



# Coding to show Newton's laws

*\* A CoSpaces Edu Pro license plan is needed for this lesson.*

**Lesson complexity:** Intermediate

**Grades:** Grade 7 and up

**Subjects:** STEM, Physics, Computer science

**Created by:** Jennifer and Brian Cauthers, CoSpaces Edu Ambassadors

## Introduction:

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](#).



### Benefits:

- Encourage kids to invent, create, and build
- Teach spatial awareness and construction basics
- Develop creativity and sense of design
- Simulation and reiteration of lab experiments, trial and error
- Coding and step by step planning
- Have fun and motivate

### 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 (example # 1 below).
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 (example #2 below).
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 (example #3 below).
4. Enable students to explore the role of velocity in collisions of objects within elastic and inelastic collisions.



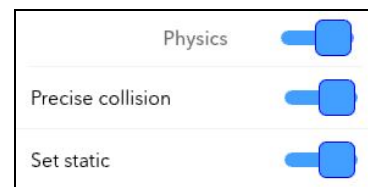
## Creation guide

1. Create a blank scene in CoSpaces Edu.
2. Use the building blocks 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.  
Alternative: provide building block sections for students to quickly build different ramps of their choice.
3. Set the angle of the ramp to your liking and use another building block to support the high end of the ramp.
4. Insert a wall from the library and place it at the end of the ramp.



5. Adjust the properties for the brick wall as follows:

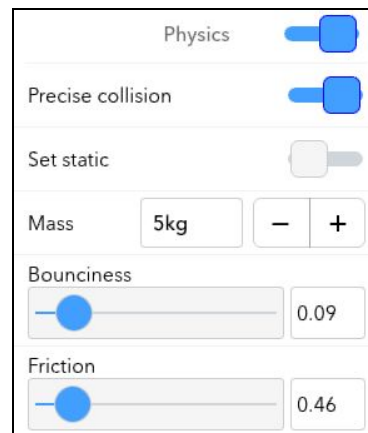
- a. Physics on
- b. Precise collision on
- c. Set static on



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

7. Adjust the properties for the sphere as follows:

- a. Physics on
- b. Precise collision on
- c. Set static off
- d. Adjust the mass as you wish
- e. Adjust bounciness to test its effects
- f. Adjust Friction to test its effects



8. 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 is 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 spaces

### **Example #1:** Rolling balls with different masses

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

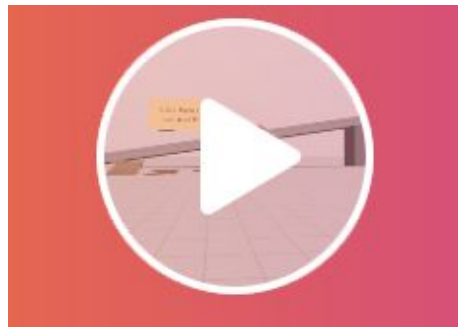
[View example space](#)



### **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.

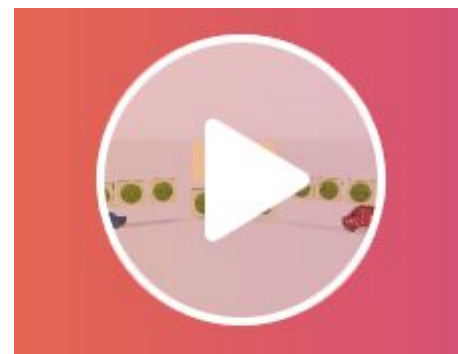
[View example space](#)



### **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.

[View example space](#)





Sample code for example #1 with rolling balls advanced space:

```

1  ▶ When play clicked
2  set Ball #1 collisions with other items off
3  remove physics from Ball #1
4  remove physics from Ball #2
5  Boy say " Hi! Do you ... " for 2.0 seconds
6  Boy say " Click the sig... " for 4.0 seconds
7  when Trial #1 is clicked
8  play animation Aggressive on Boy
9  add physics to Ball #1
10 set Ball #1 collisions with other items on
11 push Ball #1 towards Brick wall with velocity 5.0
12 pause for 4.0 sec.
13 Boy say " Click the Pur... "
14 when Ball #2 is clicked
15 run parallel
16   set position of Ball #2 to x: 6.58 y: 1.43 z: 2.26
17   Boy say " Click the pa... " for 4.0 seconds
18   remove physics from Ball #1
19   set position of Ball #1 to x: 6.17 y: -.65 z: 0.0
20   pause for 1.0 sec.
21 when Trial #2 is clicked
22 run parallel
23   play animation don't animate on Boy
24   add physics to Ball #2
25   set Ball #2 collisions with other items on
26   push Ball #2 towards Brick wall with velocity 5.0
  
```