Teacher's card

A MATTER OF SCALE

Learning objectives

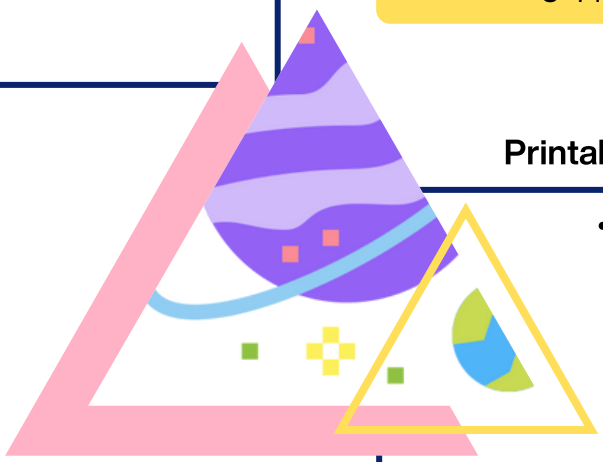
- Join a collective process
- Cultivate curiosity

Modalities of the activity

- Outside
- Physical activity
- In the classroom
- In group
- 8-11 years old

Materials needed

- Stopwatches
- Creative furniture (paint, coloured pencils)
- Balloons and paper mache (optional)
- Portable digital device (iOs 14.2 or later (optional)



Printable resources attached

- Solar system scale

Difficulty and targeted school level

- Easy - Medium
- Primary

Acts

- Act 1: The Infinitely Large
- Act 2: Create your Planetery System
- Act 3: Different life forms
- Act 4: The Interplanetary Conference

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Summary of the activity

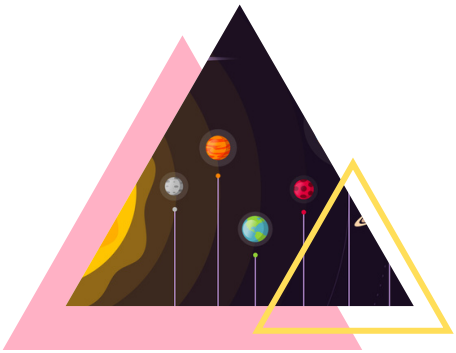
This sequence is thought as the discovery of space. First the children discover it with their own body. They experience how big are the distances in space and how the planets turn and interact with each other. This is a mess ! But if you look at it from another point of view, it's very organised, almost perfect...

In the second part, children use the knowledge earned in the first sequence and look at the videos to create their own planetary systems. For each system, constrains have to be respected. At the end, the children will present their system to the class. They will need to explain it specificities and describe all the planets.

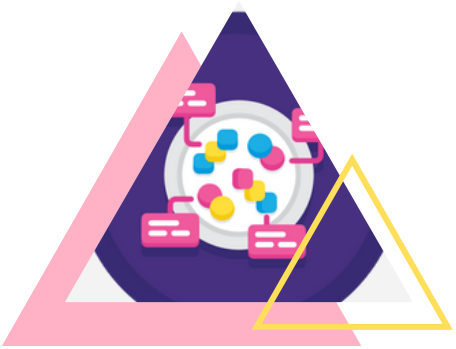
If the school is equiped with tablets, this activity can be done using augmented reality apps !

Sequencing the activity

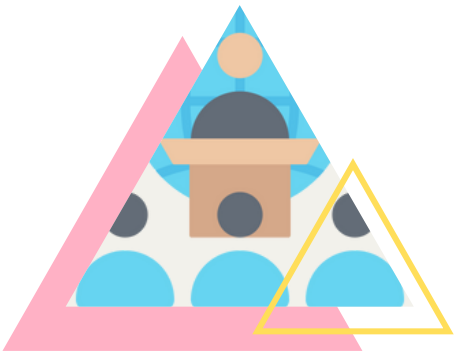
ACT 1: THE INFINITELY LARGE



ACT 2: CREATE YOUR PLANETERY SYSTEM



ACT 3: DIFFERENT LIFE-FORMS



ACT 4: THE INTERPLANETARY CONFERENCE

Learning objectives

By taking part in this exercise, each child will have to team up with the others, give his or her point of view, and accept that of others. It's a great way to bond with others. Learning in a group can also be more fun and stimulating.

