CESAR Scientific Challenge

Mission to the Moon

Plan a space mission

Teacher Guide

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Learning objetives

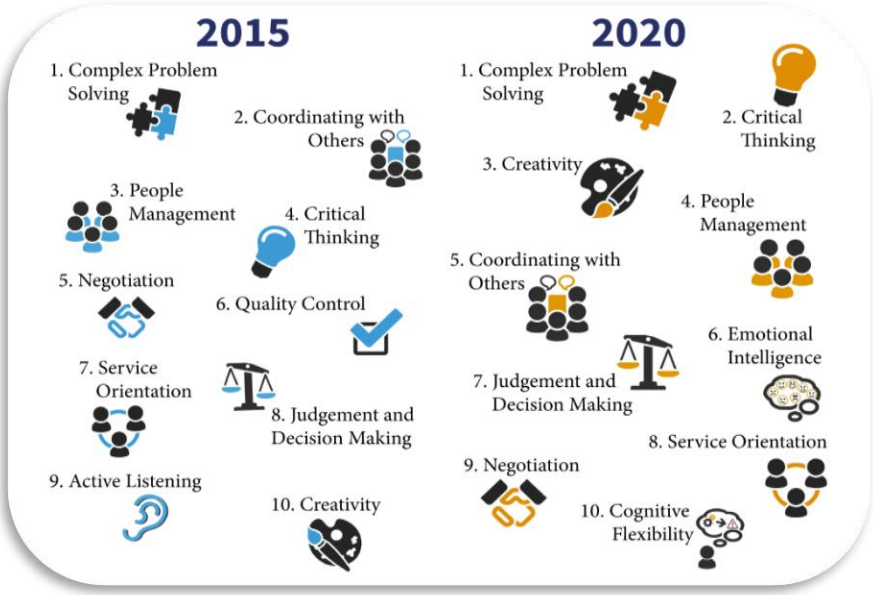


Figure I: *The considered top 10 skills in the 2020. (Credits: Refthinking).*

The CESAR Team generates activities for students to develop the considered top 10 skills in the 2020, where problem solving requires critical thinking and creativity. Our proposal is to execute these activities in teams. Students will find the environment where to develop their communication skills, managing different opinions and approaches, and making use of their emotional intelligence.

The CESAR scientific challenges aim to follow the thinking skills order established by the Bloom's taxonomy diagram, from a low order thinking skills (**remembering, understanding)** to a high order thinking skills (**evaluating, creating**), passing through mid-order thinking skills (**applying** methods and concepts for **analysing** events).

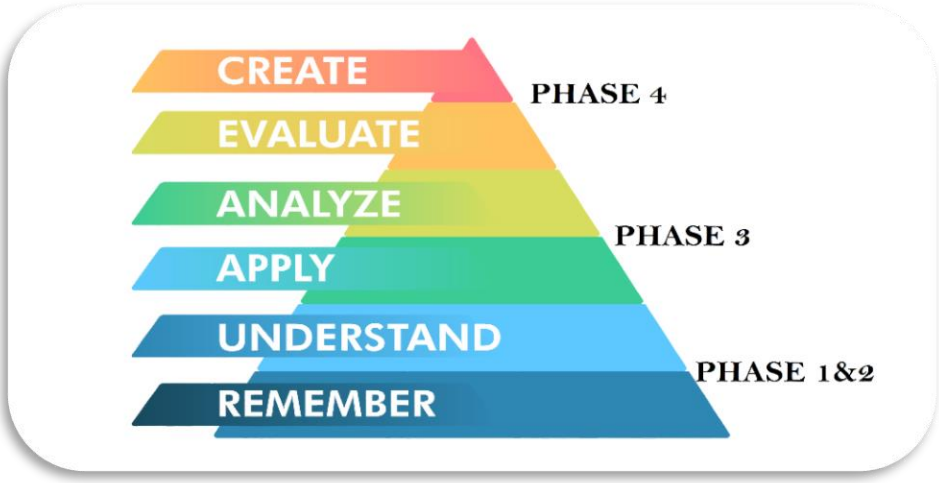


Figure II: *Bloom's Taxonomy diagram. (Credits:* https://medium.com/@ryan.ubc.edtech/*)*

Teaching Techniques:

In order to achieve the previously mentioned Learning Objectives, the CESAR Team recommends the use of some techniques like, ***flipped-classroom, solution of daily life problems (using the scientific method) and collaborative work.***

In this activity students will make use of the *flipped classroom* for Phases 0 and 1 to get ready for the problems solution of their Challenge during Phase 3. Phase 2 is optional and consist on a video call with us. In Phase 4, each team will evaluate their Experience and share it with the Scientific Community (their class/center and us, the CESAR Team). All phases are recommended to be executed as collaborative work (using **forum and blogs)**. Here we detail the process:

- **Your Scientific Challenge:** We introduce the Challenge to students and ask for their support
- **Phase 0: Putting things into context**
  - The role of the **European Space Agency** their center in Spain (European Space and Astronomy Centre, ESAC) as well as the CESAR Team. (in videos)
  - **Nowadays role models** for students to build the **Teams for their Challenge**. We recommend that Teams are formed by 4-6 people, each one of them with well-defined tasks. When possible, try to balance them in gender and diversity of capabilities.
- **Phase 1 and Phase 2:** ***remembering and understanding*** using different sources:
  - **Phase 1**: scholar cv material & new concepts (videos, documents, games)
  - **Phase 2 (optional)**: learn from an expert
    - For the teachers: talks provided by experts on the topic in previous CESAR teacher workshops.
    - For the classroom: A video call with the CESAR Team to solve doubts that may have appeared until the moment in what students have just learnt. At this stage, students had already become “experts” on the topic of the Challenge .
- **Phase 3:** ***applying*** the already known concepts following a methodology (procedures) for ***analysing*** *data* and *solving daily life problems* (their Scientific Challenge).
- **Phase 4:**
  - ***evaluating*** their learning process during the Challenge (self and co-evaluation)
  - ***creating*** a final product to show to the Community (class/school/us) their learning process. With this you could participate in the CESAR Scientific Challenge contest.

As Figure III shows, the CESAR Scientific Challenges should execute all mentioned Phases. Phase 0 and 1, are the roots for all the Scientific Experiences, always to be done in the classroom/home. Phase 2 (video call executed from the classroom to us) is optional.

Depending on the type of Phase 3, there are various CESAR Experience Types:

- **Type I: Space Science Experience(s) @ESAC**: At ESAC, (as always in the past), completely run by the CESAR Team. Total duration 1.5 hours, with 45 minutes for the Activity and another 45 minutes the tour around the ESA spacecraft models.
- **Type II : On-line Space Science Experience(s)**: In the classroom/home, (Type I but completely guided by the teacher). Total duration 1h (MIXED when combined with Type I/III)
- **Type III: On-line Research Project**: In the classroom/home, completely guided by the teacher. Total duration several days. (Type II but executing more or all the Activities of the Guide).

Phase 4 is always executed in the classroom/home to evaluate the learning process per Team as a whole.

