After the match, teachers can stimulate a discussion among the students and recall some of the concepts discussed during the game to introduce specific topics, for example, the structure of the atom or black holes. Teachers can even assign students the task of drawing how they imagine those elements of the Universe we cannot see, such as particles or black holes, or the task of inventing a short story set in a particular moment of the history of the Universe.

### Post-activity

The aim here is to help your students reflect on the knowledge they acquired in the previous phases and develop their critical thinking.

In the “Teacher Support Material” section you find all you need to complete this phase. The materials are organized according to the age of your students and include:

- Quizzes
- Suggestions for group activities
- Videos