Create with Code

Unit 3 Lesson Plans

unity

3.1 Jump Force

Steps:

Step 1: Open prototype and change background

Step 2: Choose and set up a player character

Step 3: Make player jump at start

Step 4: Make player jump if spacebar pressed

Step 5: Tweak the jump force and gravity

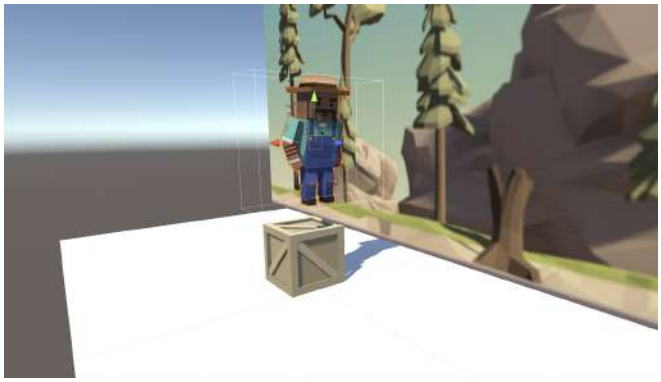
Step 6: Prevent player from double-jumping

Step 7: Make an obstacle and move it left

Step 8: Create a spawn manager

Step 9: Spawn obstacles at intervals

Example of project by end of lesson



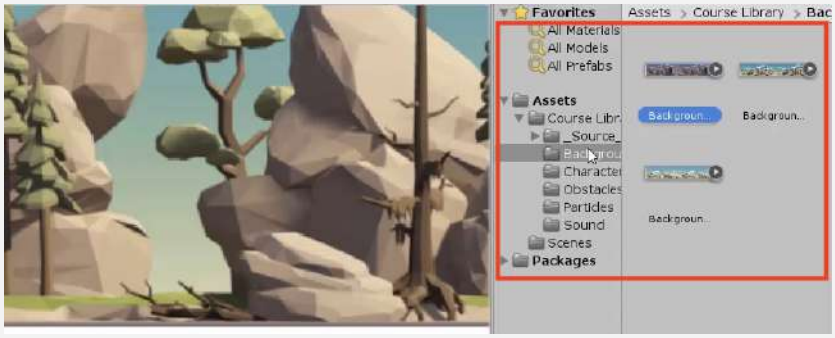
Length:	90 minutes
Overview:	The goal of this lesson is to set up the basic gameplay for this prototype. We will start by creating a new project and importing the starter files. Next we will choose a beautiful background and a character for the player to control, and allow that character to jump with a tap of the spacebar. We will also choose an obstacle for the player, and create a spawn manager that throws them in the player's path at timed intervals.
Project Outcome:	The character, background, and obstacle of your choice will be set up. The player will be able to press spacebar and make the character jump, as obstacles spawn at the edge of the screen and block the player's path.
Learning Objectives:	By the end of this lesson, you will be able to: - Use GetComponent to manipulate the components of GameObjects - Influence physics of game objects with ForceMode.Impulse - Tweak the gravity of your project with Physics.gravity - Utilize new operators and variables like && - Use Bool variables to control the number of times something can be done - Constrain the RigidBody component to halt movement on certain axes

Step 1: Open prototype and change background

The first thing we need to do is set up a new project, import the starter files, and choose a background for the game.

1. Open **Unity Hub** and create an empty "Prototype 3" project in your course directory on the correct Unity version.
   If you forget how to do this, refer to the instructions in Lesson 1.1 - Step 1
2. Click to download the Prototype 3 Starter Files, **extract** the compressed folder, and then **import** the .unitypackage into your project.
   If you forget how to do this, refer to the instructions in Lesson 1.1 - Step 2
3. Open the Prototype 3 scene and **delete** the **Sample Scene** without saving
4. Select the **Background object** in the hierarchy, then in the **Sprite Renderer** *component > Sprite,* select the *_City, _Nature, or _Town image*

- **New Concept:** Sprites / Sprite Renderer
- **Tip:** Browse all of the Player and Background options before choosing either - some work better with others

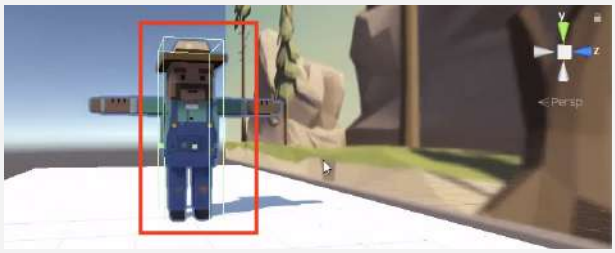


Step 2: Choose and set up a player character

Now that we've started the project and chosen a background, we need to set up a character for the player to control.

1. From *Course Library > Characters*, **Drag** a character into the hierarchy, **rename it** "Player", then **rotate it** on the Y axis to face to the right
2. Add a **Rigid Body** component
3. Add a **box collider**, then **edit** the collider bounds
4. Create a new "Scripts" folder in Assets, create a "PlayerController" script inside, and **attach** it to the player

- **Don't worry:** We will get the player and the background moving soon
- **Warning:** Keep isTrigger UNCHECKED!
- **Tip:** Use isometric view and the gizmos to cycle around and edit the collider with a clear perspective



Step 3: Make player jump at start

Until now, we've only called methods on the entirety of a gameobject or the transform component. If we want more control over the force and gravity of the player, we need to call methods on the player's Rigidbody component, specifically.