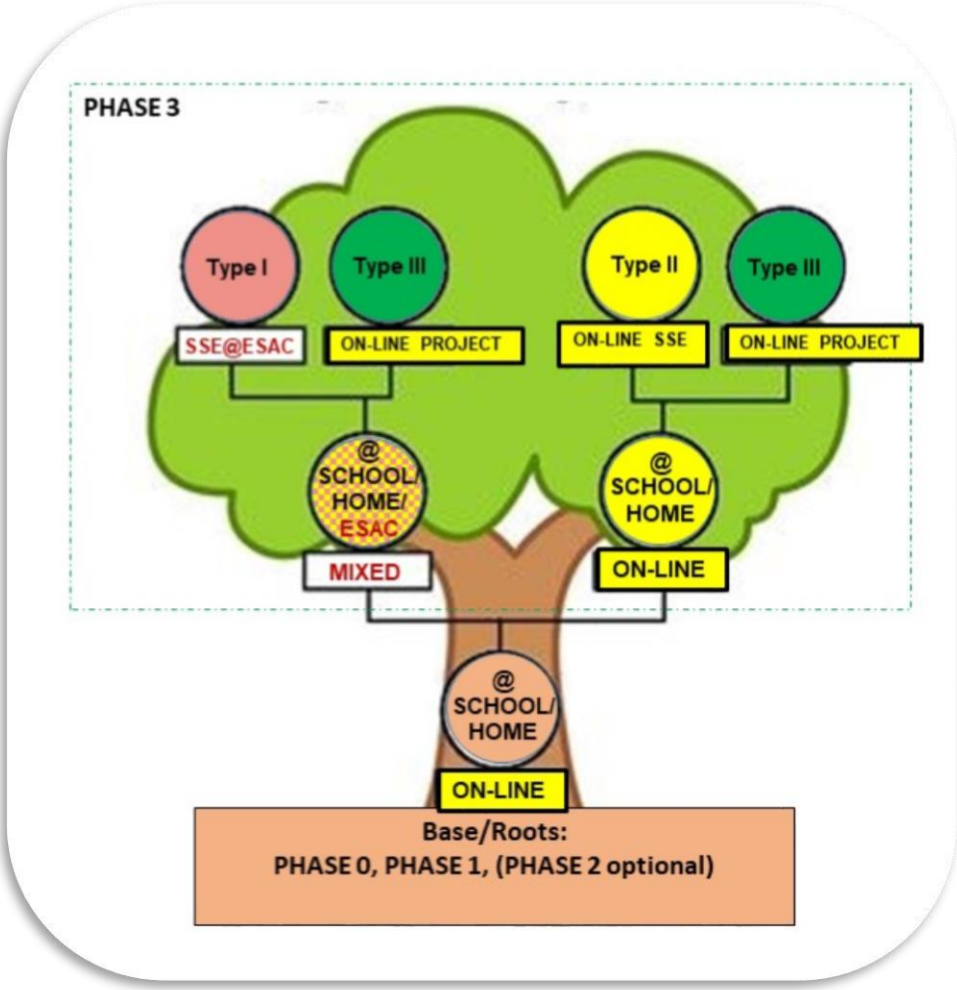


Figure III: Decision tree of the CESAR Experiences according to Phase 3 (Tipo I @ESAC, Tipo II y III, on-line) .In yellow are indicated those paths that can be run completely on-line.(Credits:teacherspayteachers.com)

Teachers are the best ones in assessing the Type of Experience (Challenge) for their classroom and school year conditions. **Per each Type of Experience we propose you different Adventures. The teacher decides if each Team in the class execute an Adventure and once finish they put them in common or whether all the Teams execute the same Adventure(s) at the time (see Tables I, II and III).** Teachers can also decide whether they want to execute some Activities on-line, and when it became feasible, to ask for the already well known an SSE @ESAC (Type I), for the same Challenge but different Adventure or another Challenge (see Figure III).

The CESAR Team recommends you to follow the phases in order (for an optimum learning process) and do not start one before closing the previous one. The Table Summary of Activities" will mention when the execution of a previous Activity is required. The CESAR Team can be contacted once in phase 2 (with the class) and in phase 3 (only for the teacher). For that, dedicated slots of 30 minutes are scheduled.

For the Scientific Challenge, the Fast Facts section provides the information regarding the school curriculum and the contents of each of the Activities (by Phase) can be found in the Table "Summary

of Activities". The flavors of Adventures, per each Type of Scientific Experience are in Tables I, III and III.

- **Table I: Space Science Experience @ESAC (SSE @ESAC):**

PHASES	0	1	2	3 (@ESAC)	3 (@school)	4	Minimum duration
ACTIVITIES (Adventure 1)	3 videos	1,2,3	4,5	12	6	15	4,15 h
ACTIVITIES (Adventure 2)	3 videos	1,2,3	4,5	7	10	15	4,15 h
ACTIVITIES (Adventure 3)	3 videos	1,2,3	4,5	8	13	15	4,15 h
ACTIVITIES (Adventure 4)	3 videos	1,2,3	4,5	9	11	15	4 h

*

- **Table II: On-line Space Science Experience (On-line SSE):**

PHASES	0	1	2	3 (@school)	4	Minimum duration
ACTIVITIES (Adventure 1)	3 videos	1,2,3	4,5	12,6	15	4,15 h
ACTIVITIES (Adventure 2)	3 videos	1,2,3	4,5	7,10	15	4,15 h
ACTIVITIES (Adventure 3)	3 videos	1,2,3	4,5	8,13	15	4,15 h
ACTIVITIES (Adventure 4)	3 videos	1,2,3	4,5	9,11	15	4,15 h

- **Table III: Research Project:** All Activities

PHASE	0	1	2	3 (@school)	4	Minimum duration
ACTIVIDADES (Aventura complete)	3 videos	1,2,3,4	5*	6,7,8,9,10,11,12,13	14,15	7-10 h

(*) The video call is optional, we recommend to do the mentimeter if this were not executed.

REALLY IMPORTANT

- As a teacher, **register on the CESAR Community here** (If you approach us for the first time, it may take some time – a non-automatic process -, but you will not regret ;o))
-
- **Once you have been confirmed as part of the CESAR Community** ask for the CESAR Scientific Experiences to live with your class **and you will be guided in the process:**
  - Click here for requesting an on-line experience – Type II & III
  - Click here for requesting a combined experience - Type I (Only for Madrid and surrounding centres)
- **Guides are very long (many possible tools) to build your Experience but also very flexible**

It is your time! Choose your Adventure!

Fast facts

FAST FACTS

- **Age range: 7-9 years old**
- **Recommended academic courses: (2-4) Elementary Education (As the challenge progresses, the activities are more complex and can be done with higher courses if the teacher considers them).**
- **Type: practical.**
- **Student activity Complexity: Medium**
- **Preparation time: 1 - 2 hours**
- **Required time: several days**
- **Location: Indoors**
- **Includes use of: Computers, internet**

Curriculum relevance

Sciences

- Use of various sources of information.
- The weight of a body.
- Machines and Inventions important for the life of man
- The Universe and the Solar System. The Earth and the Moon. The Earth and its rotation movements.
- Maps.

Mathematics

- Planning the problem-solving process. Use of technological means in the learning process.
- Length measurements. The meter and multiples.
- Measurement of weight.
- Time measurement. Equivalences between different time units
- Development of tables and interpretation of simple graphs.

Scientific Culture

- The methods of science. Use of ICTs.
- Research and exploration of the Universe
- The solar system and the origin of the elements.

Abstract

In this activity, students will learn about the moon, its main characteristics, its exploration and the importance it has for the Earth. They also learn about the past, present and future space missions to explore the moon (which they will experience).

They will design a mission with the objective of taking women and men to the moon again, executing all the necessary steps for its creation (just as the engineers of the European Space Agency do. These range from study of the element to be visited/studied, design of the spacecraft, selection of launch dates and landing on the moon. They will assess what it would be like to live on the Moon and the advantages of having a base there for future missions to other planets (such as Mars).

Students should know…

- The concepts of distance and its units
- The time units.
- The solar system and the sun. The moon and its movement.
- What is a space mission.

Students will learn...

- Some basic ideas about the moon.
- How to design a mission, understand its stages, as well as how to design a spaceship and how it works.
- About the conditions of life on the moon
- About the flight conditions of a rocket

Students will improve…

- Their strategies to work according to the scientific method. Their skills in group work and communication, evaluation and use of TICs
- Your ability to apply theoretical knowledge to real situations

Activity Summary

Phases	Activity	Material	Results	Requirements	Time
Phase 0	Works as a team		Students will improve: • Your teamwork and communication skills.	None	10 min
Phase 0	Paxi and the European Space Agency	• Who is Paxi?	Students will learn: • What is the European Space Agency and some of its most important missions in the Solar System		15 -50 min
Phase 1	1. Reviews concepts	• The solar system • Movements Moon-Earth • time units	Students will review concepts: • Movements Moon-Earth. • The solar system	None	30 min – 1 h
Phase 1	2. The Moon 2.1 Basic Information 2.2How far away is the Moon? 2.3 Phases of the Moon The History of the Moon 2.4Why is the Moon super important to the Earth?		Students will improve: • Your teamwork and communication skills. • Your knowledge of the Moon. • The concepts of distance • Importance of the Moon-Earth-Sun relationship (moon phases, seasons) Students will invent a story about the birth of the moon	It is recommended that you do this activity before and after you have seen the activity1	1 h
Phase 1	3. Exploring the Moon 3.1 Paxi explores the Moon 3.2 Humans explore the Moon	Depending on the time to invest, WEB: • https://spaceplace.nasa.gov/craters/sp/ VIDEOS: • Exploración de la Luna	Students will learn: • How to work in the European Space Agency. • Space exploration of the Moon.	It is advisable to have done Activity 2.	(10-50) min

Phases	Activity	Material	Results	Requirements	Time
Phase 1	*4.* What have you learned from the Moon?	Game	• Review of concepts learned	It is necessary to have carried out Activities 1 to 3	15 min
Phase 2	*5.* Learn from an Expert	VIDEOS • Airbus Discovery Space: **LINK** • videollamada	Videos for teachers Classes will have access to a video call with the CESAR Team to discuss questions about the Challenge	None	30 min
Phase 3	6. What would you take to the Moon?	MENTIMETER	Students begin to understand the different steps involved in organizing a space mission and the preparations.	You should have done Activities 1 to 5	30 min
Phase 3	*7.* Book your flight tickets to the Moon!	kahoot	Students will learn: • The phases of the Moon • Analyze images and select among several of the most favorable image • Units of time and organization of it to achieve a goal. Students will improve: • Their scientific and critical thinking.	Se recomienda que haya llevado a cabo las actividades mencionadas anteriormente	30 min
Phase 3	8. Choose your spacecraft fleet.	VIDEOS: • Grandes vehículos para niños pequeños	Students will learn: • What a rocket and spaceship looks like • How it is designed and what parts it has • What is necessary before designing a ship Students will improve: Their knowledge of how scientists/engineers work • Your ability to apply theoretical knowledge	It is recommended that you have carried out the above activities	30 min
Phase 3	*9.* Travel to the Moon	VIDEO	• Students will learn how the rockets are launched and selection of the launch site	It is recommended that you have carried out the above activities	30 min

