Animating a Paddle and Ball in Blender

When you first open Blender, there are lot of features that are turned off by default. These are called add-ons. You can think of them as plugins as well.

Settings and Navigation
- First, we're going to go to our settings to change our default click to left-click instead of right-click
    - File > User Preferences
        - Go to the Input tab and on the left where it says Select With, change it to Left
- Additionally, under the Input tab > 3D View > 3D View (Global) > Set 3D Cursor
    - Make sure it says Mouse
    - Click the drop-down and make sure it says Action and Double Click
        - This requires a double-click to change our cursor location
            - It's really finicky and you can accidentally move it all the time so this is a provision to prevent that
- Go to File > User Preferences… > Add-ons tab
    - Make sure "Mesh: LoopTools", "Dynamic Context Menu" and "Pie Menu: UI Pie Menu Official" is checked
- Click Save User Settings at the bottom and close your window by hitting the "X"
- Render Engine
    - The default render engine is Blender Render
        - This render engine has the Freestyle feature which has the toon shading that we will be working with today
- Opening up Blender
    - When you open up Blender, this is the typical scene you see
        - A cube, a camera and a light
            - We're going to delete our cube so click on the cube and hit "X"
                - Press Delete
- Our navigation keys that help us move around our viewport center around the middle mouse button
    - Orbit - middle-mouse button (if middle-mouse button doesn't work, try left click)
    - Pan - Shift + middle-mouse button
    - Zoom - Ctrl + middle mouse button (move your mouse up and down)
- Transformation Tools
    - We can create a quick shape in order to play around with our transformation tools
    - On the left, you can go to the Create menu and click one the shapes
    - Translate moves the shape
    - Rotate rotates the shape
    - Scale makes the shape bigger and smaller
    - Pressing X, Y, or Z after activating a transformation allows you to transform in only one direction
    - You can press Esc or right-click to not translate, rotate or scale
- X is delete
- **Modeling the Paddle Face**
    - Anything with your view is on the bottom; we're going to go into our top view
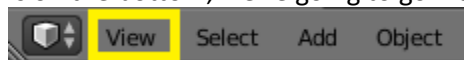
        - You can to where it says View at the bottom and choose the Top view; you can also use number pad 7 as a shortcut
    - We're going to add a new object
        - Press Shift + C to move our red and white circle to the origin
        - You can go to Add at the bottom or you can press Shift + A
            - We're going to Mesh > Circle
        - Click your numpad "." to zoom into the circle
    - On the left we have some options pop up so we can manipulate our object
        - Once we go into "Edit Mode" the options disappear

- Type "62" for Vertices
  - Click "Tab" and go to "Edit Mode"
   - Now we can see all our vertices
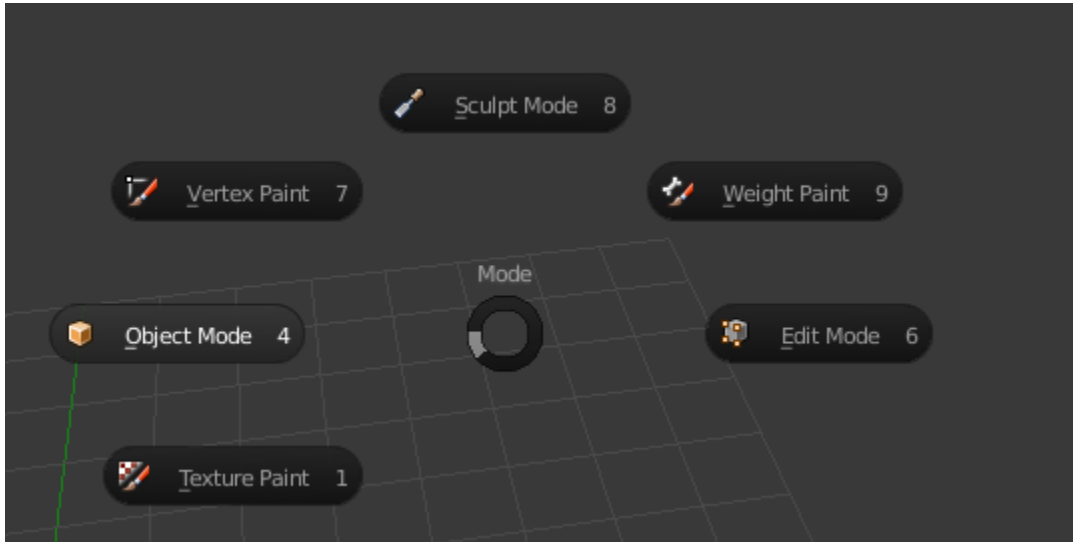
  - Vertically, we have our vertices on the axis, but you want the axis to be in the middle like it is on the X axis
    - We're going to press "R" to rotate our circle, type 90 on your numpad and hit enter and your circle should be rotated 90 degrees
      - So now the vertices should be sitting on the X-Axis
  - We're going to go to Edge mode; at the bottom you can go back and forth from point to edge to face; you can also use the shortcut (Ctrl/Cmd + Tab)
  - Right-click on your top and bottom edge, then hit "X"
   - Select Edge to delete