1. In **PlayerController.cs**, declare a new ***private Rigidbody playerRb;*** variable
2. In ***Start()***, initialize ***playerRb = GetComponent<Rigidbody>();***
3. In ***Start()***, use the AddForce method to make the player jump at the start of the game

- **New Function:** GetComponent
- **Tip:** The playerRb variable could apply to anything, which is why we need to specify using GetComponent

```
private Rigidbody playerRb;

void Start()
{
  playerRb = GetComponent<Rigidbody>();
  playerRb.AddForce(Vector3.up * 1000);
}
```

Step 4: Make player jump if spacebar pressed

We don't want the player jumping at start - they should only jump when we tell it to by pressing spacebar.

1. In **Update()** add an **if-then statement** checking if the spacebar is pressed
2. **Cut and paste** the AddForce code from Start() into the if-statement
3. Add the ***ForceMode.Impulse*** parameter to the ***AddForce*** call, then **reduce** force multiplier value

- **Warning:** Don't worry about the slow jump double jump, or lack of animation, we will fix that later
- **Tip:** Look at Unity documentation for method overloads here
- **New Function:** ForceMode.Impulse and optional parameters

```
void Start()
{
  playerRb = GetComponent<Rigidbody>();
  playerRb.AddForce(Vector3.up * 100);
}
```

```
void Update() {
  if (Input.GetKeyDown(KeyCode.Space)) {
    playerRb.AddForce(Vector3.up * 100, ForceMode.Impulse); } }
```

Step 5: Tweak the jump force and gravity

We need to give the player a perfect jump by tweaking the force of the jump, the gravity of the scene, and the mass of the character.

1. **Replace** the hardcoded value with a new ***public float jumpForce*** variable
2. Add a new ***public float gravityModifier*** variable and in ***Start()***, add ***Physics.gravity *= gravityModifier;***
3. In the inspector, tweak the ***gravityModifer***, ***jumpForce***, and **Rigidbody** mass values to make it fun

- **New Function:** the students about something
- **Warning:** Don't make gravityModifier too high - the player could get stuck in the ground
- **New Concept:** Times-equals operator *=

```
private Rigidbody playerRb;
public float jumpForce;
public float gravityModifier;

void Start() {
  playerRb = GetComponent<Rigidbody>();
  Physics.gravity *= gravityModifier; }

void Update() {
  if (Input.GetKeyDown(KeyCode.Space)) {
    playerRb.AddForce(Vector3.up * 10 jumpForce, ForceMode.Impulse); } }
```

Step 6: Prevent player from double-jumping

The player can spam the spacebar and send the character hurtling into the sky. In order to stop this, we need an if-statement that makes sure the player is grounded before they jump.

1. Add a new ***public bool isOnGround*** variable and set it equal to ***true***
2. In the if-statement making the player jump, set ***isOnGround = false***, then **test**
3. Add a condition ***&& isOnGround*** to the **if-statement**
4. Add a new ***void onCollisionEnter*** method, set ***isOnGround = true*** in that method, then **test**

- **New Concept:** Booleans
- **New Concept:** "And" operator (&&)
- **New Function:** OnCollisionEnter
- **Tip:** When assigning values, use one = equal sign. When comparing values, use == two equal signs

```
public bool isOnGround = true

void Update() {
  if (Input.GetKeyDown(KeyCode.Space) && isOnGround) {
    playerRb.AddForce(Vector3.up * jumpForce, ForceMode.Impulse);
    isOnGround = false; } }

private void OnCollisionEnter(Collision collision) {
  isOnGround = true; }
```

Step 7: Make an obstacle and move it left

We've got the player jumping in the air, but now they need something to jump over. We're going to use some familiar code to instantiate obstacles and throw them in the player's path.

1. From *Course Library > Obstacles*, add an obstacle, rename it "Obstacle", and **position** it where it should spawn
2. Apply a **Rigid Body** and **Box Collider** component, then **edit** the collider bounds to fit the obstacle
3. Create a new "Prefabs" folder and drag it in to create a new **Original Prefab**
4. Create a new "MoveLeft" script, **apply** it to the obstacle, and **open** it
5. In MoveLeft.cs, write the code to **Translate** it to the left according to the speed variable
6. Apply the MoveLeft script to the **Background**

- **Warning:** Be careful choosing your obstacle in regards to the background. Some obstacles may blend in, making it difficult for the player to see what they're jumping over.
- **Tip:** Notice that when you drag it into hierarchy, it gets placed at the spawn location

```
private float speed = 30;

void Update() {
  transform.Translate(Vector3.left * Time.deltaTime * speed);
}
```

Step 8: Create a spawn manager

Similar to the last project, we need to create an empty object Spawn Manager that will instantiate obstacle prefabs.

1. Create a new "Spawn Manager" empty object, then apply a new **SpawnManager.cs** script to it
2. In **SpawnManager.cs**, declare a new ***public GameObject obstaclePrefab;***, then **assign** your prefab to the new variable in the inspector
3. Declare a new ***private Vector3 spawnPos*** at your spawn location
4. In ***Start()***, **Instantiate** a new obstacle prefab, then **delete** your prefab from the scene and test

- **Don't worry:** We're just instantiating on Start for now, we will have them repeating later
- **Tip:** You've done this before! Feel free to reference code from the last project

```
public GameObject obstaclePrefab;
private Vector3 spawnPos = new Vector3(25, 0, 0);

void Start() {
  Instantiate(obstaclePrefab, spawnPos, obstaclePrefab.transform.rotation); }
```

Step 9: Spawn obstacles at intervals

Our spawn manager instantiates prefabs on start, but we must write a new function and utilize InvokeRepeating if it to spawn obstacles on a timer. Lastly, we must modify the character's RigidBody so it can't be knocked over.

