

Instructor: **Jan-Hendrik Müller**

Language: **English**



# **BLENDER COURSE**

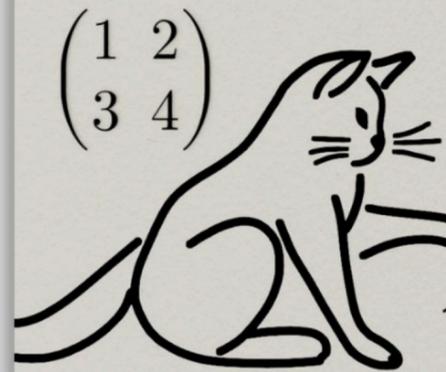
A first entry into 3D design, shading, and scientific animation.

# **21-22 AUGUST, 2025**

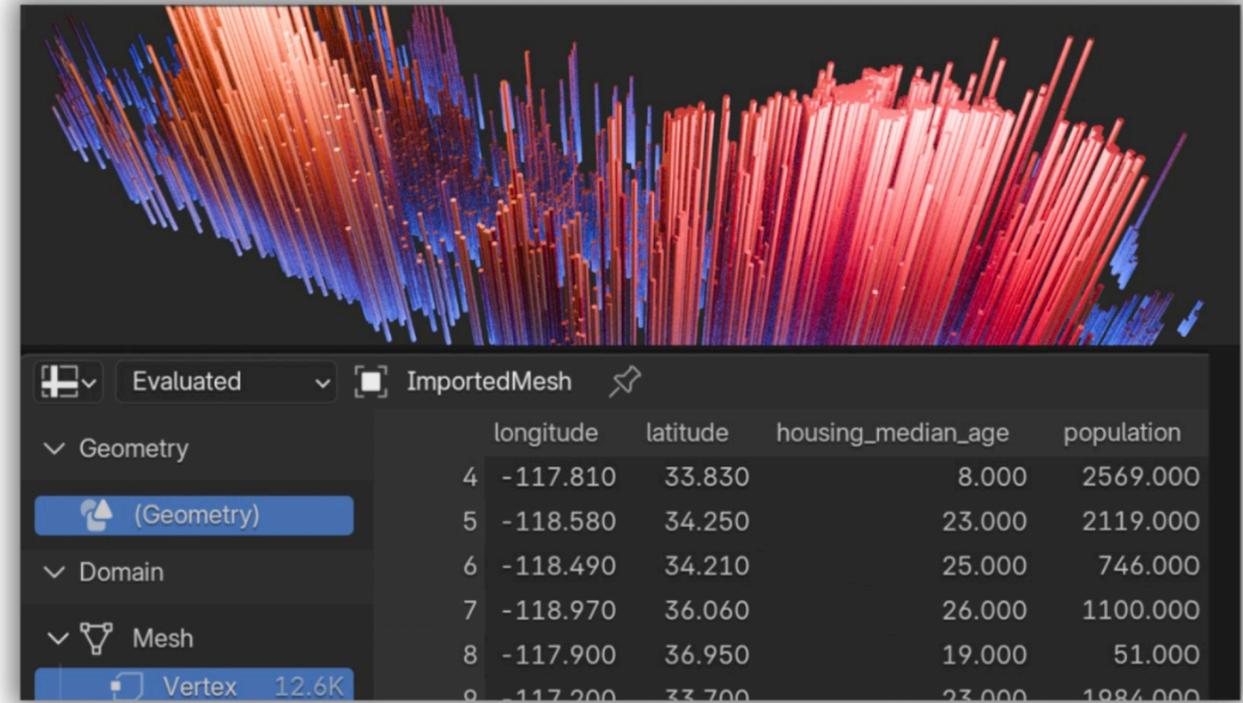
# **9:00 -17:00**

# About me

```
1 for i in range(3):  
2     if i % 2 == 0:  
3         print(f"{i} is even")
```

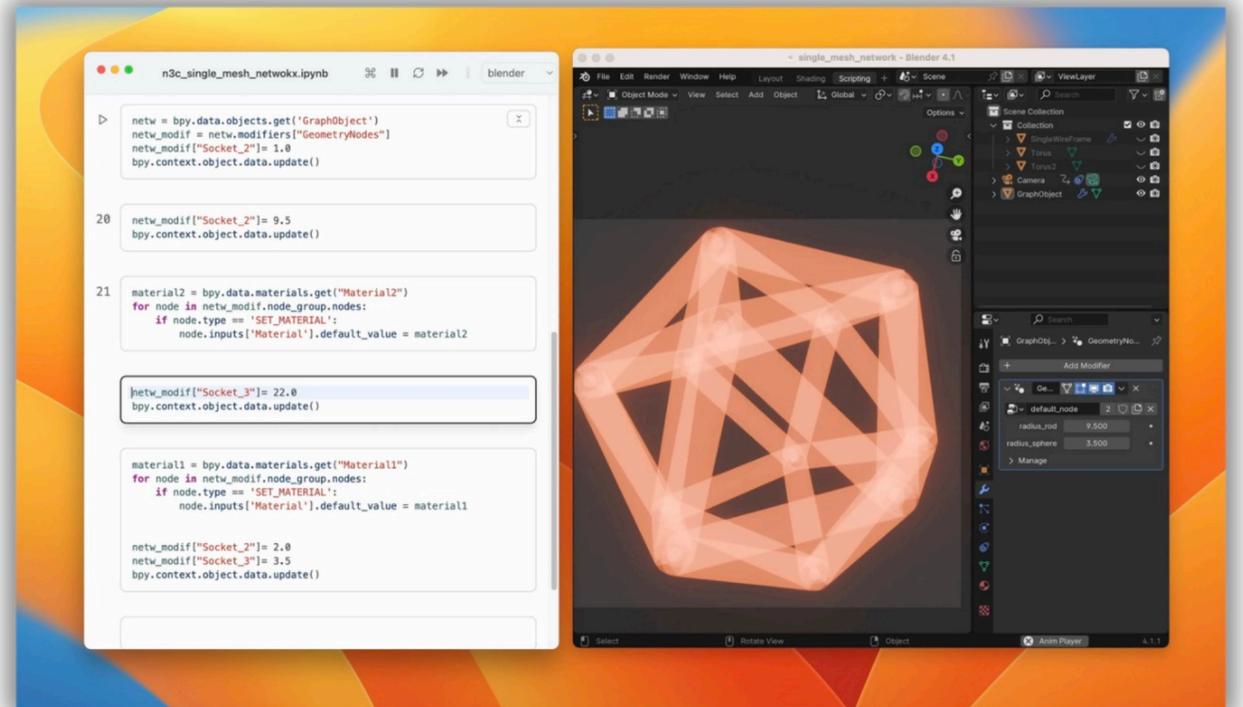

$$\begin{pmatrix} 1 & 2 \\ 3 & 4 \end{pmatrix} \iiint_V (\nabla \cdot \vec{F}) dV = \iint_{\partial V} (\vec{F} \cdot \vec{n}) dA$$
$$\hat{H}\Psi = E\Psi \quad \pi = 3.14$$

<https://extensions.blender.org/add-ons/typst-importer/>



	longitude	latitude	housing_median_age	population
4	-117.810	33.830	8.000	2569.000
5	-118.580	34.250	23.000	2119.000
6	-118.490	34.210	25.000	746.000
7	-118.970	36.060	26.000	1100.000
8	-117.900	36.950	19.000	51.000
9	-117.200	33.700	23.000	1984.000

<https://extensions.blender.org/add-ons/csv-importer/>



<https://github.com/kolibri13/bpy-gallery>

# Blender in 100 seconds



# About this course

- No academic credits (ECTS) will be awarded for this course.
- A certificate will be delivered to participants who have attended the whole training

# Code Of Conduct

## Blender workshop

### DataViz MeetUp Hamburg Code of Conduct

With the DataViz MeetUp Hamburg we want to create an inclusive and welcoming environment for everyone involved. We want to ensure a harassment-free experience at our events as well as in our online community. Therefore, we expect all attendees, speakers, or online contributors in our DataViz MeetUp Hamburg group as well as at our events to adhere to the following policy.

#### **Our Policy**

We do not tolerate harassment in any form. Harassment includes but is not limited to:

- Discriminatory language or imagery that targets gender, gender identity and expression, disability, age, sexual orientation, physical appearance, body size, race, ethnicity, religion, or technology choices.
- Displaying sexual images in public spaces.
- Intimidation, bullying, stalking, following, unwanted photography or recording.
- Sustained disruption of talks or other activities.
- Inappropriate physical contact or unwelcome sexual attention.

Participants who violate these guidelines may be sanctioned or asked to leave the event or group at the discretion of the DataViz MeetUp Hamburg event organizers or group admins.