Phases	Activity	Material	Results	Requirements	Time
Phase 3	10. The Arrival. Where to land and why	• 'How to build a spaceship'', link	Students will learn to be critical and analyze different options in order to choose the best one for the mission. They will also learn how to interpret maps	It is recommended that you have carried out the above activities	30 min
Phase 3	11. Moon landing in 3,2,1	GAME	They learn the concept of the moon landing and the process involved	It is recommended that you have carried out the above activities	15 min
Phase 3	12. Build a base on the Moon	• Look these examples ''Moon Camp''. • Play with this interactive presentation of what your house on the moon would look like game	• Students will analyze the importance of life, what is important to support life on another planet and what is important to them in designing a colony on the Moon	It is recommended that you have carried out the above activities	30 min
Phase 4	13. Co-evaluate	QUESTIONARIE	Students will check to see if they have internalized the concepts. Students will improve: • Their assessment skills.	It is recommended that you have carried out the above activities	30 min
Phase 4	14. Tell us your challenge		Students will improve: - Their understanding of the scientific method and critical thinking. - Their strategies for working as scientists. - Their evaluation skills. Their ability to apply theoretical knowledge to real life situations.		(20-40) min

Your Scientific Challenge

Mission to the Moon

50 years after humans reached the Moon none is walking on it anymore. This is going to change quite soon with the ARTEMISA Program, in which the Space Agencies from Europe (ESA), North America (NASA), Japan (JAXA), Canada (CSA), Australia (ASA) and Bolivia (ABAE), are working together.

We want to go to the moon! Will you join us?

Figure 1: The Earth and The Moon (Credits: https://www.meteorologiaenred.com)

With your help, we are going to prepare a mission to the Moon (design the trajectory and the dates, build the ship and finally land on the Moon). **Can we count on you?**

Figure 2: The exploration of the Moon (Credits: https://estandardigital.com)

Phase 0

Work as a team!

If you want to travel to the Moon, you must know that you can't handle this mission alone! Work in teams with 4-5 classmates, each one of you with a clear role. (Tip: The most different the team members think the more qualified the Team)

***Figure** 3: ESA/Kerbal Space misión team (Credits: Kerbal & ESA)*

Challenge ID		**Number of the Team**	

Writer:_____

Responsible for the material: _____

Reader:_____

Spokesperson:_____

Designer: _____

Paxi and the European Space Agency

Who is Paxi?

Hello! My name is Paxi and I come from another planet. I left my ship in orbit and parachuted to Earth to meet you.

Figure 4: Who is Paxi? (Credits: ESA & ESERO)

If you want to know more about who Paxi is and why he has come to help us, watch the following video: Who is Paxi? (3:45 min)

1. After watching the video, talk to your Team and write who do you think Paxi is.

Paxi represents the European Space Agency that explores the Space for getting knowledge about our Universe and for taking care of our spaceship, the planet Earth. This is the flag for ESA, and if you are from an European country, this is also your flag!!

Figure 5: *ESA flag on the ESA astronaut's suit (Credits: ESA)*

¿How many countries do you think that work together (as a Team) in ESA? (Tip: Count the number of flags in Figure 5)

¿Do you recognize the flag of your country? And from where are the rest of the flags?

ESA stands for European Space Agency, which is made up of 22 member countries

If you want to know some of the things ESA does, watch these videos:

- The amazing adventures of Rosetta and Philae
- The epic adventures of BepiColombo

Phase 1

Activity 1: Refresh concepts

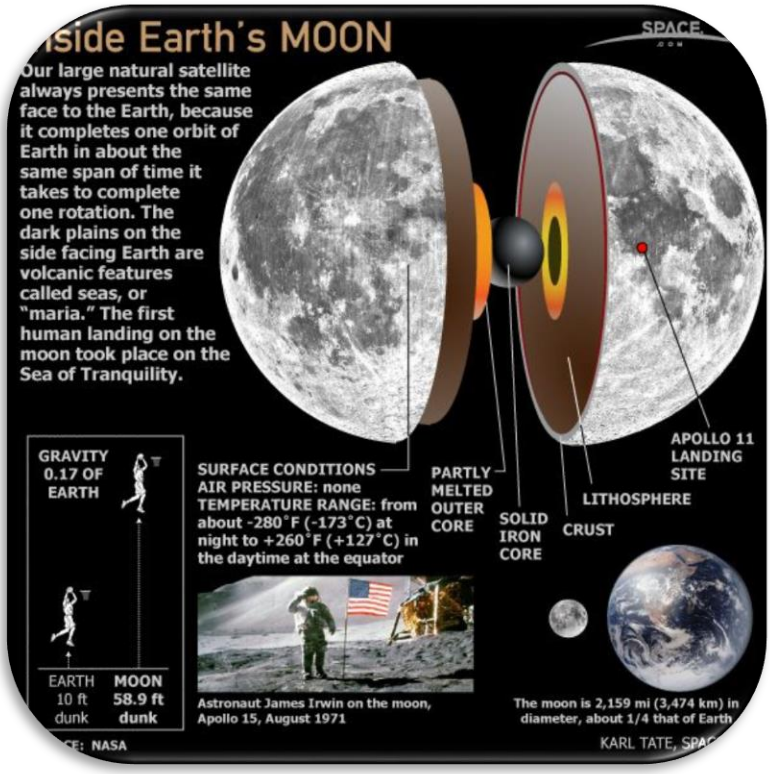
Figure 6: Paxi (Credits: ESA)

Paxi and the Solar System	video 1
Paxi - Day, night, and the seasons	video 2
Paxi and Our Moon: Phases and Eclipses	video 3
Units of Time	video 4

Activity 2: The Moon

Activity 2.1: Basic info

What do you know about the Moon? (Tip: You can write all what you have learnt before)



Activity 2.2: Distance

Can you imagine how far (in meters) is the Moon from the Earth? Write down the number of meters that you think are between the Earth and the Moon

No more and no less than 384,000 km away! It would be like flying 22 times the distance from Madrid to Sydney!

Do you think that the Moon and Earth will always be at the same distance?

Today, the Earth's satellite is 18 times farther away than when it was formed 4.5 billion years ago.

Figure 7: Distance Moon-Earth (Credits: https://www.meteorologiaenred.com)

Activity 2.3: The phases of the Moon

Have you ever stare at the night sky and see that the Moon is round Moon, but in others nights it looks like a letter "C" or a "D"? However, other nights you do not see the Moon. **Do you know why?** (Tip: If you paid attention to the videos of Paxi before you know the answer for sure!)

From the Earth we see the Moon more or less complete, depending on how it receives the light from the Sun. Watch the PAXI video to explain it better: https://www.youtube.com/watch?v=MjJxaCBjUQ4