Theatrical objectives

Theatre is teamwork. They will have to observe and listen to each other to reproduce the solar system. They will be free to interpret each planet as they see it, and it's a great way for each child to gain confidence and assert his or her ideas. Creating with others opens your imagination because you have to work with constraints, but you also benefit from advice and hep from the group.

Skills developed

The children will have to be connected to recreate the solar system. They will receive precise instructions. This exercise will enable them to put their skills to good use and combine their knowledge.

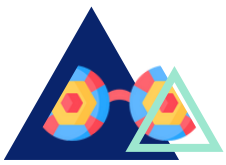
- Ability to observe and adapt to situations
- Body and space awareness
- Scientific knowledge
- Teamwork
- Arts & Crafts

Summary of the activity - Act 1 : The Infinitely Large

Physical theater

Duration of the Act : 30 minutes

Astronomy
Physics



Analytical thinking, Collaboration

Part I

Before the game the teacher print the printable 1 sheet on a A4 sheet. The teacher cuts the planets and paste them on a flag that can be carried with a stick.

The teacher creates 9 groups of children. Each group is given a stopwatch. The groups are composed as described in the table below. Feel free to adapt, reduce the number of moons or planets to match the size of your group of children.

Each group have a team leader who will play the main planet (except for the asteroid belt) and the other members of the group will be its moons.

Planet	Mercury	Venus	Earth	Mars	Jupiter	Saturne	Uranus	Neptune	Asteroid Belt
Number of students	1	1	2	3	4 or more	3 or more	3 or more	2 or more	Any number
Moons	0	0	The moon	2 : Phobos - Deimos	80 to 95 including Io - Europa - Ganymede - Callisto	146 including Titan - Enceladus	27 including Ariel - Rosalind	14 inclundin g Triton	Optional in the game

Explain to the students that you're going to make a human scale model of the solar system. You may need to explain the concept of a scale model. In our model, one step will equal 57 million kilometres !

Each group of student is given the role of a planet or celestial body. The teacher plays the sun. A stick with a planet flag is given to each group leader.

The teacher play the role of the sun and sets in the middle of the school yard/park/field. Then the planets receives instructions to take a certain number of steps away from the sun, representing the proportional distance of that planet from the Sun. The distance that the planets should take are described in the table below.

Planet	Mercury	Venus	Earth	Mars	Asteroid Belt	Jupiter	Saturne	Uranus	Neptune
Steps away from the teacher	1	2	3	4	8	13	25	50	78

Note : If the school yard is too small, the teacher can reduce the distance by dividing them in two. In this case, a step will stand for 114 million kilometers.

Part II

After evaluating the scale of the model by taking the right number of steps in groups, the children come back to the teacher. The teacher explains the concept of revolution period. Revolving around something means turning something while keeping always the exact same distance from the object. In space, the smallest object tends to revolve around bigger bodies, following the laws of attraction.

The groups returns to their distance, and are now asked to revolve around the sun according to the revolution period of their planet. Referring to the table below, if the earth revolves around the sun in 10 sec when Neptune revolves in 27 min ! The groups uses the clock-watch to try to match their revolution period while keeping their movement constant.

Planet	Mercury	Venus	Earth	Mars	Jupiter	Saturne	Uranus	Neptune	Asteroid Belt
Revolution period	87.97 days	224.7 days	365.26 days	686 days	4 328 days	10 752 days	30 660 days	59 901 days	2165 days
Revolution Period for the game	2,5 sec	6 sec	10 sec	18,5 sec	2 min	5 min	14 min	27 min	1 min

Part III

Now the children playing the moons can start revolving around their own planet as the planet is still revolving around the sun.

After a certain time of playing, the teacher can ask the children to stop. Together with the teacher analyse their model : did they manage to maintain the distances, the timings, etc. The teacher can propose a second round and the groups can be changed.

Phases of activity

1. Create groups.
2. Students move away from the sun according to their assigned position in the solar system.
3. The groups revolve around the sun according to the revolution period of the respective planet.
4. Moons start revolving around their own planet.