  - We're going to go back to Vertex mode (Ctrl/Cmd + Tab > Edge) and press "A" to select all our vertices
  - We're going to bridge our vertices
    - You can either go over to the left and scroll down to the Loop Tools we activated and click Bridge from there; you can also press the spacer to reach the Dynamic Context Menu we activated and search for "Bridge" and select "Bridge/Loft"
  - We're going to scale it up a bit vertically
    - Press "S" for Scale and "Y" to isolate the scale on the Y-Axis
    - On the bottom left, it shows you how much you're scaling it up; we're going to go up to about 1.06
  - Let's right-click our two vertices on the bottom
    - Press "O" to activate proportional editing
    - Press "S" to Scale
    - We can control the circle that pops up with the middle mouse button
      - Change the proportional size to 1.61 with your scroll wheel and change the scale to 1.12
      - Then change the proportional size to 1.46 and change the scale to 1.16
      - This gives us a wider bottom
- **Modeling the Paddle Handle**
  - With our vertices still selected, we're going to press "X" and delete vertices
  - Let's switch to Edge mode and select (right-click) the bottom edge
  - We're going to Extrude our edge
    - We can either go to the bottom to Mesh > Extrude > Edges Only or we can just press "E"
    - It's initially going all over the place, but we can lock in an axis by pressing "Y"
    - Take it down to about -1 (look at the bottom left)
  - We're going to scale it up, but we have to turn off Proportional Editing so press "O" to deactivate
    - Press "S" for Scale and scale it up to 1.20

- We're going to add some edges to our handle
    - Hit "Ctrl + R"
        - You'll see a pink line that indicates where we're going to add our cut
        - Use your scroll wheel to increase your cuts (scroll up 9 times)
            - Stop at 10 lines and click twice
        - If you mess up, you can adjust it on the left under "Loop Cut and Slide"
- With our middle mouse button, we're going to move it up and change our orthographic view to perspective
- Go to Face mode and hit "A" to select all our faces
- Press "E" to Extrude and type ".13" on your numpad and press "Enter"
- Let's hit "Tab" and go back to Object mode
- Our object is a little faceted; to smooth it out, go over to the left and on the Tools tab under Shading, click Smooth
    - It washes out our edges, so to fix that, on the right, click the wrench and add the "Edge Split" modifier
- **Creating Materials**
    - We're now are going to create the materials for our paddle
    - We want to split our view in half, so go to the top right corner with the diagonal lines and move it to the left
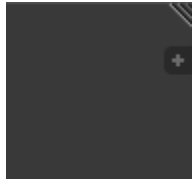
    - PLEASE, be careful with this because you can easily create a bunch of views or tools sets that you don't want
    - In the lower left, click the cube and change the view to UV/Image Editor
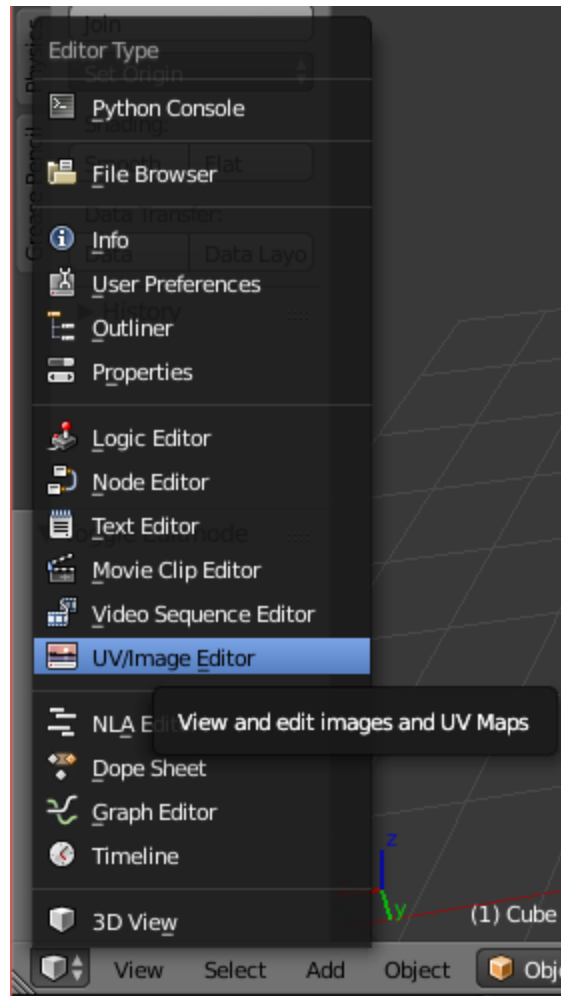
- We're going to click the file folder and bring in a jpeg called "COLORS"
  - The top color is for the ball
  - The four in the middle are for the paddle
  - The last two are for the background
- To create a new material, we're going to click on the ball with the checkerboard on it

