

Newton's Law of Universal Gravitation – VEGA Teaching Scenario



Topic: The law of Universal Gravitation and its application in Astronomy.

Subject(s): Physics

Age / Grade: 15 - 16 years old (2nd class of upper secondary school)

Short description of the interactive games in this scenario:



[Universe Sandbox](#) is a physics-based space simulator. It merges gravity, climate, collision, and material interactions to reveal the beauty of our universe and the fragility of our planet.

What can you do with Universe Sandbox?

- Simulate Gravity
- Collide planets and stars
- Create your own systems
- Model Earth's climate
- Explore historical events

In this [video](#) you can watch a teaser of the above.

Introduction to the scenario:

In this scenario students learn how planets in our solar system move, what powers hold them together and what could happen if those powers became inactive.

Learning outcomes:

The students are able to:

- They formulate and apply Newton's Law of Universal Gravitation and explain its importance for the motion of celestial bodies in our solar system. Understand how valuable water is for life on Earth.
- They relate the weight of a body to the general expression of Global attraction. Explain and analyze the results of human interventions on the natural environment.
- They derive from the LUG a relation for the acceleration of gravity and explain why all bodies fall freely with the same acceleration regardless of their mass. Report environmental problems that often arise from the interaction between humans and the environment and investigate environmental problems in order to propose sustainable solutions.

A selection of learning outcomes from the Cypriot Curriculum:

The General Purpose of the Physics course for the Lyceum is students to develop the following abilities and skills:

1. Understand basic ideas (situations, concepts, principles, laws and theories) and explanatory frameworks mainly through a qualitative and experimental approach.
2. Identify and evaluate alternative interpretations and procedures
3. Use examples to show that scientific ideas are used to explain past observations and to predict future events
4. Ask questions and make assumptions that lead to different types of scientific research
5. Create a written plan for an investigation
6. Use appropriate instruments, technology and units of measurement to collect and organize data
7. Interpret and evaluate data in order to draw conclusions
8. Convey the results of their investigations in appropriate ways (written reports, graphs, oral presentations)
9. Use units of measurement in measuring, calculating and announcing results.
10. Explain that sometimes scientific research leads to unexpected results which in turn lead to new questions and more research.
11. Give examples of how collaboration can be useful in solving scientific problems and finding results.

Formative assessment

Number of students: 20 students (4 students/group)

Duration: 2 lessons of 40-45 min each

Prerequisites:

- Computers with internet connection
- Universal Sandbox downloaded on laptops or other mobile devices
- Check that the internet is working
- Information about the topic to mediate to the students (videos, pictures, Educational tools etc.)

Before the program begins (preparatory work for teacher):

- Search and collect information and material about the topic
- Get properly acquainted with the games
- Prepare a glossary with important terms as the games are only in English
- Learn how basic game functions work (make a manual for the students if necessary)
- Prepare and collect all things needed for the scenario
- Divide students into groups of maximum four per laptop or mobile device

The main part of the scenario (amount of lessons):

Part one (1 lesson of 40-45 minutes)

Lessons 1

Preparations:

- Check that the internet is working
- Download the videos that will be used for the delivery of the lessons

Learning sessions:

Lesson 1:

- The teacher starts the lesson by showing to the students the following video (in Greek) <https://youtu.be/5nZv3eG0nfk>
- Then the teacher discusses with the students about the Universal Law of Gravitation and how it was applied in creating satellites and space stations.

Debriefing:

Newton proved that the force that causes, for example, an apple to fall toward the ground is the same force that causes the moon to fall around, or orbit, the Earth. This universal force also acts between the Earth and the Sun, or any other star and its satellites. Each attracts the other.

Part two (1 lesson x 45 minutes)

Lesson 2:

Preparations:

- Familiarise yourself with the game you are going to use
- Download the game on the mobile devices
- Check that the internet is working
- The teacher divides students into groups according to the number of mobile devices available in the classroom. The maximum number of students per group should be four.
- The teacher will explain the App/Game and how they should play. Students will have to create their own universes by applying Newton's Laws.

