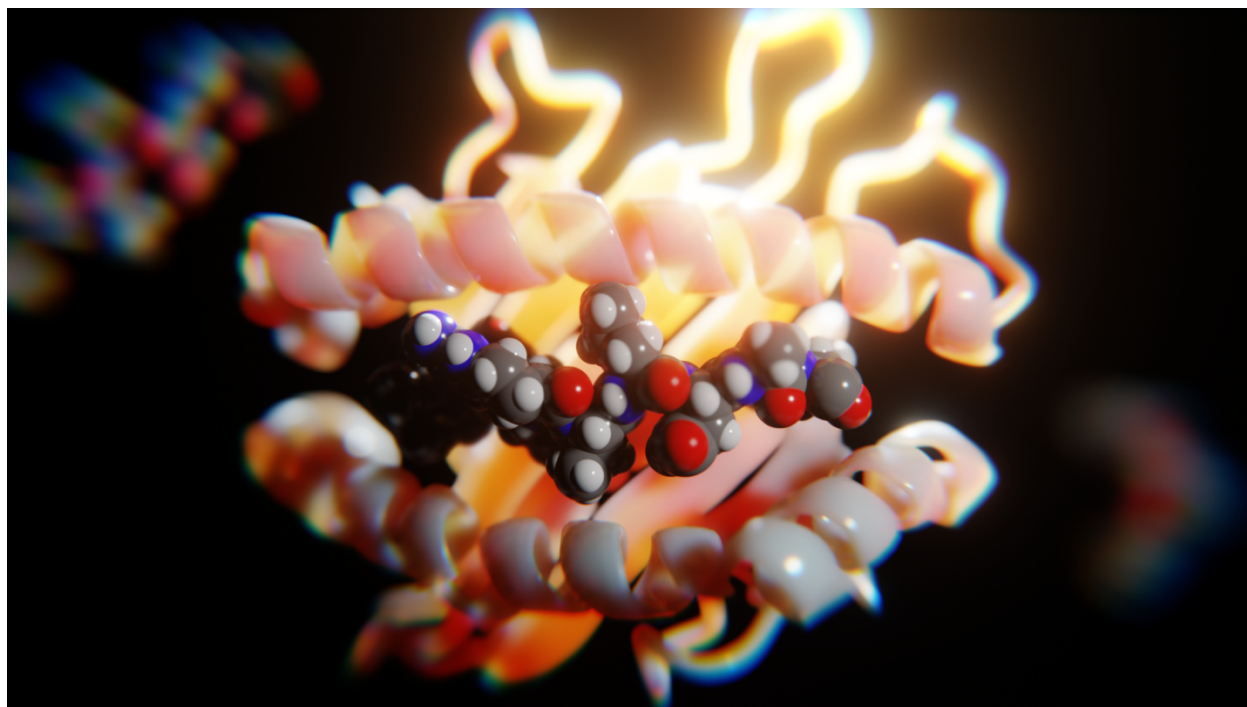


**Day:** Jan 18, 2023

**Time:** 10:30 – 11:30AM

**Room:** 56-154

# Lecture 1: The 3D Viewport and Lighting Notes



**Figure 1.** The final render from following along with Lecture 1.

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## Lesson Summary

For many of you, this will be your first introduction to the world of 3D modeling. At first it will feel foreign, and you will likely find yourself wondering, *how can I possibly remember all this?* Don't worry! Everyone feels this way when they start. In fact, this first lesson is designed to make you feel that way. By the end of this lesson, you will have seen EVERYTHING you need to make a high-quality journal cover. The next three lessons will reinforce what we learn today and introduced more advanced topics.

## Tools

Blender: <https://www.blender.org/download/>

ChimeraX: <https://www.rbvi.ucsf.edu/chimerax/>

## Class Schedule

- |   |        |
|---|--------|
| 1. 20.S947: Intro to 3D Scientific Rendering    | 5 min  |
| 2. Converting molecular structures to 3D meshes | 10 min |

3. Basics of manipulating molecular structures in Blender	15 min
4. Experimenting with Blender materials for molecules	10 min
5. Experimenting with lighting for molecular scenes	5 min
6. More realistic Eevee render settings	5 min
7. Stylize your molecular scene with the compositor	5 min

Total Time	55 min
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## 1. Converting molecular structures to 3D meshes (10 min)