Summary of the activity - Act 2 : Create your Planetery System

Creativity

Duration of the Act : 25 minutes

Biology
Astronomy

Analytical thinking, Collaboration

Introduction

The teachers asks the children what types of celestial body they now (what can be found in space). Then the teachers starts asking question while referring to the table below :

- A terrestrial planet is a planet with a solid ground like the earth. How many can we find in the solar system ? Can you name some ?
- A Jovian planet is a massive planet made of gas. How many can we find in the solar system ? Can you name some ?
- A comet is an icy celestial body that produces gas, have you ever seen one ?

Celestial body	Terrestrial Planets	Jovian Planet	Hot Jupiter	Moons or satellites	Asteroid	Comet
Definition	Planet with solid ground like the earth	Gigantic gaz planets	Gigantic gaz planet close to our solar system	Planets that orbits around other planets.	A rock to small to be a planet that rotates around the sun	Icy celestial body that produces gaz when it comes close to the Sun
Examples	Mercury, Venus, Earth, Mars	Jupiter, Saturn, Neptune, Uranus	None in our solar system.	Europe, Titan, Ganymede, The moon,		

Now the teacher explains that the solar system isn't the only planetary system. The planets outside of our solar system are called exoplanets. Most of them are part of a planetary system but some doesn't orbits around a star. In this case they are called rogue planet.

To further explain how a planetary system works, the teacher can show the videos belows

- What is an exoplanet: Did you knew that the first exoplanet that orbits around a solar-like star was discovered in 1995 in an observatory in the french Alps (observatoire de Haute-Provence). Learn more: https://www.youtube.com/watch?v=0ZOhJe_7GrE
- Exoplanet types :
  - https://www.youtube.com/watch?v=k1UcseLVNVc
  - https://www.youtube.com/watch?v=4IXYp9Fse44
  - https://www.youtube.com/watch?v=J04YN9azln8
- Habitable zone : https://www.youtube.com/watch?v=J04YN9azln8

Main activity

The teacher prepares the material for the activity, colour pens, painting, etc. The planets can be drawn on a sheet of paper or on paper mache sphere (tutorials can be found on youtube to create paper mache sphere)

The teachers create working groups (4 to 7 children per group). Each group creates a planetary system. In each group, the pupils have to coordinate themselves so that at least one child create a sun. They find a name for their solar system and have to decide together the order of the planets in the system. If there is exoplanets, they have to be situated at an plausible distance of the sun, not to close and not too far.

Each child writes information about it's planet :

- Name
- Type of planet (can refer to table in the introduction)
- Order in the system
- Number of moons (if applicable)

Then each child draws (or paint) it's own planet. Once the planets finished, it's time to show your creation to the all class. One after the other, the groups shows their system to the rest of the class. Each child gives information about it's planet, it's name, etc... This is a good exercise to improve pronunciation and public speaking.

Digital version with augmented reality

Material requirements : IOS 14.2 or later device

Using the Adobe Aero app, the teacher can create augmented reality version of the solar system. This way children will be able to take a picture of their solar system with themselves in it !

The children cuts out their planets and take a picture of it on a colour background. The teachers remove the background of the picture using any online free tool : https://www.remove.bg/fr ; https://www.erase.bg/fr

The teacher uploads the images without background into the app. He creates a new scene for each system and place the planets in it. You can even animate the planets to follow a path or rotate on themselves.

Tutorial for adobe Aero can be found here : https://helpx.adobe.com/ca_fr/aero/tutorials.html

Phases of activity

1. Create groups. Ask each group to name their solar system.
2. Each child creates it's own planet.
3. Groups present their planetary system to the class.
4. Students create theis system in augmented reality (optional).

Summary of the activity - Act 3 : Different life-forms

The groups stay the same as in act 2. After creating their planetary system the children decide on which of the planets it is possible to have an intelligent life form / maybe on one of the terrestrial planets? They try to imagine how creatures look like on this planet. The question is related to their adaptation to the living conditions : gravity, presence or absence of water , temperature conditions, etc.

