TEACHER'S MANUAL

HOW TO USE THE KIDS IN SPACE APP

KIDS IN SPACE / OBSERVATORY ARMAND PIEN | ROZIER 44, B-9000 GENT

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1. INTRODUCTION

Kids in Space is an interactive digital application, available on PlayStore for android devices and AppleStore for apple ones. It was designed for teachers who teach classes with kids from eight to twelve years old, to be used together with the teacher's guide "Op schoolreis naar de Maan", created by the Ugent Observatory Armand Pien. The app was developed by an international, multidisciplinary team of students during a European Project Semester in the spring semester of 2019 at AP Hogeschool Antwerpen.

The purpose of the Kids in Space app is to create a storyline around the aforementioned coursebook, increasing the pupil's immersion and enjoyment when learning about Space. Also included are several educational minigames and quizzes to further increase the pupil’s involvement in the storyline.

The character of ‘Ellion’ is introduced in this app’s storyline. Ellion is an astronaut that serves as the companion for the children, who can be used by the teacher during classes. Ellion will make the lesson’s content more accessible to the pupils.

The eventual, long-term goal of this app and the coursebook is to encourage children to take up studies in science fields, which is becoming an ever-growing necessity in our more and more science focused world. NASA and several other organisations, both governments funded and commercial, are planning to establish human colonies on the Moon and even Mars within the next few decades and even years. In order to fulfil this task, an enormous amount of people with careers in STEM fields (Science, Technology, Engineering and Mathematics) will be required. The engineers designing space ships, the programmers for robots, the astronauts themselves and many more. As these future scientists already are the kids in today’s classrooms, this app is focussed mainly on them.

Another important aspect of both the coursebook and the app, is that it will provide teachers with ready to use materials and background knowledge about the space related themes. This way, teachers will no longer require spending time learning about science and space travel on their own, and their preparation time for such lessons will be drastically decreased.

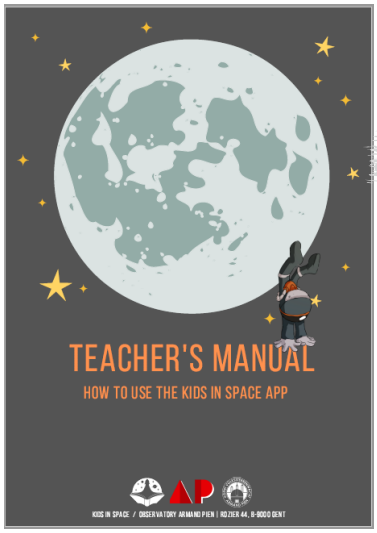
2. HOW TO FIND THE COURSE BOOK AND THE EDUCATIONAL TOOL

In order to provide to the teachers the materials to use during the lessons and all the necessary background knowledge, Kids in Space has created a website where you can find the most important information about this project.

https://kids-in-space.weebly.com/

In this website, teachers can also find in the section called "Educational tool" the downloadable version of the Teacher's manual, the Educational tool and the CourseBook.

