Designing a Roller Coaster

<table>
<tr><td rowspan="4">Integration</td><td colspan="3">21st Century Themes: Roller Coaster design</td></tr>
<tr><td rowspan="2">Concepts for STEAM Disciplines</td><td>Mathematics
Functions
Analytic geometry</td><td>Science
Kinetic energy
Centripetal force
Gravity</td></tr>
<tr><td>Technology
GeoGebra</td><td>Arts
Designing a Roller Coaster</td></tr>
<tr><td colspan="3">Prerequisite Knowledge

Mathematics
Functions
Analytic geometry

Science
-

Information Technologies
-

Arts
-</td></tr>
<tr><td colspan="3">Learning Outcomes

Grade Level: 15-17 years old
Duration: 400 minutes

Learning Outcomes for Mathematics
Functions
Analytic geometry
Applied Mathematics
Mathematics in context

Learning Outcomes for Science Education
Kinetic energy
Centripetal force
Gravity

Learning Outcomes for Information Technologies
Use of GeoGebra

Learning Outcomes for Visual Arts
Techniques of technical drawing for 2D representation of the 3D space</td></tr>
<tr><td rowspan="3">Real World Cont</td><td colspan="3">Problem Situation
Design a Roller Coaster using GeoGebra and explore the physics and maths concepts behind its operation.</td></tr>
<tr><td colspan="3">Materials
Smartphones or tablets, Documents (Different information about Roller Coasters, Web address for students to research), GeoGebra, Computers with internet access.</td></tr>
<tr><td colspan="3">Research to Prepare Lesson
The following questions will be sought answers for preparing the lesson plan

• How are Roller Coasters constructed?
• What are the materials used in Roller Coasters construction?
• What information is necessary for Roller Coasters construction?
• Which concepts of physics and mathematics are involved?</td></tr>
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e x t	**Resources** • www.geogebra.org • https://letstalkscience.ca/educational-resources/hands-on-activities/how-can-i-build-a-rollercoaster • https://www.wikihow.com/Make-a-Rolling-Roller-Coaster • https://www.youtube.com/watch?v=7O_W5ayuSk8 • https://www.geogebra.org/m/zjF5xh66
S T E A M A c t i v i t y	**Ask** The teacher starts the lesson by asking questions to the students about Roller Coasters: Have you ever seen a Roller Coaster? Have you ever ridden a Roller Coaster? Where did you see these Roller Coasters? What was the construction material? What concepts of physics and maths do you think are involved? Each student is encouraged to respond and participate. Possible answers expected from the students are as follows: • At amusement parks • Made of iron • Gravity, different forces, functions
	Research Teacher gives students the task, designing a Roller Coaster. They are asked to research what concepts are involved in the construction of a Roller Coaster and which software they think would help them when thinking about the design. They will have computers, tablets or smartphones to look for information.
	Imagine Presentations of the initial research and ideas. Groups of 3-4 students gather to start thinking about Roller Coasters design. Students are encouraged to design in GeoGebra.
	Plan Instructions: 1. Begin the activity by explaining to the students the basic physics concepts behind Roller Coasters, such as kinetic energy, centripetal force, and gravity. 2. Teach students how to use GeoGebra to create curves and lines that represent Roller Coaster tracks. You can show them how to use drawing and curve tools to create curved and steep tracks. 3. Ask students to design their own Roller Coaster in GeoGebra, using the physics and maths concepts they learned to ensure their design is functional and exciting. 4. In the second session, students can add more details to their designs, such as loops and twists, and can use animation tools to simulate the Roller Coaster ride. 5. In the third session, students can present their designs to the rest of the class and explain how they used physics and maths concepts to design a functional and exciting Roller Coaster. Other students can ask questions and provide feedback on the designs presented. 6. At the end of the activity, you can select some of the best designs and showcase them in an online virtual gallery to share with other students, parents and/or the community at large.
	Create In this phase, it is expected that they can make a presentation, exposing the route taken for obtaining the design. They must justify their choices by providing the elements that support their decisions. You can use the tool of choice for this presentation, be it PowerPoint, videos, etc. Consider that at the end of the presentation, the exposed elements will be analysed. The presentation must have an extension of 10 minutes maximum.

	Test In this phase, they are asked to present the design of the Roller Coaster. They will have 120 minutes of class to prepare the presentation of the work achieved in the team following the set slogan. This design should include a justification of their decisions. Then, there will be an exhibition of the team presentations on the design of the Roller Coaster.
	Improve Students' final reports should include the feedback given by their classmates to the presentation.
Materials	Smartphones or tablets, Documents (Different information about Roller Coasters, Web address for students to research), GeoGebra, Computers with internet access.
Test	This part will be completed by the teacher after the lesson plan is implemented in the classroom.
Improve	As an improvement of the activity, a physical Roller Coaster can be created.