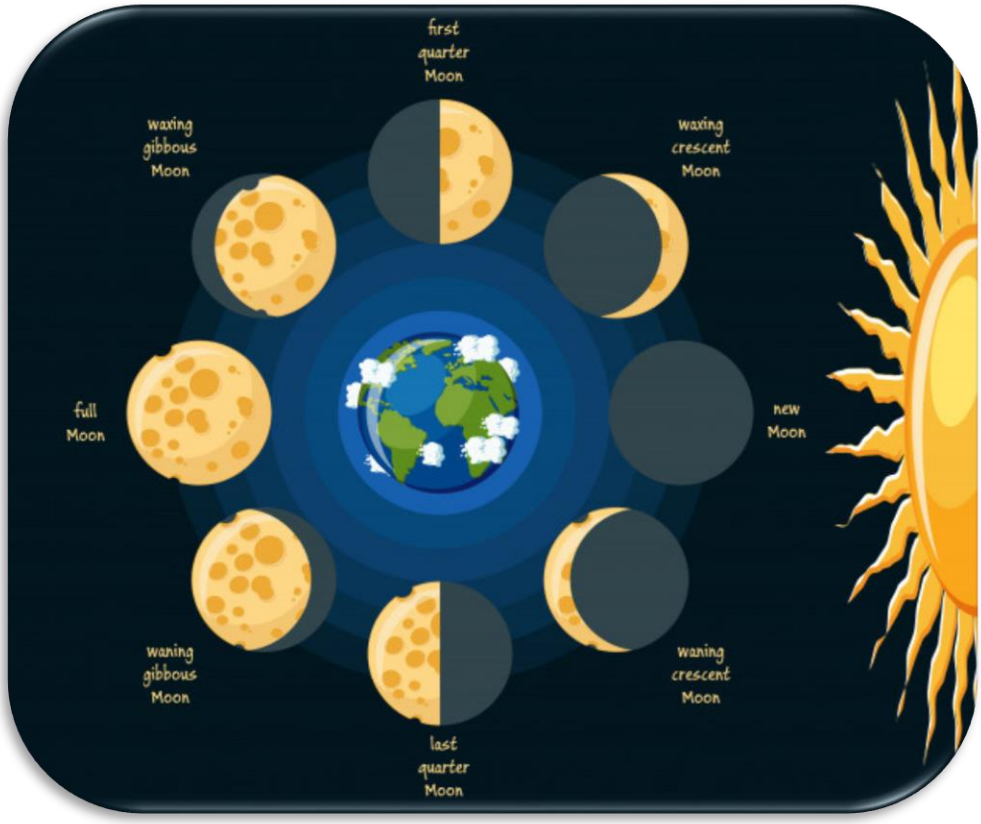


Figure 8: Phases of the Moon (Credits: https://www.freepik.es

Activity 2.4: The Story of the Moon

Figure 9: The Moon (Credits: https://www.geoenciclopedia.com/luna/)

How do you think that the Moon was born? How long do you think it has been spinning around the Earth? **Tell us a story about "how do you think" or "how would you like" the Moon would appeared:**

The Moon has been circling the Earth for over four billion years, but... where did it come from? Some scientists have thought that it was attracted by the Earth's gravity when it got too close to it. Others that it was once part of our planet.

Today, most scientists believe that it is the 'child of the Earth. It was born when an errant planet collided with the young Earth; large amounts of matter were thrown into space and eventually came together, forming the Moon (https://www.bbc.com/mundo/noticias/2015/03/150310_luna_se_aleja_lp

Activity 2.5: Why is the Moon super important to the Earth?

https://spaceplace.nasa.gov/seasons/sp/

Activity 3: Exploring the Moon

Activity 3.1: Paxi explores the moon

Watch this video and accompany Paxi to explore the moon. Video

Figure 10: Paxi en el espacio (Credits: https://www.esa.int/kids/es/Quien_es/Paxi)

What would you need to live on the Moon?

To live on the moon we need: shelter, water, electricity, food and air.

Why does the Moon have so many holes (we call it craters) on its face? How do you think that a crater is originated?

Figure 11: (Creditswww.agenciasinc.es)

Although the Moon may attract fewer pieces of space rock than the Earth, the Earth is powerless to do anything about it after it has been hit. Once something hits the Moon, that event is frozen in time. The Earth, on the other hand, simply removes these impact craters and moves on with its life.
No wonder there are so many craters on the Moon compared to the Earth!

Activity 3.2: Humans explore the Moon

In the past…

Do you know than humans have ever step on the Moon? If your answer is yes, when was it? (Tip: Ask your elder friends and family members (parents, grandparents, uncle/ant…) to get some information)

It was on July 21, 1969 when astronaut Neal Amgstron stepped on the moon

The Apollo missions.
It wasn't until the Apollo 11 mission that the ship's crew (Commander Neil Armstrong, Lunar Module Pilot Buzz Aldrin, and second Lunar Module Pilot Michaell Collins) succeeded in landing on the Moon. Imagine all the previous work that (previous missions) was necessary to be able to arrive, and all the previous missions were necessary. Not always the first one is the winner, but don't be discouraged!

Figure 12: The Earth from the Moon (Credits: https://www.pinterest. /)

Today…

Do you know if there is any mission now on the Moon?

At present, there are many active lunar exploration missions, but none of them are manned.

They are based on a series of satellites sent to orbit the Moon and send images with valuable information to prepare future missions where humans can be sent to the lunar surface again.
Some of them are: SMART-1(ESA) and Lunar Reconnaissance Orbiter (NASA)

- Tip: You may ask your friends, family members and classmates

Figure 13: Lunar Reconnaissance Orbiter (Credits: NASA/)

The future. Artemis Program.

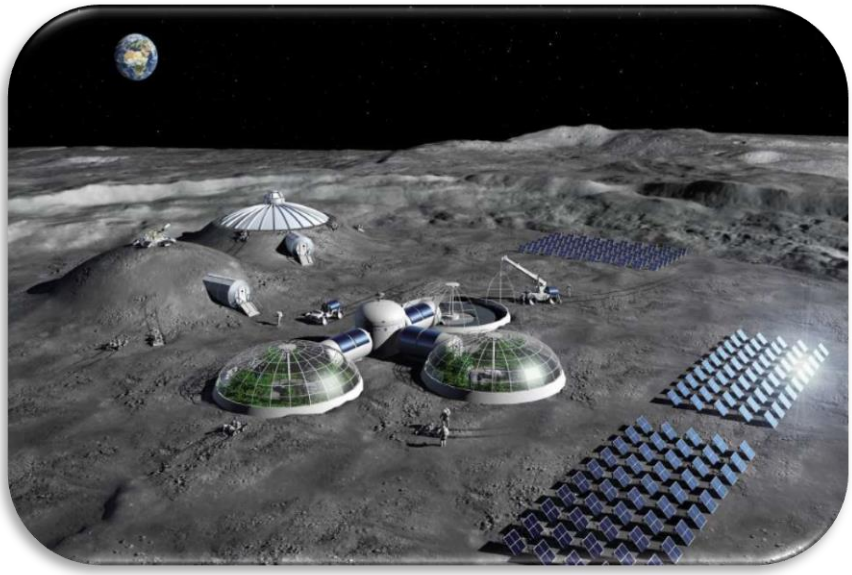
The Artemis mission wants to re-explore the Moon and bring the first woman and man, in the year 2024.

Also with this mission, ESA, NASA and other Space Agencies together, will build a Moon base to study how humans behave. If all the mission is successful humans could be sent to Mars in 2030. **Would you like to be part of their space crew?**

Figure 14: The first Women in the Moon (Credits: NASA/)

Think about how would be to live on the Moon? (Tip: You can watch again this video about Paxi explores the Moon)

Do you think that it could be like A or B?

	A
	B

Activity 4: What do you know about the Moon?

To find out what you have learned so far play the following game in a tablet or computer:

1. Click on this link game
2. Go to Play
3. Choose Teams vs. Teams
4. Wait for the Teacher to start the game

Game instructions for the teacher:

1. Click on the link of the game and above select the option to enter as a guest or enter with your own Kahoot account.
2. Now select the "team mode" option to play for the teams previously formed for this activity

3. Once inside, the access key to the game is provided (this key usually changes)

4. With the password, students can enter kahhot.it to play the game or the kahhot app if they have it installed on their devices.
5. Now that students are inside kahhot, they must enter their team number/name to identify themselves.
6. The teacher clicks "start" on their device and guides the game.
7. The teacher's screen should be projected on the board for students to see. On it will be the questions and some videos with solutions.
8. On the students' devices, they will vote and answer the questions projected on the board.
9. After each question, the solution and the percentage of success will appear
10. To move to the next question, press the "next" button.

Phase 2

Figure 15: Apollo 11 (Credits: https://ecodiario.eleconomista.es/)

Activity 5: Learn from an expert.

Together with the teacher, you will have access to an astronomer. This can happens in several ways:

- **Mode 1**: Viendo los vídeos seleccionados por CESAR para esta actividad:

- Videos Airbus Discovery Space, The Moon: **link**
- Video TED ‘’Would you live on the moon? - Alex Gendler’’ LINK

- **Mode 2:** Together with the teacher, you can have access to an astronomer, for that make a video call with the CESAR Team.

Phase 3

Preparations and Moon Arrival.

At this stage you are already an expert on the Moon. Let's start then to prepare our mission to the Moon!

1. Take 2 minutes to imagine how this experience could be with this Trailer of the movie "Fly me to the Moon"

2. As in the European Space Agency, each group is going to solve one of the keys (Activities) for going to the Moon. Your teacher will support you in what is your task for succeed together in this Challenge!

Activity 6: What would you take to the Moon?

Material to be used:

- Pencils, paper, rubber.
- Scissors
- Glue
- Cut-out
- Color pencils

Procedure

Step 1. As the Moon is very different from our Planet, we need first to find the main differences among these two world. Let's try it!

Ideas	Earth	Moon
Can I breath there?		
Can I drink there? **(potable water)**		

Can I walk there? **(weight)**		

Step 2. Imagine that you are one of the astronauts that will go to the Moon. What things, objects. .. Would we carry in your spaceship?