TEACHER'S MANUAL



EDUCATIONAL TOOL

COURSE BOOK

3. THE EDUCATIONAL TOOL

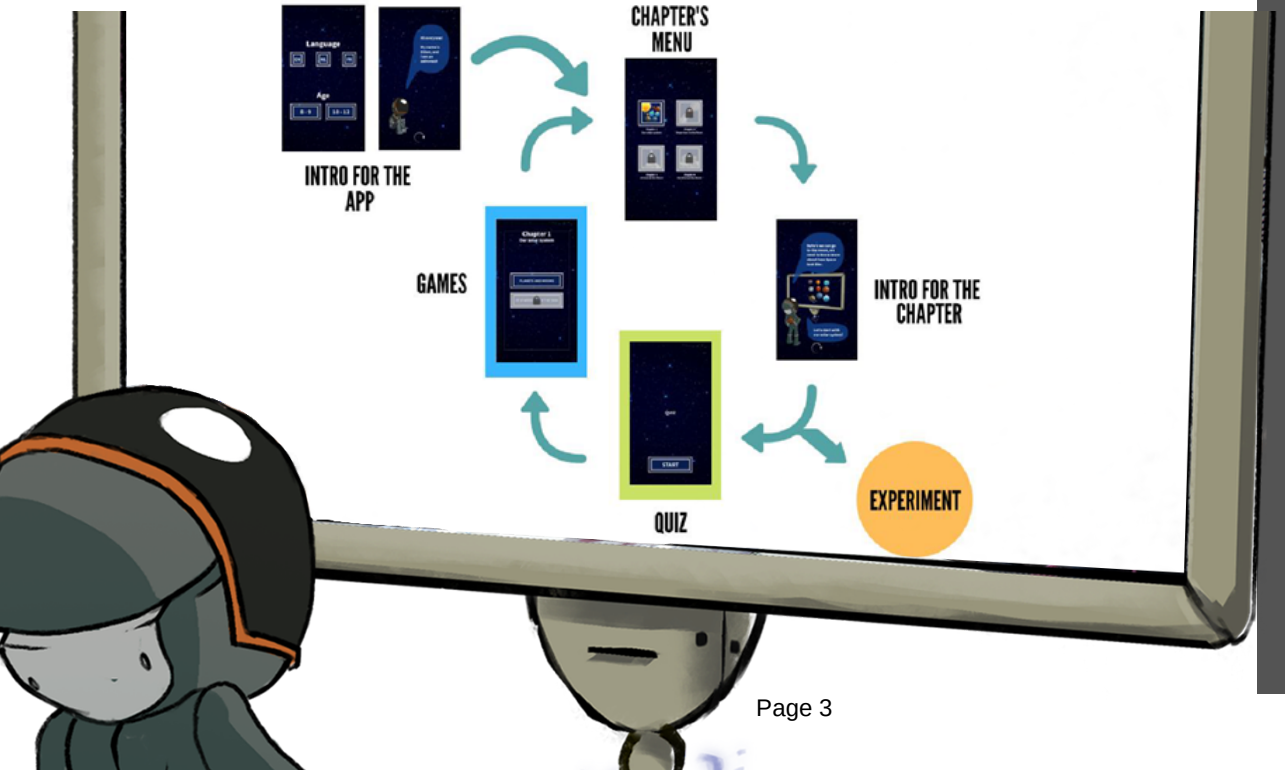
The purpose of the Kids in Space app is to create a storyline around the aforementioned coursebook, increasing the pupil's immersion and enjoyment when learning about Space. Also included are several educational minigames and quizzes to further increase the pupil's involvement in the storyline.

First, in the picture that you can find below there is the general layout of the educational tool. As you can see, the app begins with a simple menu where the students can choose the language (English, Dutch and French) and the age (which is divided in two groups depending on the level). After this menu, starts the introduction where Ellion introduce himself and invite the students to join them to the adventure of learning more about space and science.

After that, the steps are the same in every chapter. The steps to follow are:

1. Choose the chapter in order. Only the first one will be unlocked at the beginning. You need to pass every chapter to unlock the following one.
2. Once you are in the chapter, an introduction begins which the teacher can use to start and introduce the correspondent experiments or activities from the Course per each chapter. (Without using the app, only teacher's indications).
3. After the experiments, the students can use the app again and start with the Quiz. All the quizzes follow the same steps as the chapters. They need to pass every question if they want to start with the next one.
4. They need to pass the quiz if they want to play the different games.
5. Back to the chapter's menu and start with the next one.

At the end, the students will have managed to achieve the four chapters with their corresponding questions and games.



4. PEDAGOGICAL INFORMATION

This educational tool allows the students to go through imaginary journey to the Moon. Difficulties and challenges related to such a journey are introduced to the students, and they will try to find solutions and answers with the help of inquiry based experiments, questionnaires or games.

Through the experiments and questionnaires in each chapter, students are intended to think about hypotheses and then test them. In this process they will be challenged to use prior knowledge, select the most useful information, make observations and analyse the situation. Carrying out the experiments and testing them will stimulate them to communicate graphically or symbolically and constructively value the contributions of others. In addition, other skills and attitudes are stimulated, such as: participation in groups, spontaneous conversations, memorization of facts and situations related to the topic, acquisition of new words related to the field of experience, respect for speaking time, interest in understanding new information, interest in making good use of new vocabulary and appropriate expressions.