- Click "New"
- Under Shading, check "Shadeless"
- Click the white box under Diffuse and then click the eyedropper
- Hover over the top color and click
- Double-click Material.001 and change it to "yellow"
- Click the "+" to add a new material and click "New"
- Check "Shadeless" under Shading
- Click the white box under Diffuse, the eyedropper and then select the orange color
- Repeat the process for the rest of the colors
  - Salmon/Pink/Red
  - White/Eggshell
  - Green/Teal/Blue
- We can now merge our screens together, so on the paddle view, click the diagonal lines in the upper right corner, hold down and drag to the right
  - You should see a faint arrow; let go when you see this

- **Texturing the Paddle**
  - Press "Tab" and go into Edit mode
  - Now we can add our materials to specific components
  - We're going to click "numpad 5" to go into orthographic view and "numpad 7" to go to the top view

- Press "A" to deselect everything
- We want to go into Wireframe mode so that when we select our faces, the ones on the bottom are selected as well
- Press "Z" and choose "Wireframe"
- Press "B" for box select
  - We're going to select these faces
    - The black boxes are what you have to include to select the faces, so make sure to put your selection box above the black box of the 3rd face level
- Press "Z" again and go into Material mode
- We're going to select the orange color and click "Assign"
  - We can middle click and drag up to make sure the material was applied on all sides
- Now on the face of the paddle, we're going to select (right-click) the face closest to the orange color and the Ctrl + select the face on the top and all of the faces in between will be selected
  - The top face will still look yellow, but it is selected
  - You can tell by its edge being orange; if the edge is black, then it's not selected
  - We're going to assign salmon (or red or pink) to this section
- On the side of the paddle we're to right-click and Ctrl + right-click all the way around the paddle until we have them all selected
  - If we try to Ctrl + click, one side to the other, it'll take the shortest path and not click the faces we want
  - We're going to assign white to this section
- We're going to make the bottom teal
  - Rotate your view to the bottom of the paddle
  - Right-click and then Ctrl + right-click to select the bottom faces
  - Assign the teal
- Now we have a material on our object
- Hit "numpad 5" to go into perspective mode
- Press "Tab" and go into object mode

- **Setting Up Freestyle (Toon Shading)**
  - On the right, click on the camera to go back to the Render tools

  - If you click and hold then drag down, you can close all of the open tabs
  - Check "Freestyle"
  - Press "Shift + Z" to see the live render
  - On the right, click on the Freestyle dropdown
    - Change the Line Thickness to 1.2
    - This may seem thin now, but it'll be good for our project later
  - Next to the camera, there is an icon with pictures; this is the render layers; click this