Debriefing:

The last 15 minutes of the lesson the teacher will discuss with the students how they worked in each team, how was their collaboration, and if the game facilitated their learning and comprehension of the Universal Law of Gravitation.

Summative assessment:

Grades 5-10	5	6	7	8	9	10
Activity and engagement	The student has had challenges to get the task finished. The student hasn't shown signs of engagement neither at school nor at home.	The student has only occasionally shown interest in the work and has had difficulty finding motivation.	The student has mostly shown interest in the work both at home and at school.	The student has shown interest and commitment to the work both at home and at school.	The student has shown great interest and commitment both in lessons and at home.	The student has shown great interest, responsibility and commitment both in lessons and at home.
The overall picture of the work when completed.	The student misses several parts of his work and several points are not checked in the list.	The student lacks several parts of the checklist in his work.	The student lacks certain parts of the checklist, but it is largely complete.	The student has done all the parts on the checklist.	The student has done all the parts on the checklist and you can see that the student has made an effort to include all the parts.	The student has done every single part on the checklist and it can be seen that the student has processed the content.
Images and captions	The student lacks pictures.	The student has few pictures and no captions.	The student has pictures but no captions.	The student has pictures with accompanying text.	The student has several pictures and descriptive captions.	The student has versatile pictures and descriptive and explanatory text.

<p>Showing responsibility for the completion of the work. Cooperation and peer response</p>	<p>The student had difficulty cooperating with his group and did not listen to his classmates. The student did not give a peer response and did not take into account what the group gave in response.</p>	<p>The student had some difficulties in cooperating with his group and listening to his classmates. The student gave peer feedback without following the instructions. The student did not take into account the response given by the group.</p>	<p>The student mostly cooperated well with his group. The student received and gave feedback from his group almost always according to the instructions. The response was mostly constructive.</p>	<p>The student showed responsibility and mostly a good ability for cooperation. The student received and gave feedback from his group. The response was constructive.</p>	<p>The student showed evidence of good responsibility and a good ability for cooperation. The student gave a versatile response and took the response he / she received from his / her group into account.</p>	<p>The student showed evidence of excellent responsibility and an excellent ability for cooperation. The student made an effort to formulate himself in a constructive and valuable way for the task in order to help his group further in his work. The student received a response from his group and took it into account in his own work.</p>
<p>Skills</p>	<p>The student shows obvious shortcomings in the understanding of the subject.</p>	<p>The student shows some shortcomings in the understanding of the subject.</p>	<p>The student shows evidence of a certain understanding and some learned knowledge of the subject. .</p>	<p>The student shows evidence of a good understanding and has assimilated the most important content in the subject.</p>	<p>The student shows of an excellent understanding and has assimilated the most important content in the subject but lacks some knowledge.</p>	<p>The student shows evidence of an excellent understanding and fully masters the content.</p>
<p>Language learning/English</p>	<p>The student has big difficulties in learning the English words.</p>	<p>The student struggles with and has some challenges with the English words.</p>	<p>The student knows the most important concepts and words in English.</p>	<p>The student shows evidence of understanding most parts In</p>	<p>The student has a good understanding and has learned most of</p>	<p>The student masters all concepts and words in English.</p>

				English.	the concepts and knows all the words in English.	
The VR part and the app use	The student presents obvious difficulties in understanding how the game app work. Shows a lack of interest and is careless in the use of equipment needed.	The student presents some difficulties in understanding how the game app works. Trying to do according to the instructions, but can not keep the interest up all the time. The student is sometimes careless in the use of equipment needed.	The student understands the main features of how the game app works. Mostly follows the instructions, but sometimes lacks perseverance. Is usually careful with the equipment.	The student shows a good understanding of how the game app works. The student always follows the teacher's instructions and is careful with equipment.	The student shows an excellent understanding of how the game app works. Always follow the teacher's instructions and is very careful with the equipment.	The student masters the use of the game app. Always follow the teacher's instructions and help their classmates. Always be careful with technology.