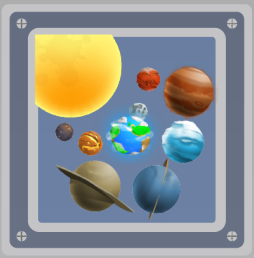
Chapter 1: Our solar system. This chapter is to make students curious to study and understand in a simple way the nature of the Solar System and the objects that are part of it. Also to know the 8 planets of our solar system, to distinguish and know some basic facts about them.

Chapter 2: Departure to the Moon. This chapter can teach children about the distance between the Earth and the Moon, and about the area in which human space flight is possible nowadays. They will also learn about the effect of gravity, how it works, and to discover it by practicing the proposed experiments and games. In addition, knowing the proximity or remoteness between Earth and Moon helps to learn basic concepts of measurement and distance. Through the proposed game, it is intended that children acquire spatial notions of orientation and direction (up, down, above, near, far, on one side, on the other side, left right).

Chapter 3: Arrival on the Moon. In this chapter the pupils will try to make the landing as less harmful as possible and, to achieve it, they must use different materials. That how they discover a variety of materials and different textures and functions, touch them, investigate, test, learn from mistakes, learn to look for different possibilities. Furthermore, they will interact with each other by giving different opinions and solutions and learn from the success and mistakes of this experience.

Chapter 4: Survival on the Moon. One of the objectives is that pupils value the elements that provide life, and respect and care for the environment. Example of the topics they learn how to extract water from the Moon, how to get oxygen from water, how to get their own food through crops, how to build a shelter or get electricity.

5. THE CHAPTERS



Chapter 1
Our solar system

Chapter 2
Departure to the Moon

Chapter 3
Arrival on the Moon

Chapter 4
Survival on the Moon

Activities and experiments recommended from the Course Book. It is necessary to do this activities before the quizzes from each chapter.

Small explanation about the game per each chapter.

Questions and correct answers (in bold) from the quizzes in the different chapters. As you can see, in some chapters there are more than one quizz about the different topics.

CHAPTER 1.
OUR SOLAR SYSTEM

The activities which are recommended for this chapter are to visualize the different parts and characteristics of the solar system.

Avoid the asteroids

In this game, kids have to explore our solar system but with some difficulties. They are going to find asteroids coming towards them and they need to avoid them, so they have to tap the screen faster to avoid them for going up and slower to go down.

Q1. How many moons does the Earth have?

a) 3.
b) 2.
c) 1.
d) None.

Lots of planets have many moons, and some even have none. Our own Earth has only one though, this is the one we call 'the Moon'.

Q2. What is the difference between a Moon and a planet?

a) Moons orbits planets, planets orbits stars.
b) Moons orbits stars, planets orbits moons.

A star is the centre of a solar system, around this star, planets can revolve. If anything revolves around those planets, they are the moons of these planets.

Q3. How many times can the Earth fit in the Sun?
This is a question about the diameter of the Earth compared to the diameter of the sun. This should be clear in the question. Example: how many Earths do we have to put in a row to reach the same width as the Sun (diameter)?

a) 109 times.
b) 9 times.
c) 1009 times.
d) 42 times.

Stars are always the heaviest and largest bodies in their systems, often they have a much larger mass than everything else in their system combined! In our Solar System, the sun accounts for 99.8% of the mass! It is therefore much larger than the Earth.

Q4. How many planets are there in the Solar System?

a) 8.
b) 9.
c) 7.
d) 10.

You may have heard that there are 9 planets in our Solar System. This is because Pluto was often considered the ninth planet. However, scientists classified it as a dwarf planet in 2006, reducing the number of planets in our Solar System to 8.

Q5. What planets do not have moons?

a) Mercury & Venus
b) Mars & Earth
c) Jupiter & Saturn
d) Neptune & Uranus

Mercury and Venus are the smallest planets with the smallest orbit around the Sun. Because of this, they are not strong enough to have their own moons.

Q6. Why is Pluto a "dwarf planet" and not just a "planet"?

a) because Pluto is not round
b) because Pluto is too small
c) because Pluto has no moon
d) because Pluto has not cleaned up its orbit around the Sun

Our Solar System is filled with small meteorites and space dust. Planets 'clean up' their orbits by attracting or colliding with this space dust. Pluto has not done this, so scientists no longer classify Pluto as a planet.

CHAPTER 2.
DEPARTURE TO THE MOON

The activities which are recommended for this chapter are to visualise the distance between the Earth and the Moon.