1. Create a new ***void SpawnObstacle*** method, then move the **Instantiate** call inside it
2. Create new **float variables** for ***startDelay*** and ***repeatRate***
3. Have your obstacles spawn on **intervals** using the ***InvokeRepeating()*** method
4. In the Player RigidBody component, expand **Constraints**, then **Freeze** all but the Y position

- **New Concept:** RigidBody constraints

```
private float startDelay = 2;
private float repeatRate = 2;

void Start() {
  InvokeRepeating("SpawnObstacle", startDelay, repeatRate);
  Instantiate(obstaclePrefab, spawnPos, obstaclePrefab.transform.rotation); }

void SpawnObstacle () {
  Instantiate(obstaclePrefab, spawnPos, obstaclePrefab.transform.rotation); }
```

Lesson Recap

New Functionality	• Player jumps on spacebar press • Player cannot double-jump • Obstacles and Background move left • Obstacles spawn on intervals
New Concepts and Skills	• GetComponent • ForceMode.Impulse • Physics.Gravity • Rigidbody constraints • Rigidbody variables • Booleans • Multiply/Assign ("*) Operator • And (&&) Operator • OnCollisionEnter()
Next Lesson	• We're going to fix that weird effect we created by moving the background left by having it actually constantly scroll using code!

3.2 Make the World Whiz By

Steps:

Step 1: Create a script to repeat background

Step 2: Reset position of background

Step 3: Fix background repeat with collider

Step 4: Add a new game over trigger

Step 5: Stop MoveLeft on gameOver

Step 6: Stop obstacle spawning on gameOver

Step 7: Destroy obstacles that exit bounds

Example of project by end of lesson

Length: 70 minutes

Overview: We've got the core mechanics of this game figured out: The player can tap the spacebar to jump over incoming obstacles. However, the player appears to be running for the first few seconds, but then the background just disappears! In order to fix this, we need to repeat the background seamlessly to make it look like the world is rushing by! We also need the game to halt when the player collides with an obstacle, stopping the background from repeating and stopping the obstacles from spawning. Lastly, we must destroy any obstacles that get past the player.

Project Outcome: The background moves flawlessly at the same time as the obstacles, and the obstacles will despawn when they exit game boundaries. With the power of script communication, the background and spawn manager will halt when the player collides with an obstacle. Colliding with an obstacle will also trigger a game over message in the console log, halting the background and the spawn manager.

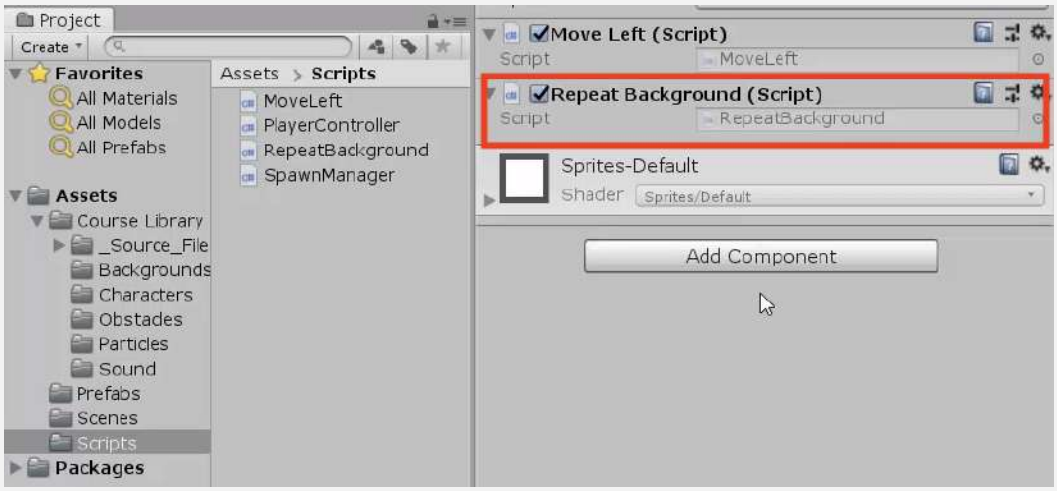
Learning Objectives: By the end of this lesson, you will be able to:
- Use tags to label game objects and call them in the code
- Use script communication to access the methods and variables of other scripts

Step 1: Create a script to repeat background

We need to repeat the background and move it left at the same speed as the obstacles, to make it look like the world is rushing by. Thankfully we already have a move left script, but we will need a new script to make it repeat.

1. Create a new script called **RepeatBackground.cs** and attach it to the **Background Object**

- **Tip:** Think through what needs to be done: when the background moves half of its length, move it back that distance



Step 2: Reset position of background

In order to repeat the background and provide the illusion of a world rushing by, we need to reset the background object's position so it fits together perfectly.

1. Declare a new variable ***private Vector3 startPos;***
2. In ***Start()***, set the ***startPos*** variable to its actual starting position by assigning it ***= transform.position;***
3. In ***Update()***, write an **if-statement** to reset position if it moves a certain distance

- **Don't worry:** We're setting it at 40 for now, just to test basic functionality. You could probably get it right with trial and error… but what would happen if you changed the size?

```
private Vector3 startPos;

void Start() {
  startPos = transform.position; }

void Update() {
  if (transform.position.x < startPos.x - 50) {
    transform.position = startPos; } }
```

Step 3: Fix background repeat with collider

We've got the background repeating every few seconds, but the transition looks pretty awkward. We need make the background loop perfectly and seamlessly with some new variables.

