Coding to show Newton's laws Lesson plan

Created by Jen and Brian Cauthers

Education level: From middle school

Subject: STEAM, physics, computer science

Format: Individual activity

Duration: Approx. 1 hour

Introduction and lesson objectives:

The CoSpaces Edu library contains a range of objects that students and teachers can use to recreate and simulate lab experiments.

This lesson plan involves Newton's Laws of Motion by enabling the physics features of certain objects to allow for collisions, gravity and friction.

Newton's laws of motion are typically taught in an exploratory manner, which lends itself well to having students use CoSpaces Edu to design events to test and simulate the concepts.

Newton's laws of motion are roughly stated as follows:

- The first law states that an object will remain at rest or in uniform motion in a straight line unless acted on by an external or unbalanced force.
- The second law explains that the acceleration of an object changes when it is subjected to an external force. The acceleration is directly proportional to the force applied and inversely proportional to the mass of the object.
- The third law states that for every action in nature there is an equal and opposite reaction.

For lesson tutorials on Newton's laws you can visit the Physics Classroom website.

Learning goals and student benefits:

- Learn 3D creation skills
- Develop spatial awareness
- Develop sense of design
- Practice computational thinking
- Develop coding skills
- Learn by experimenting

Activity example:

1. Create a simulation to test Newton's Laws of Motion by setting up a ramp with spheres of different masses and collide into a static wall (see example 1).
2. Create a scene that allows students to use ramp templates to build their own ramps to test Newton's Laws using spheres of different masses (see example 2).
3. Enable students to use objects with different masses, adjust friction and other parameters to test Newton's Laws of Motion while constructing different ramps and allowing for creativity in scene design (see example 3).
4. Enable students to explore the role of velocity in collisions of objects within elastic and inelastic collisions.

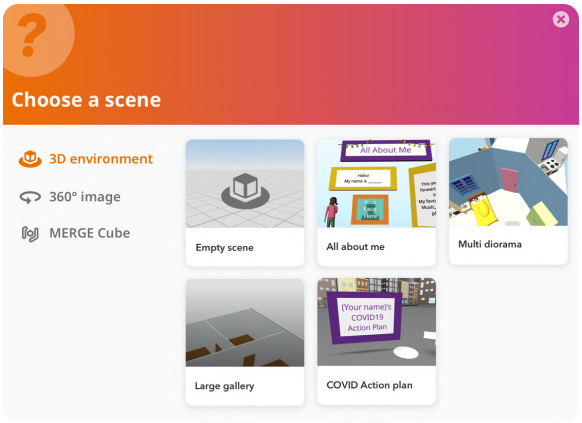
Extension idea:

Hold a class discussion about the simulations' results and what students learned.

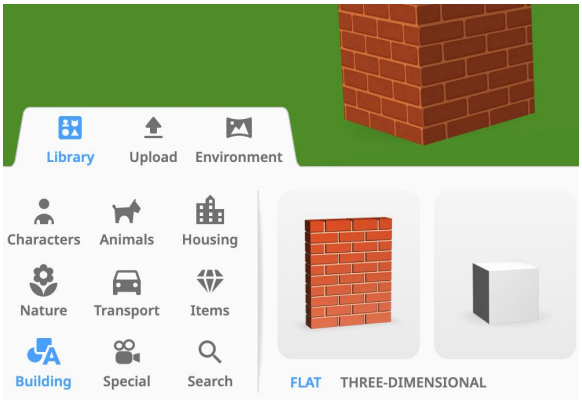
Assessment and evaluation suggestions:

- Have your students managed to experiment with the simulations?
- Did your students find ways to test Newton's Laws?
- Have your students experimented with various physics properties?
- Did your students get a good understanding of Newton's Laws?