Written version:

Write a list of important things you would take on your trip. Then round off with a green circle the things you think are necessary:

-Dehydrated food.
-Water
-Oxygen
-Batteries
-work clothes
-medicaments
-vitamins
-energy
-personal distraction elements

On-line version:

To help you choose, play the following game MENTIMETER with your classmates, with many options and ideas of things to take to the Moon:

MENTIMETER

Step 3. Congratulations! We have already a luggage list!

- Choose from your list (here your list) what would take to the Moon?
- Paste or draw it in the table ONLY 6 of the cutouts
- Order your list in by importance, being 1 the most important item and 6 the least important one to bring to the Moon

(Tip: You know that in the spaceships you can only carry with what is necessary, it does not fit and it is heavy)

1		2	
3		4	
5		6	

Activity 7: Book your flight tickets to the Moon!

Required material:

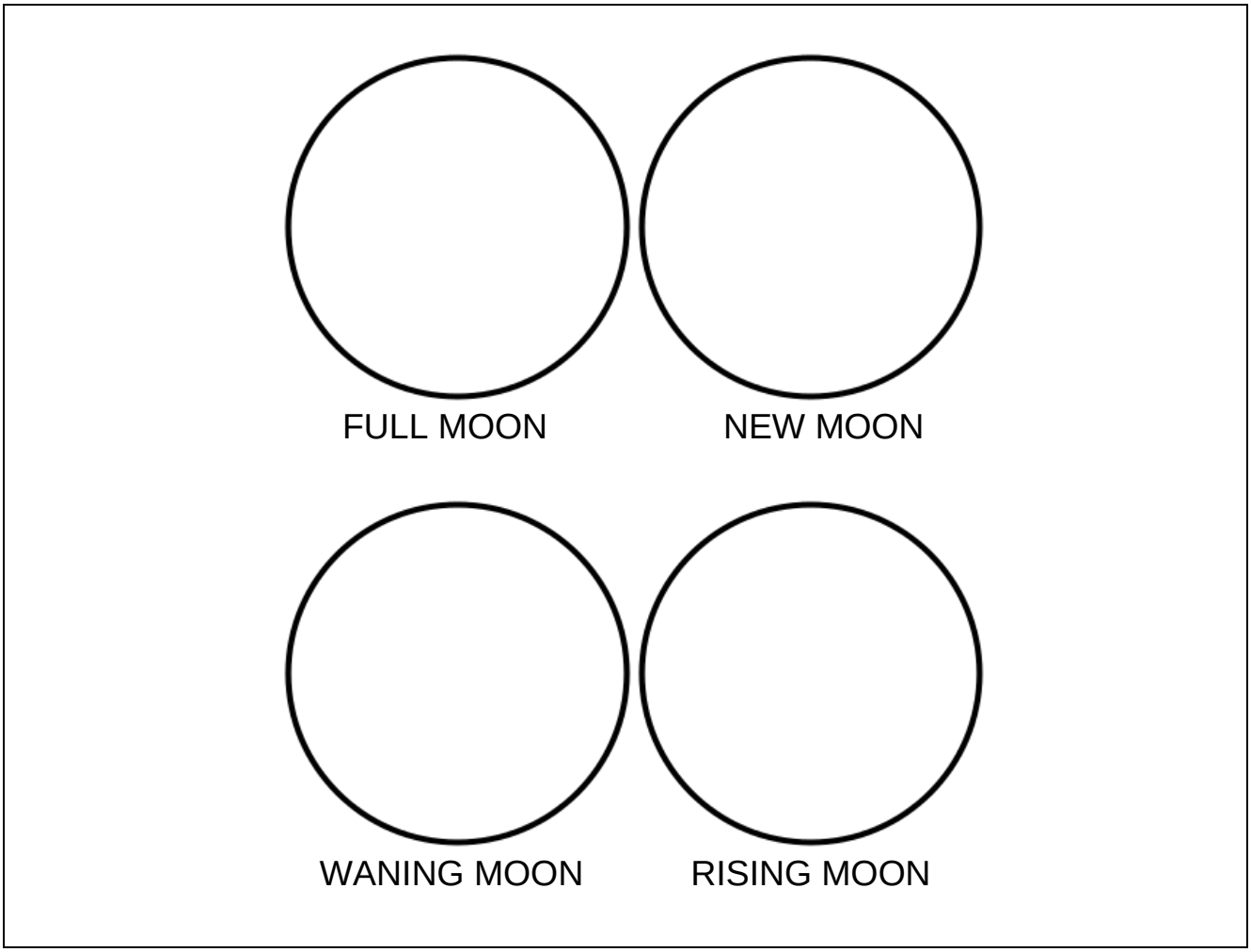
- - Pencils, paper, rubber.
- Color pensiles

Procedure (Instructions/steps to follow)

Step1. Look at the Moon

As we studied in Activity 2.3, the Moon can have different shapes (amount of illuminated area) when we observe it from the Earth.

1. Draw with the pencil, in dark, the following circles to indicate the various phases of the Moon



2. Join the left and right sentences

• When I see full moon, the Sun • When I see wining moon, • When I see a rising moon • When I see a new moon (don't see it)	• The face of the moon that I see is completely illuminated • The face of the moon that I see is only partly illuminated • The face of the Moon that I see is not iluminated

Step 2. Where should I land my spaceship on the Moon?
We should think about whether we want to get to the Moon when it's there by day (full Moon), by night (new Moon), or something in between (waning or rising). Think of the batteries as being charged by sunlight and also giving us the warmth of the day.

The best option is to arrive with a full moon

Step 3. How long will the trip from Earth to the Moon last?

We have calculated that the trip will take 5 days. So we have to look at the following lunar calendar to know what day we are going to leave the Earth and what day we will arrive, taking into account the Moon that we have just colored.

- Let's have a look at the following lunar calendar to know
  - **What day we are going to leave the Earth**?
  - what day we will arrive?
  - Note: take into account the Moon phase when you want to land that we have just colored.

Figure 16: Moon phases (Credits: ESA)

Step 4. Agree with your colleagues on dates using this kahoot game: [kahoot]

Date of departure from Earth: _____

Date of arrival to the Moon: _____

Activity 8: Choose your spaceship fleet!

Rocket and spaceships are not exactly the same. Do you know why?

The rocket is the vehicle where the spacecraft is launched, until it is separated into stages and once in space it leaves flight autonomy to the spacecraft being manned. We could say that in this case the spacecraft is the payload (the element that is transported from the rocket) and is in the last stage of the rocket (the head). Similarly, the rockets can transport other elements as payloads, as is the case with satellites

What shape should the rocket have to take the astronauts to the Moon? Watch this video, it will explain the parts of a rocket and relate the 4 main parts of a rocket learned to the ones you see in this image**.** Video

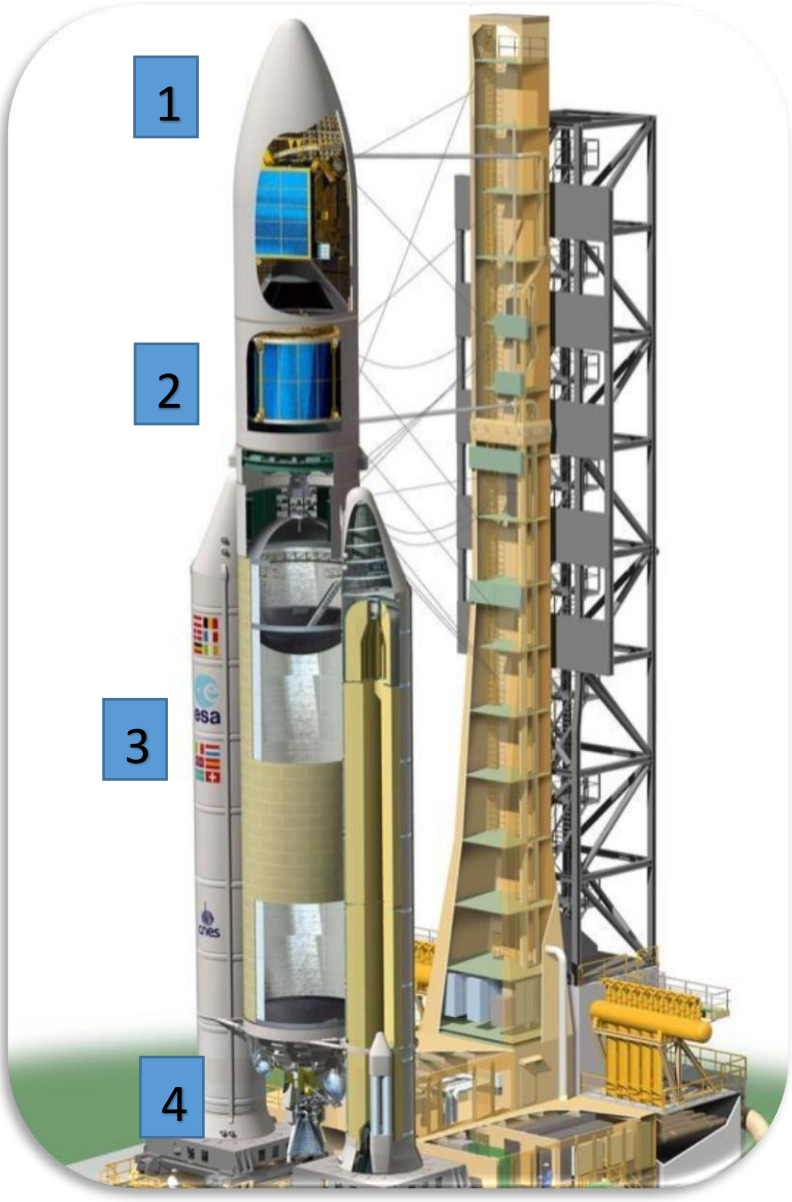


Figure 17: Ariane 5 (Créditos: ESA)