Escaping gravity

For this chapter there is only one game, based on the famous Doodle Jump game. It is called Escaping gravity. The children need to tap on the screen in order to escape the Earth's gravity easier.

The game consists of these platforms on which the rocket will have to jump. If the rocket lands on the broken asteroid or satellite, the rocket will fall through, and the game would be over.

DISTANCES

Q1. Why is the Earth known as a blue planet?

a) People are blue.
b) The sky is blue.
c) The blue sky is reflected in the sea.
d) Blue is a nice colour, and our planet is nice too.

As far as we know, the Earth is unique for its large amounts of liquid water. It is because of this that Earth looks mainly blue from a distance (the colour of the sky is reflected on the sea, which behaves as a huge mirror), which is why humans have given it cute nickname: "the blue planet".

Q2. How many Earths fit between the Earth and the Moon?

a) 30.
b) 10.
c) 50.
d) 2.

Unlike what you may see in cartoons or artistic images, the moon is much further away from Earth than you would expect.

Q3. If you look at the globe, what does the green represent?

a) Plants.
b) Ice.
c) Water.
d) Desert.

As far as we know, Earth is the only planet with plants. They can be seen even from outer space, especially in regions such as the rainforests.

Q4. What is the closest from the International Space Station?

a) Sun.
b) Earth.
c) Mars.
d) Moon.

The International Space Station is in a low orbit around earth. This means that it is very close to our planet, and not even close to halfway to any other celestial body.

Q5. What are the small, dark and round spots on the Moon?

a) Water.
b) Cities.
c) Mountains.
d) Craters.

As the Moon doesn't have its own atmosphere, lots of meteorites crash on its surface, these form large craters which can be seen from earth as small dark spots.

CHAPTER 2.
DEPARTURE TO THE MOON

ESCAPING THE EARTH

Q1. If you roll a ball from the table, it will fall down as follows:

a) Straight downwards at an ever-increasing speed.
b) In a parabolic arc at an ever-increasing vertical speed and a constant horizontal speed.
c) In a parabolic arc at an ever increasing vertical and horizontal speed.
d) In an arc at a constant horizontal and vertical speed.

When objects fall on Earth, it is always with the same constant vertical acceleration (about 10 m/s every second), the horizontal speed remains the same.

Q2. The task of a rocket is:

a) Taking the space probe above the atmosphere.
b) Flying to the Moon and then land on the Moon.
c) Taking the space probe above the atmosphere and then throw it in horizontal direction.
d) Protecting the astronauts in space in a safe pressure cabin.

If we want to bring the space probe in orbit around the earth, it needs to leave the atmosphere first, and then it must be thrown in the orbit itself.

Q3. Humans in the ISS are weightless because:

a) They are constantly falling.
b) There is almost no gravity in space.
c) The engines are moving them so fast forward.

An object in orbit, such as the ISS, is constantly falling. The reason it never hits the Earth, is because it has such a horizontal speed so that it constantly misses the planet. Object inside the ISS therefore behave like in a falling elevator and appear weightless.

Q4. In a journey to the Moon and back to Earth, gravity changes several times:

a) You are weightless all the time.
b) You are weightless on the Moon, but not on the way from Earth to Moon.
c) You are weightless during rocket launch, weightless in the way to the Moon, and in reduced gravity on the Moon.
d) You are in higher gravity during rocket launch, weightless in the way to the Moon, and in reduced gravity on the Moon.

During the launch of the rocket, you get pushed back into the seat of the rocket, just as you would in a speeding car. This means you weigh more in this system. On your way towards the moon, gravity has a reduced effect on you, and the gravity of the moon is lower.

CHAPTER 3.
ARRIVAL ON THE MOON

The experiment which is recommended for this chapter it is called “Landing safely Earth” and can be found in the course book on page 28.

Lunar landing
The kids need to tap the rocket to put in the perfect position to land.

Q1. In which of these examples is friction with air used to keep them in the air longer?

a) Acorn.
b) Dandelion seeds.
c) Almond.
d) Leaf.

Leaves may be shaped in such a way that they stay in the air longer, but this is purely coincidental. Acorns and Almonds drop down without much effect from friction. Dandelion seeds however are shaped especially so that they stay in the air longer, this way they can float further away. This is because the seeds need to spread out as far as possible in order for the dandelion to properly procreate.