Before we jump into Blender, we will need a structure. In this lesson, we will be rendering the MHC from assignment 2 of 20.420. Some of you may remember it! As this is the first class, many won't have the software downloaded yet, so I have provided the starting file:

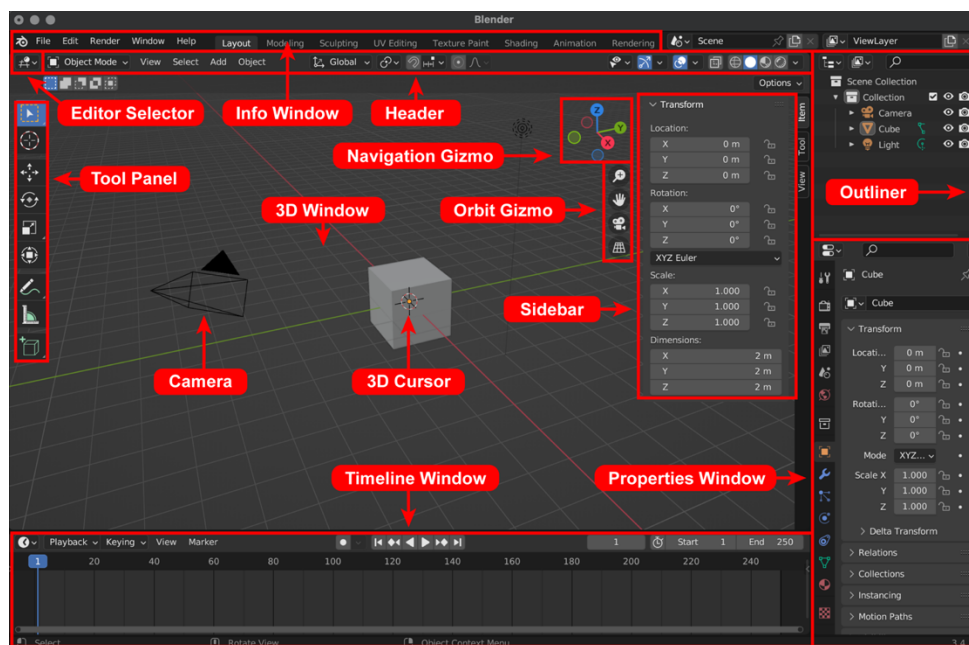
**Start.blend.** Now sit back and relax. It isn't necessary to follow along for section 1. However, I do want to show you every step so you can replicate it on your own later.

- Download ChimeraX: <https://www.rbvi.ucsf.edu/chimerax/>
- Download the PDB file: <https://files.rcsb.org/download/2BVP.pdb>
- Open the PDB in ChimeraX
  - Delete waters → delete :HOH
  - Delete everything but the MHC → delete /B /A:181-274
  - Hide interacting amino acids → hide /A atoms
  - Increase cartoon width → cartoon style width 3.5
  - Increase cartoon thickness → cartoon style thickness 1
  - Update colors → color byelement
  - Add in hydrogens → addh /C
  - Depict peptide as spheres → style /C sphere
  - Save as a model → save structure.glb format gltf instancing true

## 2. Basics of manipulating molecular structures in Blender (15 min)

Now that you have a model of your structure, we can open it in Blender and begin practicing with the interface. This is where you can follow along if you'd like, although some may prefer to just watch depending on their learning style. This section is half the battle of learning Blender. If you are comfortable moving around the 3D Window, a lot of things become much easier.

- Download Blender: <https://www.blender.org/download/>
- Open Blender



**Figure 2. Getting to know the 3D viewport.** No one expects you to memorize all these terms, but I will use these terms in the tutorial so I made this as a quick cheat sheet.