1	Nose Cone-payload
2	2nd stage
3	Fuel tank 1st stage
4	Engines

Now you know what parts a rocket has. Do you know how many types of rockets are? Look at Figure 18 to see some

Required material:

- Pencils, paper, rubber.
- Color pencils

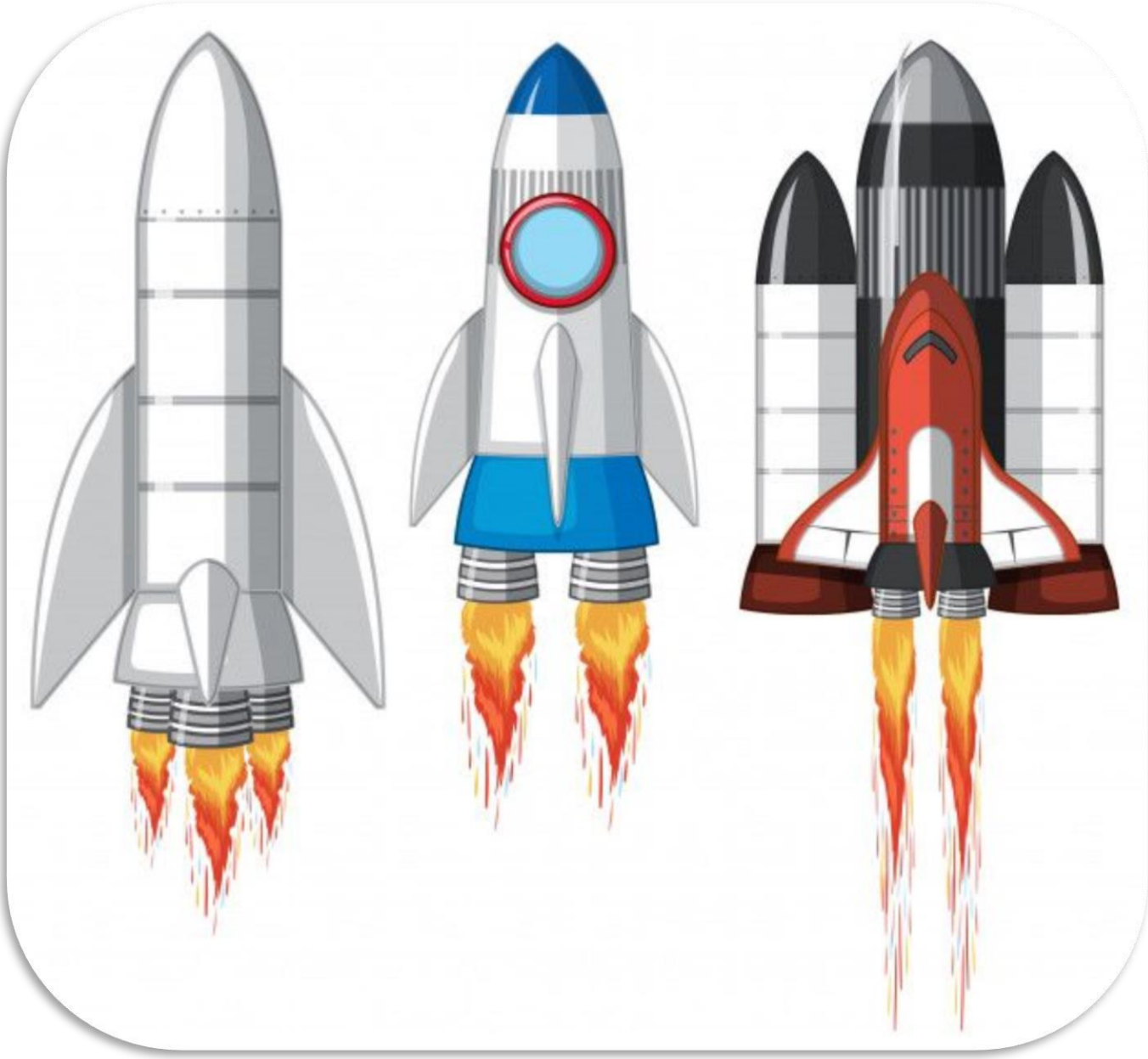
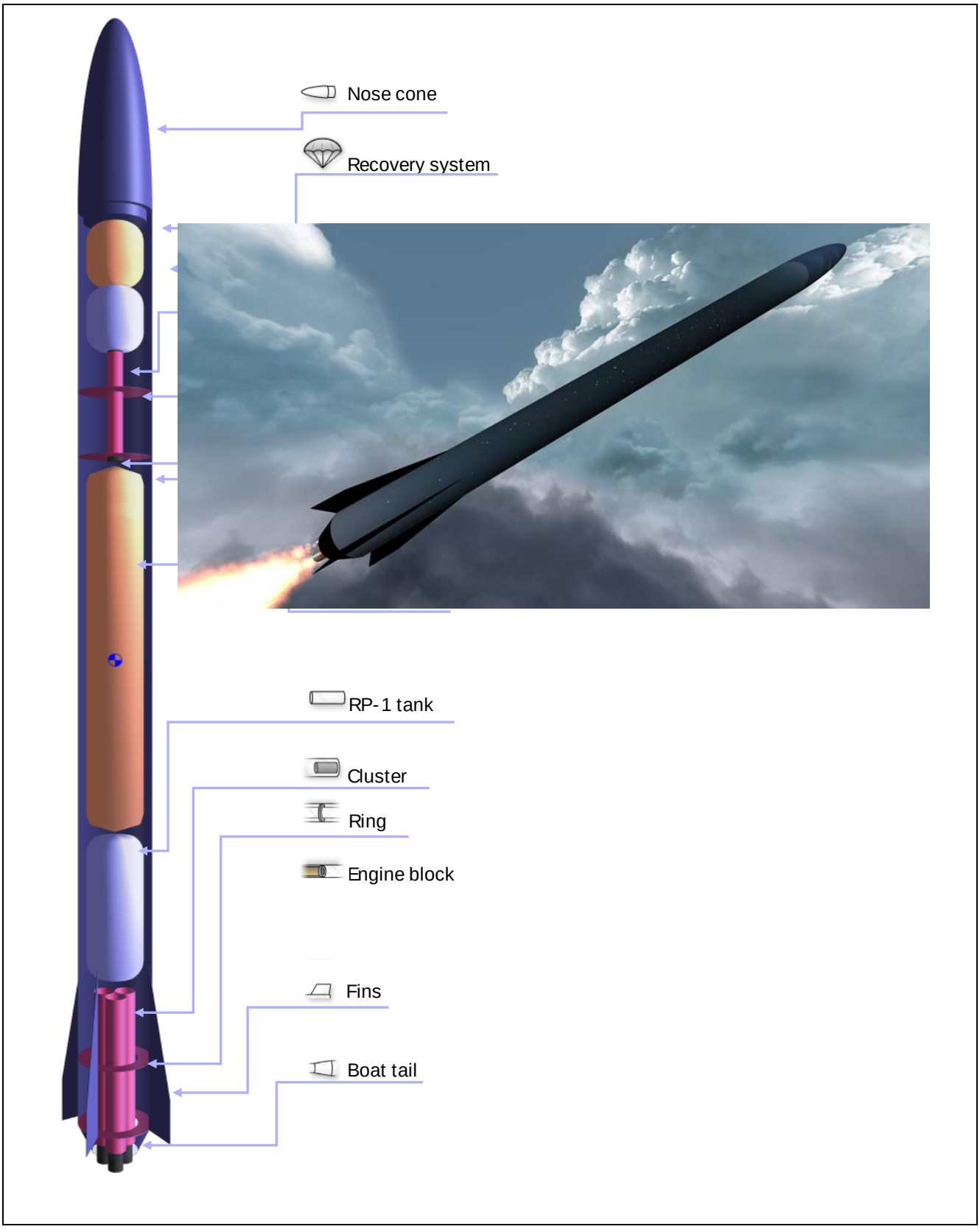


Figure 18. Types of rockets (Credits: https://www.google.com/imgres

Look at the examples, use your imagination and **design an incredible rocket**
On the outside (before drawing here, you can do dirty drawings on other sheets)



When the rocket is launched several pieces are being detached in different phases (stages) as Figure 19 shows.