1. Add a **Box Collider** component to the **Background**
2. Declare a new ***private float repeatWidth*** variable
3. In ***Start()***, get the width of the **box collider**, divided by 2
4. Incorporate the ***repeatWidth*** variable into the **repeat function**

- **Don't worry:** We're only adding a box collider to get the size of the background
- **New Function:** .size.x

```
private Vector3 startPos;
private float repeatWidth;

void Start() {
  startPos = transform.position;
  repeatWidth = GetComponent<BoxCollider>().size.x / 2; }

void Update() {
  if (transform.position.x < startPos.x - 50 repeatWidth) {
    transform.position = startPos; } }
```

Step 4: Add a new game over trigger

When the player collides with an obstacle, we want to trigger a "Game Over" state that stops everything In order to do so, we need a way to label and discern all game objects that the player collides with.

1. In the inspector, add a "Ground" tag to the **Ground** and an "Obstacle" tag to the **Obstacle prefab**
2. In PlayerController, declare a new ***public bool gameOver;***
3. In ***OnCollisionEnter***, add the **if-else statement** to test if player collided with the "Ground" or an "Obstacle"
4. If they collided with the "Ground", set ***isOnGround = true***, and if they collide with an "Obstacle", set ***gameOver = true***

- **New Concept:** Tags
- **Warning:** New tags will NOT be automatically added after you create them. Make sure to add them yourself once they are created.
- **Tip:** No need to say gameOver = false, since it is false by default

```
public bool gameOver = false;

private void OnCollisionEnter(Collision collision) {
  isOnGround = true;
  if (collision.gameObject.CompareTag("Ground")) {
    isOnGround = true;
  } else if (collision.gameObject.CompareTag("Obstacle")) {
    gameOver = true;
    Debug.Log("Game Over!"); }
}
```

Step 5: Stop MoveLeft on gameOver

We've added a gameOver bool that seems to work, but the background and the objects continue to move when they collide with an obstacle. We need the MoveLeft script to communicate with the PlayerController, and stop once the player triggers gameOver.

1. In **MoveLeft.cs**, declare a new ***private PlayerController playerControllerScript;***
2. In ***Start()***, initialize it by finding the **Player** and getting the PlayerController component
3. Wrap the **translate method** in an **if-statement** checking if game is not over

- **New Concept:** Script Communication
- **Warning:** Make sure to spell the "Player" tag correctly

```
private float speed = 30;
private PlayerController playerControllerScript;

void Start() {
  playerControllerScript =
  GameObject.Find("Player").GetComponent<PlayerController>(); }

void Update() {
  if (playerControllerScript.gameOver == false) {
    transform.Translate(Vector3.left * Time.deltaTime * speed); } }
```

Step 6: Stop obstacle spawning on gameOver

The background and the obstacles stop moving when gameOver == true, but the Spawn Manager is still raising an army of obstacles! We need to communicate with the Spawn Manager script and tell it to stop when the game is over.

1. In **SpawnManager.cs**, get a reference to the **playerControllerScript** using the same technique you did in MoveLeft.cs
2. Add a condition to only instantiate objects if ***gameOver == false***

```
private PlayerController playerControllerScript;

void Start() {
  InvokeRepeating("SpawnObstacle", startDelay, repeatRate);
  playerControllerScript =
  GameObject.Find("Player").GetComponent<PlayerController>(); }

void SpawnObstacle () {
  if (playerControllerScript.gameOver == false) {
    Instantiate(obstaclePrefab, spawnPos, obstaclePrefab.transform.rotation);
} }
```

Step 7: Destroy obstacles that exit bounds

Just like the animals in Unit 2, we need to destroy any obstacles that exit boundaries. Otherwise they will slide into the distance… forever!

1. In **MoveLeft**, in ***Update()***; write an if-statement to **Destroy** Obstacles if their position is less than a ***leftBound*** variable
2. Add any **comments** you need to make your code more **readable**

- **Tip:** Reference your code from MoveLeft

```
private float leftBound = -15;

void Update() {
  if (playerControllerScript.gameOver == false) {
    transform.Translate(Vector3.left * Time.deltaTime * speed); }

  if (transform.position.x < leftBound && gameObject.CompareTag("Obstacle")) {
    Destroy(gameObject); } }
```

Lesson Recap

New Functionality	• Background repeats seamlessly • Background stops when player collides with obstacle • Obstacle spawning stops when player collides with obstacle • Obstacles are destroyed off-screen
New Concepts and Skills	• Repeat background • Get Collider width • Script communication • Equal to (==) operator • Tags • CompareTag()
Next Lesson	• Our character, while happy on the inside, looks a little too rigid on the outside, so we're going to do some work with animations

3.3 Don’t Just Stand There

Steps:

Step 1: Explore the player’s animations

Step 2: Make the player start off at a run

Step 3: Set up a jump animation

Step 4: Adjust the jump animation

Step 5: Set up a falling animation

Step 6: Keep player from unconscious jumping

Example of project by end of lesson

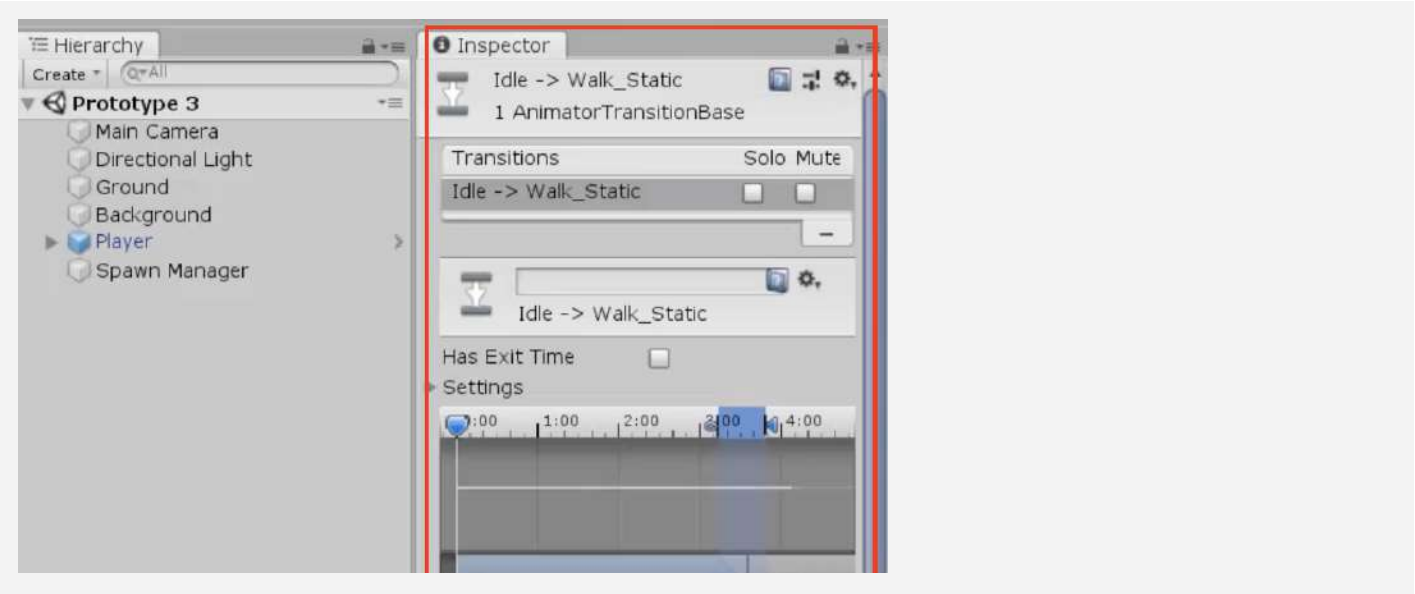
Length:	60 minutes
Overview:	The game is looking great so far, but the player character is a bit… lifeless. Instead of the character simply sliding across the ground, we’re going to give it animations for running, jumping, and even death! We will also tweak the speed of these animations, timing them so they look perfect in the game environment.
Project Outcome:	With the animations from the animator controller, the character will have 3 new animations that occur in 3 different game states. These states include running, jumping, and death, all of which transition smoothly and are timed to suit the game.
Learning Objectives:	By the end of this lesson, you will be able to: - Manage basic animation states in the Animator Controller - Adjust the speed of animations to suit the character or the game - Set a default animation and trigger others with anim.SetTrigger - Set a permanent state for “Game Over” with anim.SetBool

Step 1: Explore the player's animations

In order to get this character moving their arms and legs, we need to explore the Animation Controller.

1. Double-click on the Player's **Animation Controller**, then explore the different **Layers**, double-clicking on **States** to see their animations and **Transitions** to see their conditions

- **New Concept:** Animator Controller
- **New Concept:** States and Conditions

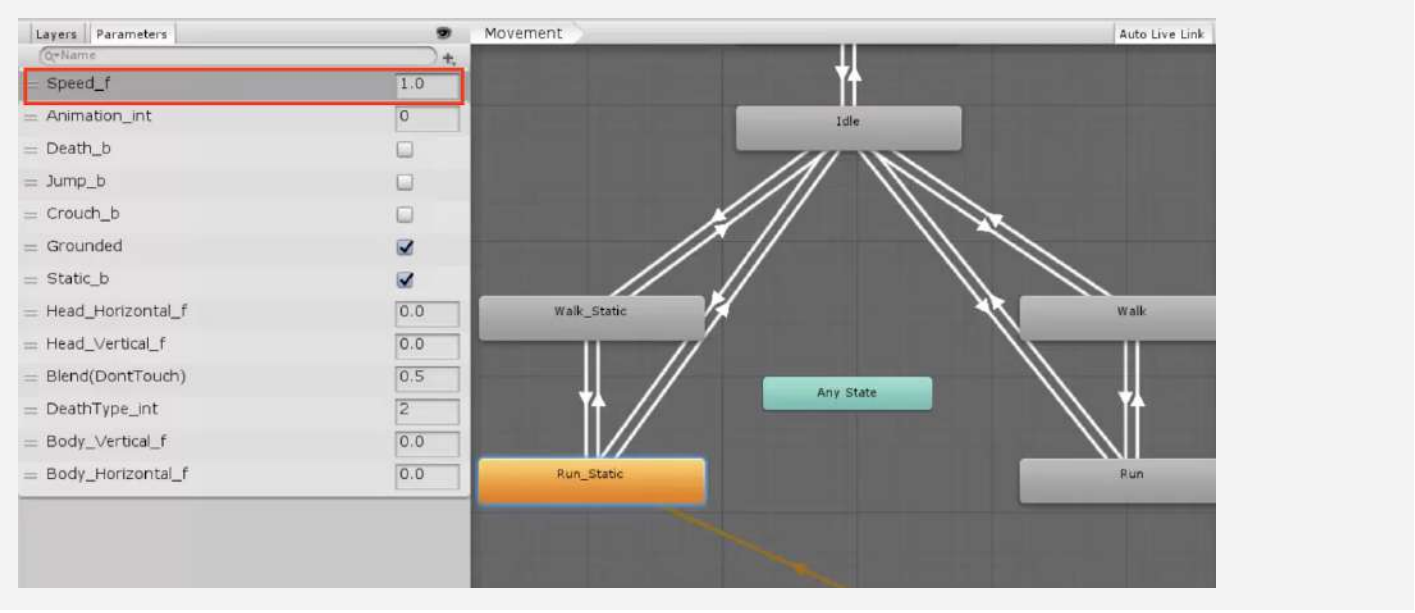


Step 2: Make the player start off at a run

Now that we're more comfortable with the animation controller, we can tweak some variables and settings to make the player look like they're really running.