The task is to become these creatures. To invent how do they move and walk, do they communicate with words or otherwise ? Do they have technological equipment ? How do they act, what do they eat... Children's imagination has the opportunity to run wild. A creature can be played by a group of children. For example, if the creatures on the planet have 6 legs, then one creature will be represented by at least two participants from the group. The groups have fifteen minutes to work on their creature.

Then each group has 3 minutes to present it's planet inhabitants to the class. One children per group plays the newscaster. Like in a documentary, he will explain in plain words how the creature lives on the planet, what they do, etc. while the other members of the group imitates the creatures.

The activity brings a lot of fun, gives the opportunity to children to unleash their imagination and creativity during a theatrical and expressive improvisation. But it's also linked to science, exploring possible living conditions on different planets and life adaptation to these conditions.

At the end of the activity, if there is any time left, the children can be asked to draw the creatures they created.

Acting and improvisation

Duration of the Act : 40 minutes

Biology
Astronomy

Analytical thinking, Collaboration

Phases of activity

1. The groups imagine and decide what creatures live on the planets.
2. Decide how they move, how they walk, etc.
3. Show time.
4. The children draw their creature.

Summary of the activity - Act 4 : The Interplanetary Conference

The Interplanetary Conference
The game is played in pairs. Each group contains an alien and a translator. The alien is presented to the audience as speaking a fictional language (gibberish), and the translator translates. Everything is entirely in the hands of the translators and their ability to quickly improvise. The game is very useful for language development and public speaking. The topic of The Interplanetary Conference can be chosen by the teacher. For example "Ecology - what are the most important resources on my planet and how to protect them?", "How are children educated on my planet?", "What are the most interesting professions on my planet?", "What are we afraid of, what are we striving for, why are we fighting and how can we stop?". Each group has a preparation time of about 10 minutes, which includes:

- Rehearsal : how do the creatures express themselves ? The possibilities are unlimited, they may not make any sound with their mouths at all, they may speak only with their eyes or lying on the floor only with their toes. Free up your imagination
- Choosing a translator - one of the group who translates to the others in English /in our case the official language of the Interplanetary Conference :) /
- Clarification of some basic expressions and words related with the topic that will be used in the presentation - for example, certain gestures, signs, sounds with a precise meaning, which the translator will have to pay attention to during the translation...

The Interplanetary Art festival
In this version, the groups stay the same as in the previous acts. Instead of a conference, the children can work on an interplanetary art festival. Spontaneously and improvised within the session, each group presents a dance, a song, a music, a show... linked to the way of existence on the alien's planet. The session structure is the same :

- Time for rehearsal
- Organizing the "stage" and the presentation order
- Show time.

Acting and improvisation

Duration of the Act : 35 minutes

Biology
Astronomy

Analytical thinking, Self-expression

Phases of activity

1. Create pairs.
2. Rehearsal in pairs.
3. Organise the "stage" and the presentation order.
4. Show time!

Topic 1 - Understand the concept of infinitely large

- https://www.youtube.com/watch?v=i93Z7zljQ7I&t=1s&ab_channel=HarryEvett
- https://openstax.org/books/astronomy/pages/11-2-the-giant-planets
- https://www.youtube.com/watch?v=NIyjtgvRcnQ&ab_channel=NatGeoFrance
- https://www.youtube.com/watch?v=I7cajVnzm8k&ab_channel=C'estpassorcier

Topic 2 - Create a planetary system

- https://fr.scribd.com/article/509136083/Make-Your-Own-Solar-System-Mobile
- https://www.teacherspayteachers.com/Product/Make-your-own-SOLAR-SYSTEM-incl-instructions-all-designs-lesson-on-planets-5592770
- https://simpop.org/solar-system/solar-system.htm

Topic 3 - Habitable Zone: the Earth

- https://www.youtube.com/watch?v=J04YN9azln8
- https://www.youtube.com/watch?v=6Ihbuy5g84g&ab_channel=FiveThings

Topic 4 - Exoplanets

Exoplanets are part of the solar system. Here are some video resources to help you understand them.

- https://www.youtube.com/watch?v=0ZOhJe_7GrE
- https://www.youtube.com/watch?v=k1UcseLVNVc
- https://www.youtube.com/watch?v=4IXYp9Fse44