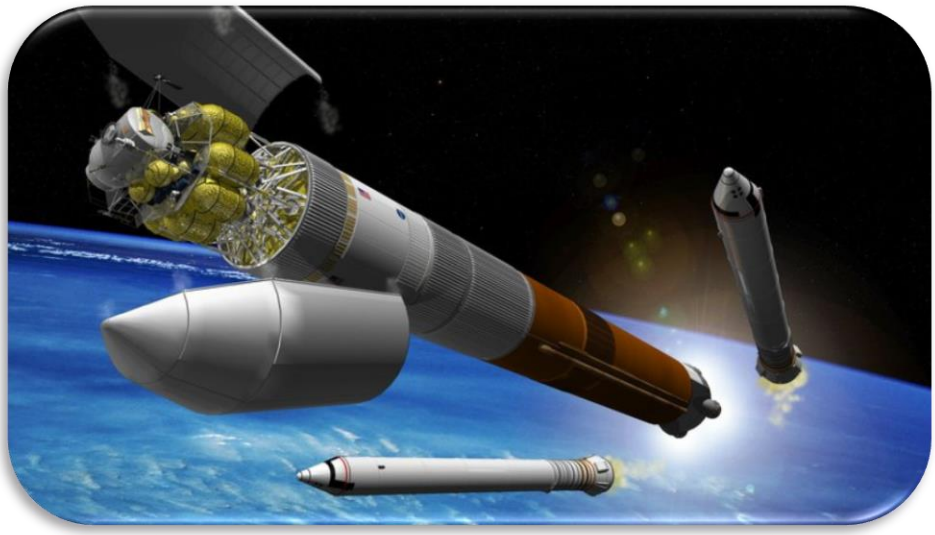


Figura 19. Separación etapas (Créditos: spacex)

The spaceship (where the astronauts and /or the scientific instruments are located) is in the upper compartment of the rocket (yellow part in Figure 19). With this “small” ship the astronauts must complete their journey and land on the Moon.

How do you imagine it could be **the internal part of your spaceship?? Draw it**!

Activity 9: Take off

Figure 20. Ariadne 5 launch (Créditos: ESA*)*

What do you think the launch of a rocket looks like?

Get an idea with this launch simulator here

The principle by which a rocket and a balloon move is basically the same. They move forward thanks to the expulsion of pressurized gas backwards **http://www.esa.int/kids/es/)**

https://www.planetariodearagon.com/wp-content/uploads/2019/03/Guia-lanzamientos-de-cohetes.pdf

Watch this video of what the trip in the spacecraft would be like since it was launched from the Earth to the Moon. Video 1

Video 2: Mission Kerbal Space

Do you know from where in the world ESA launches are made?

In the last 30 years, all European rockets have been launched from Kourou in South America. Why did Europe choose a spaceport on the other side of the world? The search for a new site began in the 1960s when France had to give up its launch base in the Algerian desert. The French Space Agency eventually selected a site on the coast at the edge of the jungle in French Guiana. The new location was near a fishing village called Kourou, not far from the old Devil's Island prison.

Figure 21: Ariadne 5 launch (Credits: https://www.youtube.)

Activity10: Arrival. Where to land and why?

Not all places on the Moon are the same, and it is important to decide where it is best to land.

Required material:

- Pencils, paper, rubber.
- Coloured pencils

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Procedure

Step 1. Look at the map and think about which conditions you think are important to choose where to land, and which will be the best area. You can help yourself from this video

Figure 22: The two faces of the Moon (Credits https://blog.nuestroclima.com/las-misteriosa)

- http://cesar.esa.int/upload/201902/mapaluna.pdf

Step 2. Look at the map and mark three places that seem very different to you. Then, let's write down what we think we might find there:

Step 3. Now it is time to decide among yourselves which of the places is the best to land on the moon. **Explain why you have chosen that place for the moon landing:**

Activity 11: Moon landing in 3, 2, 1...

Can you imagine what the Apollo 11 moon landing looked like? video Apollo 11

Play and try to land on the moon without destroying your ship! Game

Instructions for the teacher:

1. The main objective is to land the ship in a swift manner so that it and its occupants do not suffer any damage. Give PLAY to start.
2. The ship begins to descend in free fall, so if it continues like this it will hit the earth with great force, so to diminish the impact, we provide Thrust to the ship (vertical force opposite to the fall movement provided by the engine)
3. To do this, press the space button and provide Thrust to the ship for a short period of time and as many times as you consider appropriate for the ship to descend in a controlled manner
4. It is considered a soft landing if it is reached with a speed less than 2 m/s
5. It is considered a hard landing that can cause serious damage to the aircraft and its occupants when the arrival speed is greater than 12 m/s. Depending on this speed some damage or other is produced.

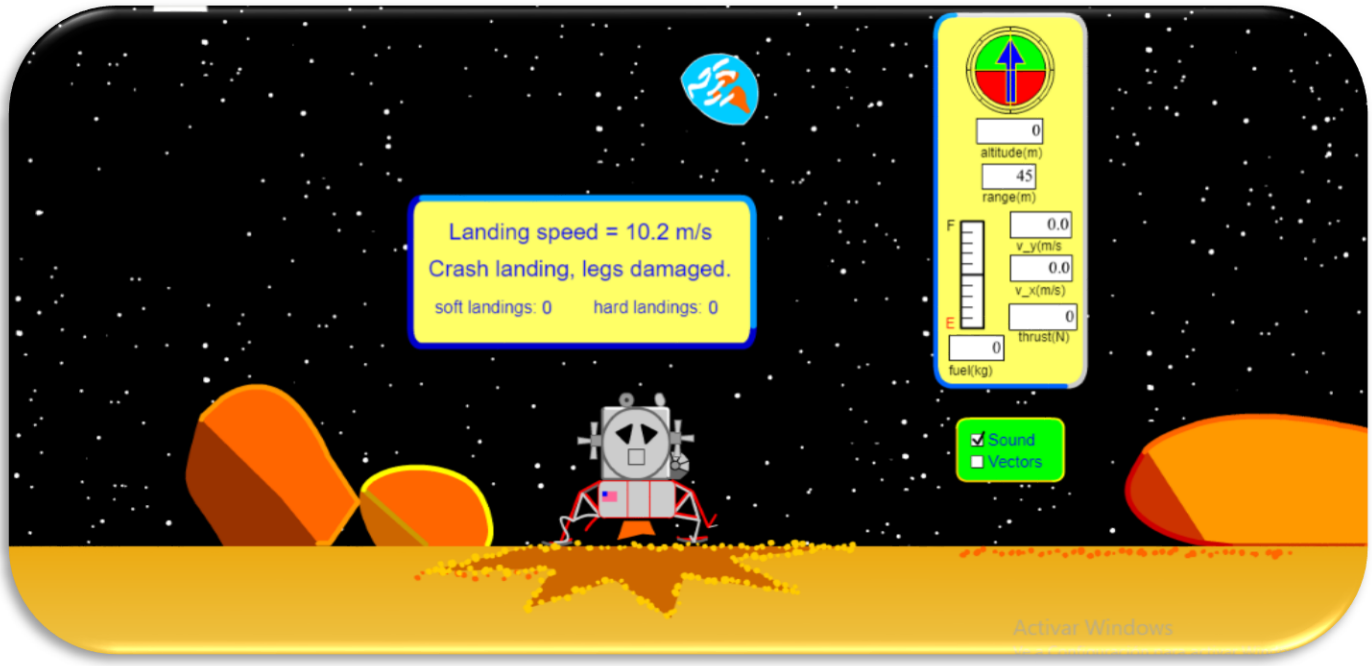


Figure 23: Game (Credits https://phet.colorado.edu/sims/lunar-lander/lunar-lander_en.html)