1. In the **Parameters tab**, change the **Speed_f** variable to 1.0
2. **Right-click** on *Run_Static > Set as Layer Default State*
3. **Single-click** the the Run_Static state and adjust the **Speed** value in the inspector to match the speed of the **background**

- **Tip:** Notice how it transitions from idle to walk to Run - looks awkward - that's why need to make run default



Step 3: Set up a jump animation

The running animation looks good, but very odd when the player leaps over obstacles. Next up, we need to add a jumping animation that puts a real spring in their step.

1. In **PlayerController.cs**, declare a new ***private Animator playerAnim;***
2. In ***Start()***, set ***playerAnim = GetComponent<Animator>();***
3. In the **if-statement** for when the player jumps, trigger the jump:
   animator.SetTrigger("Jump_trig");

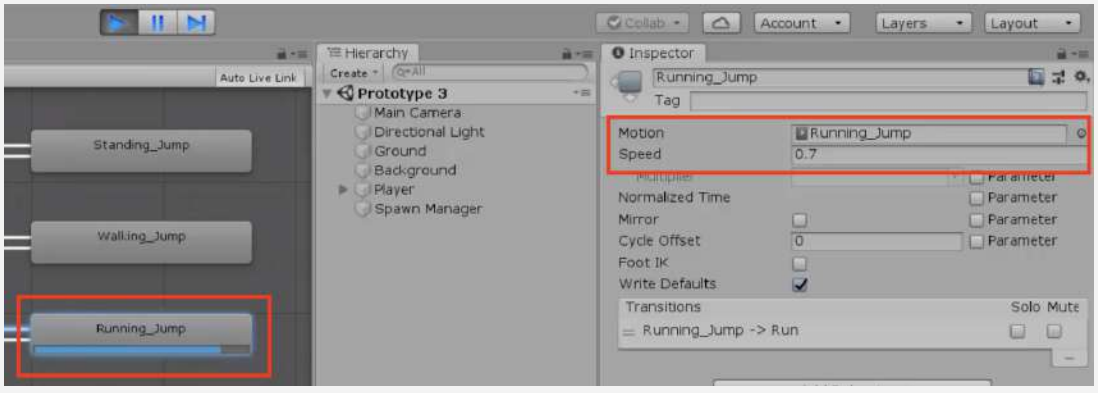
- **New Function:** anim.SetTrigger
- **Tip:** SetTrigger is helpful when you just want something to happen once then return to previous state (like a jump animation)

```
private Animator playerAnim;

void Start() {
  playerRb = GetComponent<Rigidbody>();
  playerAnim = GetComponent<Animator>();
  Physics.gravity *= gravityModifier; }

void Update() {
  if (Input.GetKeyDown(KeyCode.Space) && isOnGround) {
    playerRb.AddForce(Vector3.up * 10 jumpForce, ForceMode.Impulse);
    isOnGround = false;
    playerAnim.SetTrigger("Jump_trig"); } }
```

Step 4: Adjust the jump animation

The running animation plays, but it's not perfect yet, we should tweak some of our character's physics-related variables to get this looking just right.

1. In the Animator window, click on the **Running_Jump** state, then in the inspector and **reduce its Speed** value to slow down the animation
2. Adjust the player's **mass**, jump **force**, and **gravity** modifier to get your jump just right



Step 5: Set up a falling animation

The running and jumping animations look great, but there's one more state that the character should have an animation for. Instead of continuing to sprint when it collides with an object, the character should fall over as if it has been knocked out.

1. In the **condition** that player collides with Obstacle, set the **Death bool** to **true**
2. In the same **if-statement**, set the **DeathType** integer to 1

- **New Function:** anim.SetBool
- **New Function:** anim.SetInt

```
public bool gameOver = false;

private void OnCollisionEnter(Collision collision) {
  if (collision.gameObject.CompareTag("Ground")) {
       isOnGround = true;
  } else if (collision.gameObject.CompareTag("Obstacle")) {
       Debug.Log("Game Over")
       gameOver = true;
       playerAnim.SetBool("Death_b", true);
       playerAnim.SetInteger("DeathType_int", 1);
  }
}
```

Step 6: Keep player from unconscious jumping

Everything is working perfectly, but there's one small disturbing bug to fix: the player can jump from an unconscious position, making it look like the character is being defibrillated.

1. To prevent the player from jumping while unconscious, add ***&& !gameOver*** to the **jump condition**

- **New Concept:** ! "Does not" and != "Does not equal" operators
- **Tip:** gameOver != true is the same as gameOver == false

```
void Update() {
  if (Input.GetKeyDown(KeyCode.Space) && isOnGround && !gameOver) {
    playerRb.AddForce(Vector3.up * jumpForce, ForceMode.Impulse);
    isOnGround = false;
    animator.SetTrigger("Jump_trig");
  }
}
```

Lesson Recap

New Functionality	• The player starts the scene with a fast-paced running animation • When the player jumps, there is a jumping animation • When the player crashes, the player falls over
New Concepts and Skills	• Animation Controllers • Animation States, Layers, and Transitions • Animation parameters • Animation programming • SetTrigger(), SetBool(), SetInt() • Not (!) operator
Next Lesson	• We'll really polish this game up to make it look nice using particles and sound effects!