    - Click and drag down to collapse all of the tabs
  - Under Freestyle Line Set
    - Under Edge Types, check Material Boundary

- **Rigging the Paddle**
  - Shift + Z to go back to our normal view
  - To rig our paddle, we're going to add a bend modifier
  - On the right, click on the wrench for the Object modifiers


    - Click on Add Modifier and select Simple Deform
  - Right away you can notice some craziness going on because we're on the Twist tab
    - Switch to the Bend tab
  - Click the eye on our modifier to disable it temporarily
  - Press "Tab" and go into Edit mode

- In Blender, wherever the cursor is (red and white circle), that's where your object will come in when you create a new one
  - We want to create our new object at the end of paddle handle
  - Select the face at the bottom > Shift + S > Cursor to Selected
    - The cursor is now in the center of our face
    - Make sure not to accidentally click somewhere else
- Press "Tab" and go into Object mode
  - Press Shift + A and click the Empty > Sphere
    - On the left, we're going to adjust the radius of our empty to 0.1
  - Double-click on the Empty on the right in the object manager and type "origin"
- Let's label our paddle too; change "circle" to "paddle"
- We're going to place our paddle and our origin into a new null
  - With our cursor still at the bottom of our handle, press Shift + A > Empty > Plain Axes
    - Change the radius (on the left) to 0.3
  - Rename our new Empty "paddle_CTRL"
  - Click and drag the paddle and origin icons into the paddle_CTRL to make them children
    - It won't work if you don't select the icon
  - Doing this allows us to select the paddle_CTRL and move the paddle and origin too
    - Press "G" to test this out
      - Right-click to put the paddle back in its place
      - If you accidentally click somewhere else, press Ctrl + Z
- Right-click on our paddle and enable our Simple Deformer again by clicking the eye
- Click under Axis, Origin and select "origin"
- Click on the "origin" null and rotate it 90 degrees in the X-Axis and Z-Axis
  - Now we should be set up properly
- Right-click on the object and in the deformer, go to where it says Deform
  - Move the Angle from left to right and you can see our paddle bending
- **Animating the Paddle Hit**
  - In the upper-left, go to our Animation layout
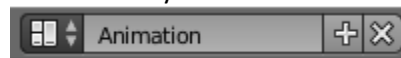
    - This gives us more tools to play with
  - In the bottom-left, we're going to change our start frame to "0" and our end frame to "34"
  - Let's hover over our timeline and hit "Home" and it will zoom in on our frames
    - Test "Home" over the Dope sheet and F-curve as well (can always hit it after setting all the keys)
  - We're going to be animating the Angle value of our bend deformer so make sure that your paddle is selected
  - Go to frame 0
    - Change the Angle to -35 (make sure you click the wrench)
    - You can either right-click on the Angle field and choose Insert Keyframe or you can press "I" as a shortcut
      - You have to hover over the Angle field when you're pressing "I"
  - Go to frame 6
    - Change the Angle to 35
    - Press "I"
  - Go to frame 17
    - Press "I"
  - Go to frame 23
    - Change the Angle to -35
    - Press "I"
  - Go to frame 34
    - Press "I"
  - You can press play to see what we have so far