Activity 12: Build a base on the Moon

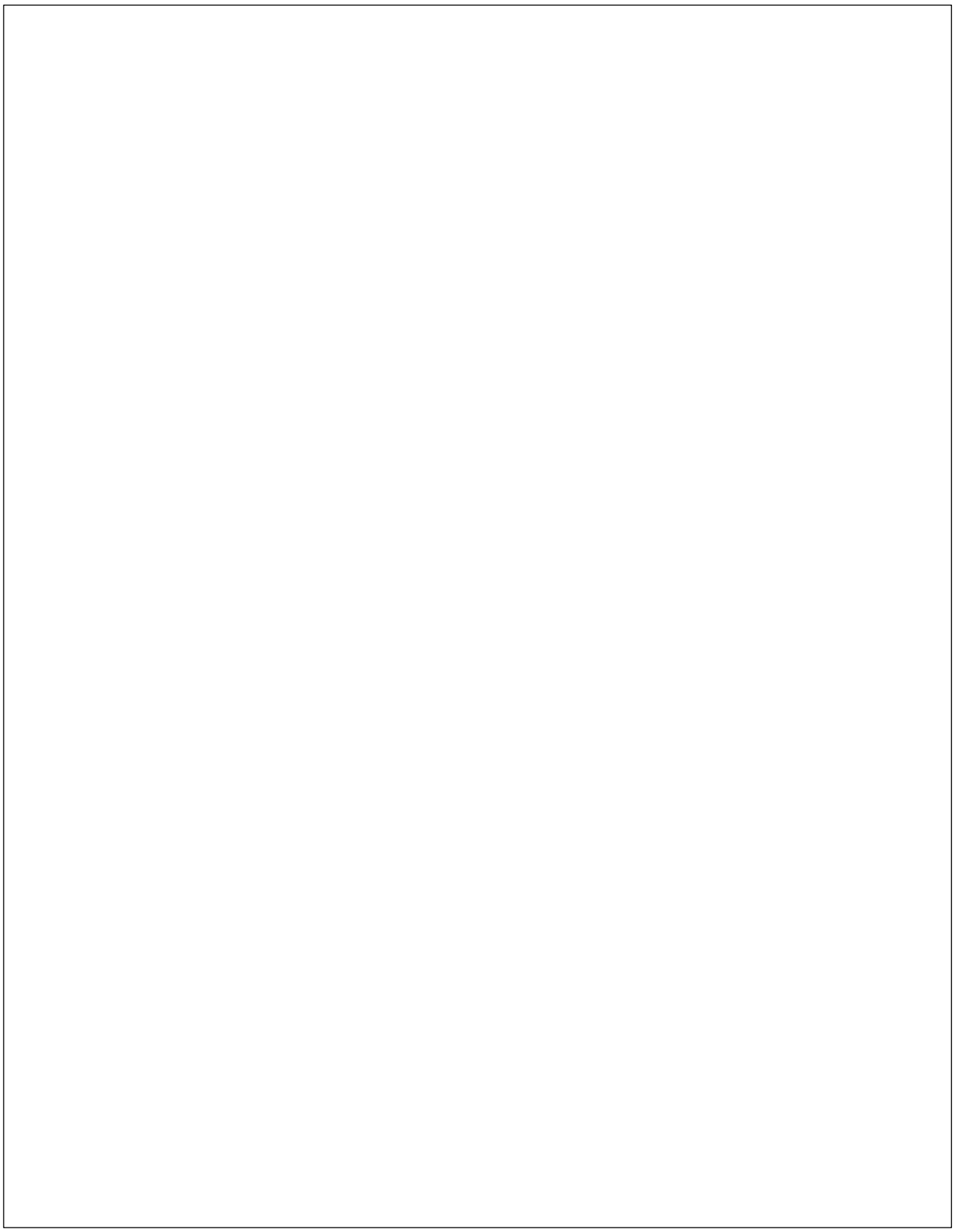
Imagine that we have finally arrived with our space rocket.

Step 1. What do you imagine the Moon will look like? What would you like to find there? Let's draw it!

Step 2. Build a Colony on the Moon

Draw what your Moon Colony would look like, create a Base with everything you need to live

- If you need inspiration, check out this video
- EXAMPLES ESA ‘’Moon Camp’’
- Play with this interactive presentation of what your house on the moon would look like GAME



Activity 13: Safe trip back

Think about this … would it be more difficult to leave the Moon than the Earth with a rocket? If so, could it be easier or not to go from the Moon to other planets like Mars?

It would be easier because as the Moon is a smaller object, the gravity that attracts the rocket at launch would be less, and therefore it could carry more load in the rocket.

This is part of the reason why the Artemis mission will be done in two phases
NASA has Artemis as the next step toward the long-term goal of establishing a sustainable presence on the Moon and in lunar orbit,5 and laying the groundwork for private companies to strengthen a lunar economy and eventually send humans to Mars, starting in 2033

If desired, students can play with the Playmobil “Mars Mission” app https://play.google.com/store/apps/details?id=com.playmobil.space&hl=en_US

What would you bring back home, if anything, to be analyzed?

Rocks for analysis
A diary with experiments
The impact on the astronauts body to be studied

What experiments do you think you should do on the Earth before going again? Would you like to go often to the Moon as a 2nd house?

How the human body reacts in conditions similar to the Moon, births? New technology

Phase 4

Congratulations! You've done it!

Activity14: Congratulations! You have achieved your goal

Respond to the following cuestionario

Teachers will ensure that students perform:

- **Teams:** Respond to the following cuestionario in order to prove that they have learned the concepts.
- **All the class:** mentimeter (code QR Figure 32) in order to co-evaluate how the process has gone:
  - Bloom's Taxonomy
  - The development of the various capacities of the Team
  - Your perception of the content used in the Challenge... (feedback)

Figure 30: QR code de Evaluación Final del Reto

Students will respond to and self-assess on what they have learned and the learning process.

Activity 15: Present your results

Tell us what you have learned through teamwork: Create a presentation in which you demonstrate your understanding of the development of the activity. The format of the presentation is free (ppt, youtube, Word)

Links

LINKS PHASE 0:

- **VIDEOS:**

- https://www.youtube.com/watch?v=fYa-hmNzlAQ&list=PLbyvawxScNbucdsnNdB9p89RmePmGv5cM&index=14
- https://www.youtube.com/watch?v=HD2zrF3I_II
- https://www.youtube.com/watch?v=MKEcanjC0eM

- **WEBS:**
- **http://esero.es/**
- **https://www.esa.int/**
    - **https://www.esa.int/kids/es/Home**

LINKS PHASE 1:

- **VIDEOS:**

- https://www.youtube.com/watch?v=mibxJwpennU&list=PLbyvawxScNbucdsnNdB9p89RmePmGv5cM&index=12
- https://www.youtube.com/watch?v=TagG32gwiBo&list=PLbyvawxScNbucdsnNdB9p89RmePmGv5cM&index=7
- https://www.youtube.com/watch?v=w4U_cuF-_hI&list=PLbyvawxScNbucdsnNdB9p89RmePmGv5cM&index=4
- https://www.youtube.com/watch?v=zjz_rcia79Y
- https://www.youtube.com/watch?v=PxqltnER8E4
- https://www.youtube.com/watch?v=w4U_cuF-_hI&list=PLbyvawxScNbucdsnNdB9p89RmePmGv5cM&index=4

- **APP/JUEGO/CUESTIONARIO:**

- **https://create.kahoot.it/share/ee9504a3-0243-41d2-aa2f-7c95f4b28092**

- **WEBS:**

- https://www.meteorologiaenred.com/distancia-de-la-tierra-y-la-luna.html

- https://www.freepik.es/vector-premium/diagrama-fases-luna-basica_3785117.htm
- https://spaceplace.nasa.gov/seasons/sp/
- https://www.nasa.gov/

LINKS PHASE 2:

- **VIDEOS:**
- https://www.youtube.com/watch?v=Pk1D7AGLiX8&list=PLVwi8znytoZJ13qPUf0OJql5ZFhkY_2ZC
- https://www.youtube.com/watch?v=I5V2tcg1BvQ&feature=youtu.be

LINKS PHASE 3:

- **VIDEOS:**
- https://www.youtube.com/watch?v=a1smyXGnZao
- https://www.youtube.com/watch?v=lPmaBlf94lc
- https://www.youtube.com/watch?v=L_0QxcDNuM0
- https://www.youtube.com/watch?v=EjOgdBm1dqc&feature=youtu.be
- https://www.youtube.com/watch?v=tpLrp0SW8yg
- https://www.youtube.com/watch?v=h5X3CTfShyE&feature=youtu.be

- **APP/JUEGO/CUESTIONARIO:**
- https://www.menti.com/45i9qv5roc
- http://cesar.esa.int/upload/201902/recortables_mision_a_la_luna.pdf
- https://www.sciencelearn.org.nz/embeds/132-rocket-launch-challenge
- https://create.kahoot.it/share/4fb4146d-32a7-4f37-8ff4-f5633e8ad704
- https://phet.colorado.edu/sims/lunar-lander/lunar-lander_en.html
- https://www.airbus.com/company/sustainability/airbus-foundation/discovery-space/kids/mission-to-the-moon.html
- **WEBS:**
- http://cesar.esa.int/upload/201902/mapaluna.pdf
- https://mooncampchallenge.org/moon-camp-discovery/
- http://esero.es/eventos/moon-camp/

LINKS PHASE 4:

- **APP/JUEGO/CUESTIONARIO:**

- Cuestionario: http://cesar.esa.int/form.php?Id=14&k=qw9AN7nVmx&ChangeLang=en