Creation guide

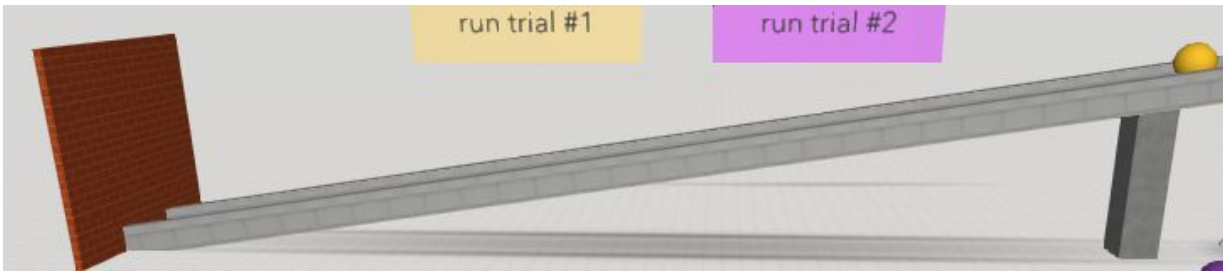


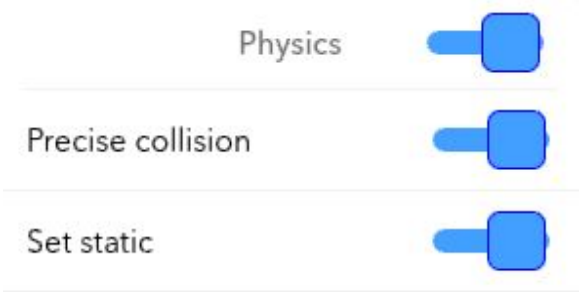
In CoSpaces Edu, create an **Empty scene** inside a **3D environment**.



Use the **building blocks** available under **Building** in the **Library** to build a ramp for the balls to roll down. Be sure to add side rails to your ramp or else the ball will roll off of the flat ramp.

Set the angle of the ramp to your liking and use another building block to support the high end of the ramp. Add a wall and place it at the end of the ramp.





Adjust the **Physics** properties of the **brick wall** as follows:

- **Physics** on
- **Precise collision** on
- **Set static** on

Insert a sphere and place it at the top of the ramp.

Adjust the properties for the sphere as follows:

- **Physics** on
- **Precise collision** on
- **Set static** off
- Adjust the **Mass** as you wish
- Adjust **Bounciness** to test its effects
- Adjust **Friction** to test its effects

Test the physics of the ball by pressing **Play**. The ball should roll down the ramp and bounce off of the brick wall and stop.

Extra tip: You can increase the complexity of this scene by adding another ball with a different mass so that you can compare how the two balls respond.

There's also a 3D character added to the end of the ramp to pretend to "push" the ball to get it started down the ramp.

In order to place the other ball onto the ramp, use coding in order to switch the positions of the balls when you click an object, such as a sign.
In order to not have the ball start rolling immediately, use coding to turn physics for the sphere on and off with the click of an object in the scene.

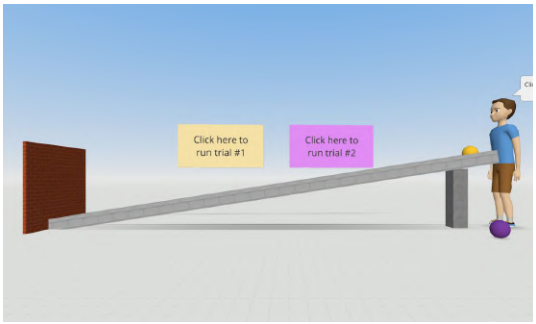
In our example, physics is turned off at first, then turned on when the sign is clicked and the ball is pushed by the boy. When the second ball is clicked, the balls switch positions. When the sign is clicked, the second ball with a different mass is pushed down the ramp by the boy.

Example CoSpaces

Example 1: Rolling balls with different masses

Essential question: Will balls with different masses roll down the ramp and collide with the wall at the same time?

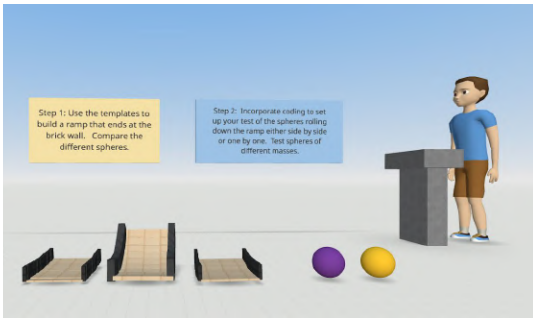
edu.cospaces.io/JVZ-UUV



Example 2: Build your own ramp to test Newton's Laws

This alternate scene uses template sections to let students quickly build a variety of ramps and experiment with Newton's Laws.

edu.cospaces.io/ZQF-KEW



Example 3: Colliding vehicles of different masses

Essential question: How is a head on collision affected by having vehicles of various masses? Users can adjust the vehicle masses to study Newton's Laws.

edu.cospaces.io/QTE-JBB