# Unit 1 - Lesson 6. Introduction to Rigidbody and Game Physics

**Aim:** How do we control the movements of a game object through keyboard and mouse? What is Rigid Body and why is it important in video games? What is the game physics engine and how do we use some of the forces?

**Objectives:** After the lesson, students should be able to:

* Obtain basic understanding of controller
* Obtain basic understanding of Rigid Body and physical engine

**CLASS PROCEDURE:**

***Do Now:***

Open Unity. Create a new project and name it “Rolling”. Create a new scene. In the new scene, add a 3-D plane at the position of (0, 0, 0) and a 3-D sphere at (0, 0, 0). Now, how do we write a script to allow the user rolls the sphere to the left, right, forward and back by using the keys on the keyboard?

***Presentation / Discussion:***

1. ***Solution to the “Do Now”:***

using UnityEngine;

using System.Collections;

public class RollSphere : MonoBehaviour {

public float speed;

private Rigidbody rb;

void Start ()

{

rb = GetComponent<Rigidbody>();

}

void FixedUpdate ()

{

float moveHorizontal = [Input.GetAxis](http://docs.unity3d.com/Documentation/ScriptReference/Input.GetAxis.html) ("Horizontal");

float moveVertical = [Input.GetAxis](http://docs.unity3d.com/Documentation/ScriptReference/Input.GetAxis.html) ("Vertical");

Vector3 movement = new Vector3 (moveHorizontal, 0.0f, moveVertical);

rb.AddForce (movement \* speed);

}

}

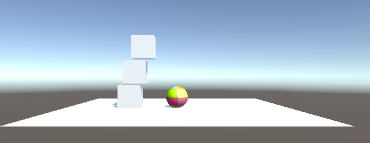
1. What is a physics engine?
   1. To have convincing physical behavior, an object in a game must accelerate correctly and be affected by collisions, gravity and other forces.
   2. Unity’s built-in physics engines provide components that handle the physical simulation for you. With just a few parameter settings, you can create objects that behave passively in a realistic way (ie, they will be moved by collisions and falls but will not start moving by themselves).
   3. By controlling the physics from scripts, you can give an object the dynamics of a vehicle, a machine or even a moving piece of cloth.
   4. There are actually two separate physics engines in Unity: one for 3D physics, and one for 2D physics. The main concepts are identical between the two engines (except for the extra dimension in 3D), but they are implemented using different components. For example, there is **Rigidbody** component for 3D physics and an analogous **Rigidbody 2D**for 2D physics.
2. What is Rigidbody and why do we need Rigidbody in Unity?
   1. *Rigidbodies* enable your GameObjects to act under the control of physics.
   2. The Rigidbody can receive forces and torque to make your objects move in a realistic way.
   3. Any GameObject must contain a Rigidbody to be influenced by gravity, act under added forces via scripting, or interact with other objects through the NVIDIA PhysX physics engine.
3. How do we add force to Rigidbody?

We can use the Addforce() method.

1. What are the forces in the game physics engine and how do we use the forces?

***Pair – sharing Activity: Explore the Game Forces***

Open Unity, and open the rolling sphere scene you created yesterday in class. Add three stacked cubes in your scene. Place one cube on top of another and make the top ones shifted to one side. Click Play and roll the sphere to make it knock on the cubes, the cubes should tumble down. If you like, add materials and colors to the sphere and the three cubes to make the game more colorful.



Now stop Play, choose the cube that is on the top, go to the Inspector menu, under Rigidbody, check the “Is Kinematic”. Play the game again. What would happen?

***Work with your peers, explore, and answer the questions below:***

1. What does the Is Kinematic do?

* If “Is Kinematic” is enabled, Forces, collisions or joints will not affect the rigidbody anymore. The rigidbody will be under full control of animation or script control by changing transform.position.
* Kinematic rigidbodies are particularly useful for making characters which are normally driven by an animation, but on certain events can be quickly turned into a ragdoll by setting isKinematic to false.
* Kinematic bodies also affect the motion of other rigidbodies through collisions or joints. Eg. can connect a kinematic rigidbody to a normal rigidbody with a joint and the rigidbody will be constrained with the motion of the kinematic body.

1. How can we add constant force to the Rigidbody?

***Exploring the Physics / Constant Forces***

1. Select a cube, i.e., the middle one. Under the Inspector menu, choose “Add Component” and add “Constant Force”.
2. Give it a Z force of 10. Click on Play. What do you observe?
3. Stop Play, and change the Z force to -10, and click Play. What do you observe?
4. Now stop Play mode.
5. Add a Constant Force component to the top cube.
6. Set its Relative Force, Y to -2.
7. Click Play. What do you observe?
8. Stop the Play mode, and select the bottom cube.
9. In the Rigidbody Constraints, activate its X and Z Freeze Rotation parameters.
10. Add a Constant Force component to it.
11. Set its Torque, Y to 1.
12. Click Play. What do you observe?

***Appendix:*  Properties of Constant Force in Unity**

| ***Property:*** | ***Function:*** |
| --- | --- |
| Force | The vector of a force to be applied in world space. |
| Relative Force | The vector of a force to be applied in the object’s local space. |
| Torque | The vector of a torque, applied in world space. The object will begin spinning *around* this vector. The longer the vector is, the faster the rotation. |
| Relative Torque | The vector of a torque, applied in local space. The object will begin spinning *around* this vector. The longer the vector is, the faster the rotation. |