- Delete default cube Click on the cube → **X** → **d**
- Import the molecular structure → **File** → **Import** → **glTF (.glb/.gltf)**
- Clean up the structure
  - Create new collection called **Complex** → **C**
    - Create new collection called **MHC** → **C**
    - Create new collection called **Peptide** → **C**
    - **Hint:** If you press **C** while after selecting a folder in the **Outliner**, it will automatically create a collection inside the selected collection
  - Right-click and delete **2bvp.pdb**
  - Drag and drop **ribbons** inside the new **MHC** collection
  - Right-click and delete **Atoms**
  - Drag and drop all **atoms** inside the new **Peptide** collection
- Right click **MHC** and **Select Objects**
  - Set the origin to your object → **Object** → **Set Origin** → **Origin to Geometry**
- Center the object at **World Origin**
  - Click on an **orthographic viewpoint** in the **Navigation Gizmo**
  - Move the object with **Move** in the **Tool Panel** on the left-hand side
  - Repeat with the other **orthographic viewpoints** in the **Navigation Gizmo**
- Scale **Complex** by selecting **Scale** in the **Tool Panel**
- Fit the molecule to the camera view
  - **View (Sidebar)** → **Camera to View**
  - Use **Scale**, **Rotate**, and **Move** in the **Tool Panel** to position the molecule
- Lastly, let's learn how to copy objects as the scene would look better if there were more substrates floating in the background

- In the **Outliner**, Right-click **Peptide** and **Duplicate Collection**
  - Select the new peptide **Right-click → Select Objects**
    - Maneuver it to the back of the scene using the **Move** button in the **Tools Panel**
  - Repeat this as many times as you'd like.
    - I think two looks best. One on the left and one on the right.
- 

### 3. Experimenting with Blender materials for molecules (10 min)

In this section, we will be playing with some of the default materials that are available in Blender and exploring their settings. Most textures can be replicated using only the most basic of properties so mastering this section can give you a big advantage.

- Switch to render view by selecting **Rendered Display** (far right button) from **Viewport Shading** in the **Header bar**
    - You will notice that the colors are dull and uninteresting
  - Adjust the colors of the MHC by selecting it and going to the **Material Properties** tab in the **Properties Window**
    - Press **New**
    - **Subsurface** = 2.0
    - **Roughness** = 0.2
    - Check **Screen Space Refraction**
    - Check **Subsurface Translucency**
  - Adjust the colors of each atom (you only need to change one of each type)
    - **Metallic** = 0.0
    - **Roughness** = 0.2
    - **Base Color** to full saturation
- 

### 4. Experimenting with lighting for molecular scenes (5 min)

While this section is small, lighting is the single most important part of any scene so we will set aside time to talk about lighting in each lesson.

- Change the background to black in **World Properties** of the **Properties Window**
    - **Color** → **Hex** → **000000**
  - Select **Light**
  - Change the light type in the **Object Data Properties** tab in the **Properties Window**
    - **Area**
    - **Move Light** around until you get some interesting shadows
  - Add back light
    - Duplicate **Light** with **Shift+D**
    - **Move** it behind the protein
    - Change the **Power** to 750
-

## 5. More realistic Eevee render settings (5 min)

While Eevee is faster and easier to use, there is no doubt that it does not look as good as the Cycles render engine. However, there are some small tips and tricks you can use to improve the quality of your Eevee renders

- Adjust the camera settings
    - Select **Camera** in the **Outliner** panel
    - Select the **Object Data Properties** tab in the **Properties Window**
    - Check **Depth of Field**
    - Expand the **Depth of Field** option
      - Expand **Aperture** by selecting the arrow on the left-hand side
        - **F-Stop** = 0.05
    - The image now looks blurry
    - Expand **Viewport Display**
      - Select **Limits**
      - A green crosshair just appeared in the **3D Window**
        - Maneuver it to wherever you would like to be in focus
  - Go to **Render Properties** tab in the **Properties Window** and check:
    - **Ambient Occlusion**
    - **Bloom**
    - **Screen Space Reflections**
    - **Color Management** → **Look** → **High Contrast**
- 

## 6. Stylize your molecular scene with the compositor (5 min)

After your scene is rendered, Blender stores the raw render data which we can then manipulate in the compositor similar to photoshop.

- Post processing adjustments in the compositor
  - Go to the **Compositing** tab in **Info Window**
  - Check **Use Nodes**
  - **Shift+A** → **Search** → **Lens Distortion**
    - Drag and drop it between **Render Layers** and **Composite**
    - **Dispersion** = 0.175
  - **Shift+A** → **Search** → **Glare**
    - Drag and drop it between **Render Layers** and **Lens Distortion**
    - **Streaks** → **Fog Glow**
    - **Medium** → **High**
- Now let's render the image
  - Select **Render** from the **Info Window**
  - **Render Image**
  - We are using **Eevee**, which is lower quality but very fast. It should finish in less than a minute