3.4 Particles and Sound Effects

Steps:

Step 1: Customize an explosion particle

Step 2: Play the particle on collision

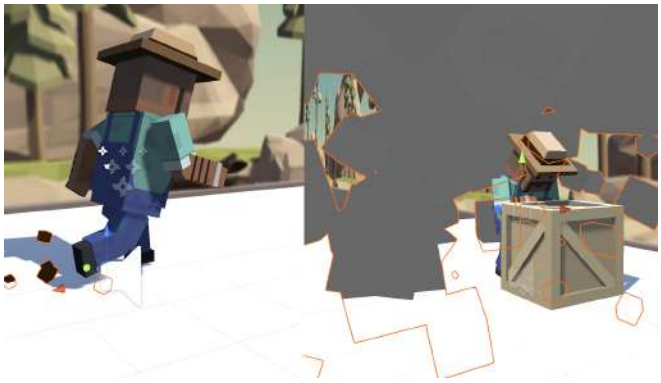
Step 3: Add a dirt splatter particle

Step 4: Add music to the camera object

Step 5: Declare variables for Audio Clips

Step 6: Play Audio Clips on jump and crash

Example of project by end of lesson



Length: 60 minutes

Overview: This game is looking extremely good, but it's missing something critical: Sound effects and Particle effects! Sounds and music will breathe life into an otherwise silent game world, and particles will make the player's actions more dynamic and eye-popping. In this lesson, we will add cool sounds and particles when the character is running, jumping, and crashing.

Project Outcome: Music will play as the player runs through the scene, kicking up dirt particles in a spray behind their feet. A springy sound will play as they jump and a boom will play as they crash, bursting in a cloud of smoke particles as they fall over.

Learning Objectives: By the end of this lesson, you will be able to:

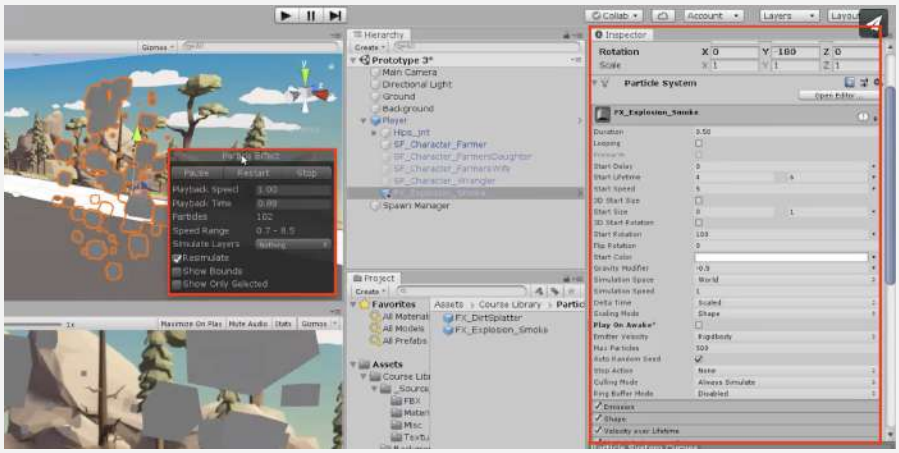
- Attach particle effects as children to game objects
- Stop and play particle effects to correspond with character animation states
- Work with Audio Sources and Listeners to play background music
- Add sound effects to add polish to your project

Step 1: Customize an explosion particle

The first particle effect we should add is an explosion for when the player collides with an obstacle.

1. From the *Course Library > Particles*, drag **FX_Explosion_Smoke** into the hierarchy, then use the **Play** / **Restart** / **Stop** buttons to preview it
2. Play around with the **settings** to get your **particle system** the way you want it
3. Make sure to **uncheck** the **Play on Awake** setting
4. Drag the **particle** onto your player to make it a **child object**, then position it relative to the player

- **New Concept:** Particle Effects
- **Warning:** Don't go crazy customizing your particle effects, you could easily get sidetracked
- **New Concept:** Child objects with relative positions
- **Tip:** Hovering over the settings while editing your particle provides great tool tips



Step 2: Play the particle on collision

We discovered the particle effects and found an explosion for the crash, but we need to assign it to the Player Controller and write some new code in order to play it.

1. In **PlayerController.cs**, declare a new ***public ParticleSystem explosionParticle;***
2. In the Inspector, assign the **explosion** to the **explosion particle** variable
3. In the **if-statement** where the player collides with an obstacle, call ***explosionParticle.Play();***, then test and tweak the **particle properties**

- **New Function:** particle.Play()

```
public ParticleSystem explosionParticle;

private void OnCollisionEnter(Collision collision other) {
  if (other.gameObject.CompareTag("Ground")) {
    isOnGround = true;
  } else if (other.gameObject.CompareTag("Obstacle")) {
    ... explosionParticle.Play(); } }
```

Step 3: Add a dirt splatter particle

The next particle effect we need is a dirt splatter, to make it seem like the player is kicking up ground as they sprint through the scene. The trick is that the particle should only play when the player is on the ground.

1. Drag **FX_DirtSplatter** as the Player's **child object**, reposition it, rotate it, and edit its settings
2. Declare a new ***public ParticleSystem dirtParticle;***, then **assign** it in the Inspector
3. Add ***dirtParticle.Stop();*** when the player jumps or collides with an **obstacle**
4. Add ***dirtParticle.Play();*** when the player lands on the **ground**

- **New Function:** particle.Stop()

```
public ParticleSystem dirtParticle

void Update() {
  if (Input.GetKeyDown(KeyCode.Space) && isOnGround && !gameOver) {
    ... dirtParticle.Stop(); } }

private void OnCollisionEnter(Collision collision other) {
  if (other.gameObject.CompareTag("Ground")) { ... dirtParticle.Play();
  } else if (other.gameObject.CompareTag("Obstacle")) {  ... dirtParticle.Stop(); } }
```

Step 4: Add music to the camera object

Our particle effects are looking good, so it's time to move on to sounds! In order to add music, we need to attach sound component to the camera. After all, the camera is the eyes AND the ears of the scene.

