Gravity, Orbits, and Celestial Collisions – VEGA Teaching Scenario

Topic: Gravity, orbits and celestial collisions

Subject(s): Science

Age / Grade: 11+ / grade 5+

Short description of the VR game in this scenario:

Universe Sandbox is an interactive sandbox gravity simulator video game and educational software. Using Universe Sandbox, users can see the effects of gravity on objects in the universe scale simulations Simulations include the Solar System, various galaxies, and other simulations. At the same time the users are interacting and maintaining control over gravity, time, and other objects in the universe.

Introduction to the scenario

This scenario introduces the students to Universe Sandbox's different tools and how to use them to manipulate objects in-game. Students will run experiments and observe the consequences. The lesson is split into three phases: Theory, play (tasks in-game), and debrief. This scenario also introduces the students to gravity and how it determines celestial body interaction in space. Why are orbits formed and how do different Newtonian laws come into play? The game uses Universe Sandbox 2 and students play the game for about 50% of the class.

Please open the computers after the theory section for better concentration.

Learning outcomes:

The students are able to:

- better understand the role of gravity in the universe
- understand how gravity is linked to orbits
- understand what might cause celestial collisions
- experiment and research idea in a digital sandbox

A selection of learning outcomes from the Finnish Curriculum

Finnish curriculum Grades 3-6

- T1 generates and maintains the student's interest in the environment and the study of environmental studies, and helps the student experience all areas of environmental science as relevant to him/her
- T5 guides the student to plan and carry out small studies, make observations and measurements in diverse learning environments using different senses and research and measurement tools
- T6 guides the student to identify cause-and-effect relationships, draw conclusions from their results and present their results and research in different ways
- T11 guide the student to use information and communication technology in the acquisition, processing and presentation of information and as a means of interaction responsibly, safely and ergonomically
- T13 guide the student to understand, use and make different models that can be used to interpret and explain people , environment and their phenomena

[Formative assessment](#)

Number of students: Duration (estimated time/number of lessons):
- 2 students per one computer / device
- 2 lessons á 45 min

Prerequisites (necessary materials and online resources):

- Please see the [powerpoint](#) and make sure the game works (Universe sandbox 2)
- **All the teacher materials and guides are listed on the [powerpoint](#) you can use to structure your class and visualize things to students.**

Before the program begins (preparatory work for teacher):

- Please make sure the game works on the devices
- Have a look at the [powerpoint](#) so you'll have a general understanding of the class structure.

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

Part one (45min)

Celestial collisions

Preparations: Both parts (1 and 2) are split into three phases:

Theory, play and debrief. Please open the powerpoint provided.

Theory phase: Discuss the topic and see the instructions on how to open the right simulation from the saved simulations. Open the game after the instructions have been checked.

Play phase: Please pay attention to the tasks provided on the slides. Please instruct your students to play and test the tasks step by step. (The Roche limit is discussed in the VR lesson 1 for US2) Each group / pair should have notation devices with them to answer each task on a separate document. Faster students can move forward quicker and experiment with tasks provided on the final task slide.

Debriefing: Share and discuss on the slides. 4 Please discuss the topics provided on the slides. Presenter notes will provide the answer to the questions if needed. Feel free to have a free discussion with the students. They might also have interesting ideas on how to utilize the game in school.

Part two (45min)

Preparations: Please open the powerpoint (second part) provided.

Theory phase: Discuss the topic and see the instructions on how to open the right simulation from the saved simulations. Open the game after the instructions have been checked. Instructions are on the slide show just after the 'play phase'.

Play phase: Please pay attention to the tasks provided on the slides. Please instruct your students to play and test the tasks step by step. Each group / pair should have notation devices with them to answer each task on a separate document. Faster students can move forward quicker and experiment with tasks provided on the final task slide. It is a good idea to once in a while check that all students have taken notes.

Debriefing: Share and discuss on the slides. Please discuss the topics provided on the slides. Presenter notes will provide the answer to the questions if needed. Feel free to have a free discussion with the students. They might also have interesting ideas on how to utilize the game in school.

ASSESSMENT

Student evaluation rubric				
Knowledge content	1	2	3	4
Information recall	Student can't recall information covered in game	Student can recall some information covered in game	Student can recall most information covered in game	Student can recall all the information from the game well
Transfer	Student can't connect the information in game to information on books or in other medias	Student can transfer some information from the game to other medias	Student can transfer majority of information from the game to other medias	Student can connect the information in game very well to contents in other medias
Skills	1	2	3	4
Problem-solving	Student did not try to solve problems in game / during activity	Student was somewhat active in solving problems during the activity	The student worked rather actively on solving problems during class.	Student worked very actively on solving problems during class
Collaboration	Student was not able / willing to collaborate with others.	The student participated, but was not particularly active in collaboration.	Student was actively collaborating while working.	Student was very actively collaborating while working.

Creativity	Student did not actively consider / provide creative solutions to tasks or challenges	Student provided some creative ideas and solutions during the activity	Student actively considered / provided creative solutions to tasks or challenges	Student very actively considered/provided creative solutions to tasks or challenges
	1	2	3	4
Exercise completion	Student was not able to complete the tasks in the game	Student was able to complete some of the tasks in the game	Student was able to complete most of the tasks in the game	Student was able to complete all (or nearly all) tasks in the game
Engagement	Student was not engaged during the class	Student was slightly engaged during the class	Student was engaged during the class	Student was very engaged during the class

or students - more for evaluating the game itself. Most useful when experimenting

Student self-assessment rubric (includes game/scenario assessment)				
	1	2	3	4
Clear goals	I didn't understand what I was supposed to do in the game.	I somewhat understood what I was supposed to do in the game.	I knew what to do in the game.	I knew exactly what to do in the game.
Challenge level	The game was so hard that I felt frustrated.	My skill and game's difficulty were in balance.	The game didn't provide me with too much challenge.	I felt bored, the game was too easy.
Feedback	The game didn't provide me any feedback	The game provided me some feedback	The game provided me a lot of feedback	The game provided all the feedback I needed.
Concentration	I wasn't able to concentrate on the game.	I was able to somewhat concentrate on the game.	I was able to almost fully concentrate while playing.	I was able to fully concentrate while playing.
Completion	I wasn't able to complete the tasks in the game.	I was able to complete some tasks in the game.	I was able to complete almost all tasks in the game.	I was able to complete all the tasks in the game.
Learning	I didn't learn anything.	I did learn something from the game.	I feel that I learned quite a few things from the game.	I feel that I learned a lot from the game.
Fun	I didn't like playing the game.	I had some fun playing the game.	Playing the game was fun.	Playing the game was a lot of fun.