Q2. What is the difference between the gravity on Earth and the Moon?

a) Gravity on the Moon is much smaller than on Earth.
b) Gravity on the Moon is the same as on Earth.
c) Gravity on the Moon is much bigger than on Earth.

Gravity is determined mainly by the amount of mass of an object. The Moon has a mass of seventy sextillion kilograms (a seven with twenty two zeroes), and the Earth has a mass of six septillion kilograms (a six with 24 zeroes). Therefore, gravity on the moon is considerably smaller.

Q3. How can you avoid damage when landing on the Moon?

a) Airbags & parachutes.
b) Trampolines & retrorockets.
c) Airbags & retrorockets.
d) Trampolines & parachutes.

Trampolines would require us to send material to the Moon before the arrival of the probe. This first visit would then need trampolines as well, which is not an efficient way to avoid damage. Parachutes may seem like a good alternative, although they work by increasing air pressure on the inside, which won’t work on the moon as there is no air at all. Because of this, airbags (not unlike the ones in a car) and retrorockets (rockets to slow the descent) form a preferably alternative.

Q4. What is your weight going to be in the Moon?

a) Approx. 50 kg.
b) Approx. 5 kg.
c) Approx. 12 kg.
d) Approx. 200 kg.

As the gravity on the moon pulls less on you than the gravity of the earth, your weight will also be smaller. About 16% of your weight on Earth.

CHAPTER 4.
SURVIVAL ON THE MOON

The experiments recommended in the Course Book are:

Cooking water without heath	Page 41
How are the ditches on Mars formed?	Page 53
Cleaning water	Page 58
Atmosphere in a bottle	Page 69
Seasons on Earth	Page 75
Space suit; Protection against micrometeorites	Page 90
Making oxygen from water	Page 105

Water & Food
The aim of this game is to make kids aware of the importance of water. They have to click on the sections of the pipeline to connect the water source to the lunar colony.

Pop the particles
This is the last challenge for your pupils. They need to help Ellion to protect the ship from the incoming radiation by "popping" it away. For that, they need to tap on the particles that will appear to protect Ellion.

SYRINGE EXPERIMENT

Q_{water}: If there's any air in it? When we pull the syringe, what will we find in it? (picture of syringe in the book)	a) Nothing. b) Water. c) Water & air. **d) Water & vacuum (empty space).**
Q_{water}: What happens with the water when the pressure decreases?	**a) Water boils.** b) Water will freeze. c) Water will disappear.
$Q_{marshmallow}$: What happens with the marshmallow when you pull the syringe?	a) It breaks. **b) It expands (grows).** c) Nothing happens.

PURIFYING WATER

Q1. What is the colour of the dirty water?	a) Blue. b) Transparent. **c) Brown.**
Q2. What is the colour of the filtered water?	a) Blue. b) **Transparent.** c) Brown.
Q3. What has happened with the dirt in the polluted water?	**a) It stayed in the filter.** b) It's still in the water. c) It has disappeared entirely.

ATMOSPHERE AND THE BOTTLE

Q1. Which of the three bottles receives the lightest?	a) Mars. b) Moon. c) Earth. **d) They receive the same amount of light.**
Q2. In which bottle does the temperature rise the fastest?	a) Mars. **b) Moon.** c) Earth. d) They receive the same amount of light.

THE SEASONS

Q1. What is the difference between the both light sources?	a) Nothing. **b) There's more light in one and less light in the other one.**
Q2. Imagine an ant walking on a paper, would it experience a higher temperature in the circle of light in the bigger eclipse of light?	**a) Circle.** b) Eclipse.

CHAPTER 4.
SURVIVAL ON THE MOON

MATERIALS FOR THE SPACESUIT

Q1. Why do astronauts need a spacesuit?

a) To protect them against dangers like space dust.
b) Because it looks fancy.
c) To help them jump on the Moon surface.

Q2. What kind of materials are the best for the spacesuits?

a) Rigid, strong, light
b) Heavy, flexible, weak.
c) Light, flexible, strong.

ELECTROLYSIS

Q1. What happens with the spoons when we connect them with the battery?

a) There will be sparks in the cud of the cables.
b) **We will see the gas bubbles on the spoon.**
c) The spoon will glow.

Q2. What happens when we put a burning or burned match in the oxygen test tube?

a) The wooden stick glows brighter.
b) The matches go out, the water changes colours.