1. Select the Main **Camera** object, then *Add Component > Audio Source*
2. From *Course Library > Sound*, drag a **music clip** onto the **AudioClip** variable in the inspector
3. Reduce the **volume** so it will be easier to hear **sound effects**
4. Check the **Loop** checkbox

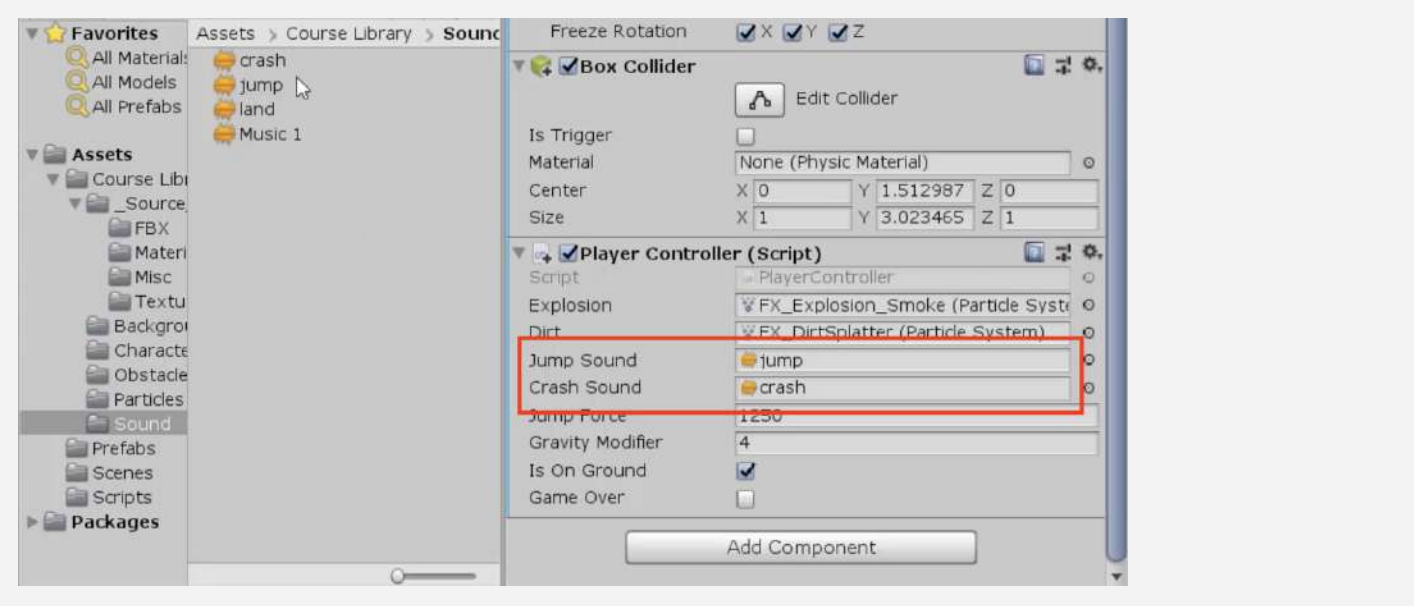
- **New Concept:** Audio Listener and Audio Sources
- **Tip:** Music shouldn't appear to come from a particular location in 3D space, which is why we're adding it directly to the camera

Step 5: Declare variables for Audio Clips

Now that we've got some nice music playing, it's time to add some sound effects. This time audio clips will emanate from the player, rather than the camera itself.

1. In **PlayerController.cs**, declare a new ***public AudioClip jumpSound;*** and a new ***public AudioClip crashSound;***
2. From *Course Library > Sound*, drag a clip onto each new **sound** variable in the inspector

- **Tip:** Adding sound effects is not as simple as adding music, because we need to trigger the events in our code



Step 6: Play Audio Clips on jump and crash

We've assigned audio clips to the jump and the crash in PlayerController. Now we need to play them at the right time, giving our game a full audio experience

1. Add an **Audio Source** component to the **player**
2. Declare a new ***private AudioSource playerAudio;*** and initialize it as ***playerAudio = GetComponent<AudioSource>();***
3. Call ***playerAudio.PlayOneShot(jumpSound, 1.0f);*** when the character **jumps**
4. Call ***playerAudio.PlayOneShot(crashSound, 1.0f);*** when the character **crashes**

- **Don't worry:** Declaring a new AudioSource variable is just like declaring a new Animator or RigidBody

```
private AudioSource playerAudio;

void Start() {
  ... playerAudio = GetComponent<AudioSource>(); }

void Update() {
  if (Input.GetKeyDown(KeyCode.Space) && isOnGround && !gameOver) {
    ... playerAudio.PlayOneShot(jumpSound, 1.0f); } }

private void OnCollisionEnter(Collision collision other) {
  ...
  } else if (other.gameObject.CompareTag("Obstacle"))
  {  ... playerAudio.PlayOneShot(crashSound, 1.0f); } }
```

Lesson Recap

New Functionality	• Music plays during the game • Particle effects at the player's feet when they run • Sound effects and explosion when the player hits an obstacle
New Concepts and Skills	• Particle systems • Child object positioning • Audio clips and Audio sources • Play and stop sound effects