- **Animating the Paddle Spin**
  - Now we're going to animate our paddle_CTRL so select that
    - Do not put these keyframes on the paddle itself
  - Go to frame 6
    - Right-click on the Y Rotation and select "Insert Single Keyframe"
      - We don't want to press "I" right now because this sets a keyframe on XY and Z and we don't need all of those keyframes
  - Go to frame 17
    - Change the Y Rotation to 180
    - Now, if we hit "I", it'll set a single keyframe
  - Go to frame 22
    - Press "I"
  - Go to frame 34
    - Set the Y Rotation to 360
    - Press I
- **Editing the Curves**
  - In the lower-left, we have our F-Curve editor
    - If we press "N", more options come up
  - Click on our key at frame 6 and scroll down to the Right Handle
    - Click in the "X" field and after your number add "+ 5" then press "Enter"
  - Click our key at frame 22 and do the same thing
    - Make sure you pay attention to see that it's affecting the right key
  - Now our timing looks different and we have a slower start
- **Create and Animate Ping Pong Ball**
  - Press "Shift + C" so that the cursor goes to the origin of our viewport
  - Press "Shift + A" > Mesh > UV Sphere
  - Move our ball up a bit in the Z-Axis
  - On the right, reduce the scale to 0.18 for X, Y, and Z
  - On the left, with our sphere selected, under Shading, click Smooth to smooth our ball out
  - "Numpad 3" to go to the side view ("Numpad 5" if your view isn't orthographic)
  - Go to frame 6 and place your ball so that it is right above your paddle
    - On the Z of the Location, right-click and select "Insert Single Keyframe"
  - Got to frame 15 and change the Z location to 3.5 and press "I"
  - In our Dope Sheet in the upper-left, we're going to right-click on our first keyframe and press "Ctrl + C" to copy it
    - Go to frame 23 and "Ctrl + V" to paste it
  - In the lower-left, in our F-Curve editor, we're going to press "Home" to see all of our keys
    - Select (right-click) our first keyframe and press "S", then "0" and "Enter" to make the curve flat
    - Do the same for our last keyframe
    - Right-click our top keyframe and press "S" and scale your handles up until your right handle says about 21
  - It's currently, one movement and we need the keys to loop to the left and to the right
    - Go to the Modifiers tab and click "Add Modifier"
      - Select Cycles
    - Now, if you hit play, our ball is constantly going up and down
- **Setting Up Our Camera**
  - Go back to our Default layout

  - Press "Numpad 0" to view through your camera
  - Press "N" to bring up some options
    - Check "Lock Camera to View"
  - We want our camera view to be square, so click the camera over on the right to go into the render settings

- ▪ Under Dimensions, change the Resolution to 500 by 500 in the X and Y
    - ▪ Change the 50% to 100%
  - o Go to your Timeline and press "Home"
    - ▪ Go to frame 16 and set your camera angle to how you like it
      - • We're at frame 16 because that's where the ball is at its highest and we need to make sure that it's in frame
  - o Press play to see what it looks like and adjust if you need to
- **Texturing Our Ball**
  - o If you press "Shift + Z", you'll see that our ball is not textured properly
  - o Right-click to select our ball, click the checkerboard sphere on the right to go into the Material Editor
    - ▪ Don't click "New"
      - • We already have the material we're going to use
    - ▪ Click the two up and down triangles next to the checkerboard sphere and then choose "yellow" for your ball color
- **Animate Our Background**
  - o Let's create our second view again
    - ▪ Go to the type right of our viewport to the diagonal lines and drag it over
  - o Click the cube in the lower-left of our viewport and choose UV/Image Editor
  - o We're going to click the folder and open our COLORS.jpg image again
  - o Click the world icon on the right
  - o Click on the Horizon color and select the eyedropper
    - ▪ Choose the light blue background
  - o Go to frame 6
    - ▪ Hover over the Horizon color and press "I" to insert a keyframe
  - o Go to frame 7
    - ▪ Click on the Horizon color, select the eyedropper and change the color to purple
    - ▪ Hover over the Horizon color and press "I" to insert a keyframe
  - o Go to frame 23
    - ▪ Hover over the Horizon color and press "I" to insert a keyframe
  - o Go to frame 24
    - ▪ Click the Horizon color, select the eyedropper and change the color back to light blue
    - ▪ Hover over the Horizon color and press "I" to insert a keyframe
- **Render Our Animation**
  - o Get rid of our extra window like we did before
    - ▪ Click the diagonal lines in the upper-right and drag it over until you see the faint arrow, then let go
  - o Click on the camera on the right to go to our render settings
  - o Under Frame Range, make sure your Start Frame is 0 and your End Frame is 34
    - ▪ Your Frame Step should be 1
    - ▪ Close up the Dimensions tab
  - o Go down to Output and select where you want your animation to save to
    - ▪ In the empty field before the location field, type "pingPong_animation"
    - ▪ The Desktop is a good place to save our file
      - • Navigate to the Desktop and press Accept to set the location
  - o Typically, when you're rendering out animation sequences, we use image sequences, but since our animation is so simple, we can just render out to a video
  - o Where it says PNG, go to H.264
  - o Under Encoding, change the Format to MPEG-4
  - o When you have everything set, go to the Render dropdown, click Animation and go to the Desktop to play your movie