#### **Reporting Concerns**

If you experience or witness any behavior that makes you feel uncomfortable, we encourage you to report it to a member of our team. If you feel comfortable, you may speak directly with one of our organizers, who will be introduced at the start of each event. The group admins can also be reached via direct message on the MeetUp channel, if you prefer to approach us online. Of course, you may also ask a trusted individual at the event to report on your behalf.

Our team is committed to addressing issues promptly and thoughtfully, so please reach out to us if you have any concerns.

# Schedule

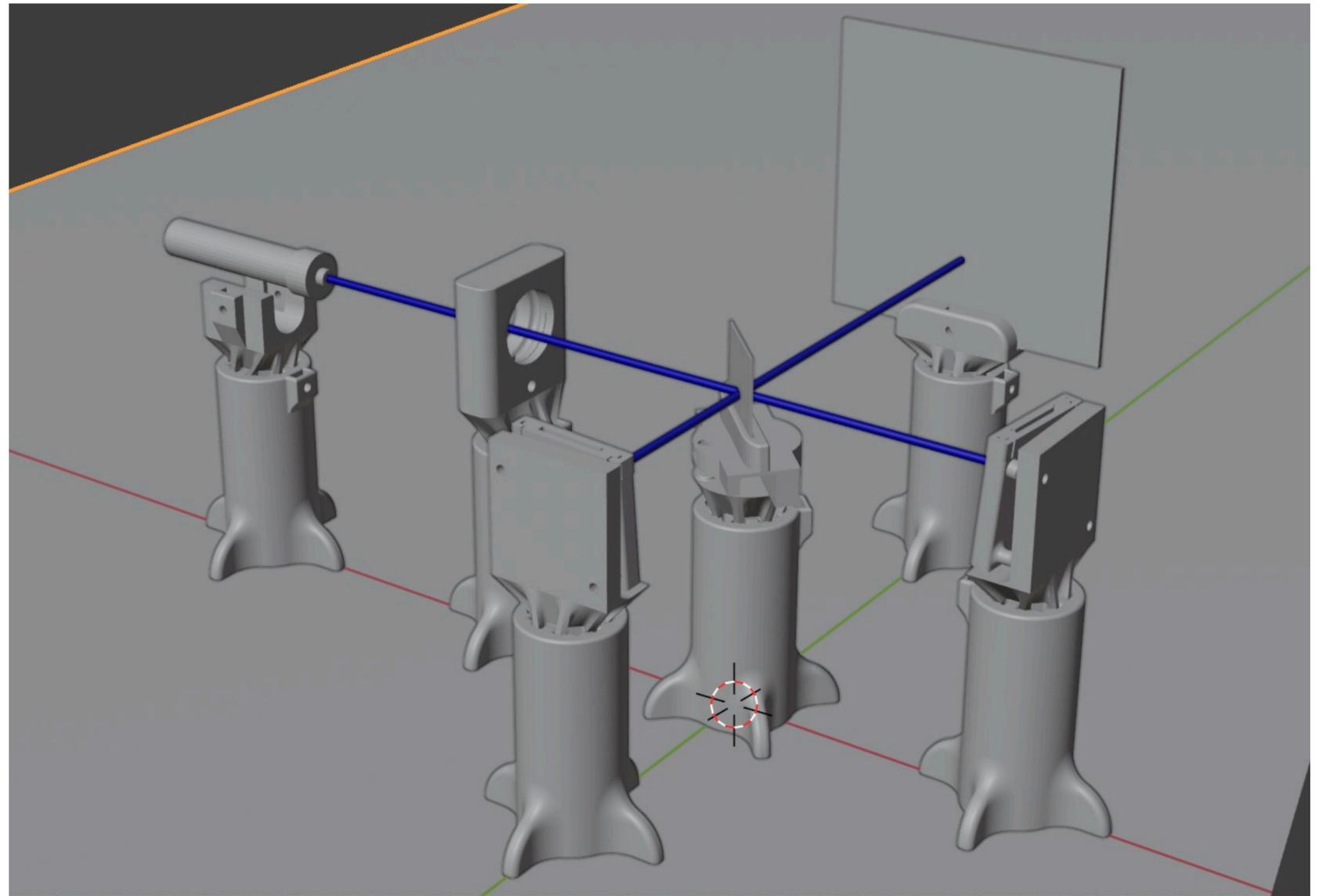
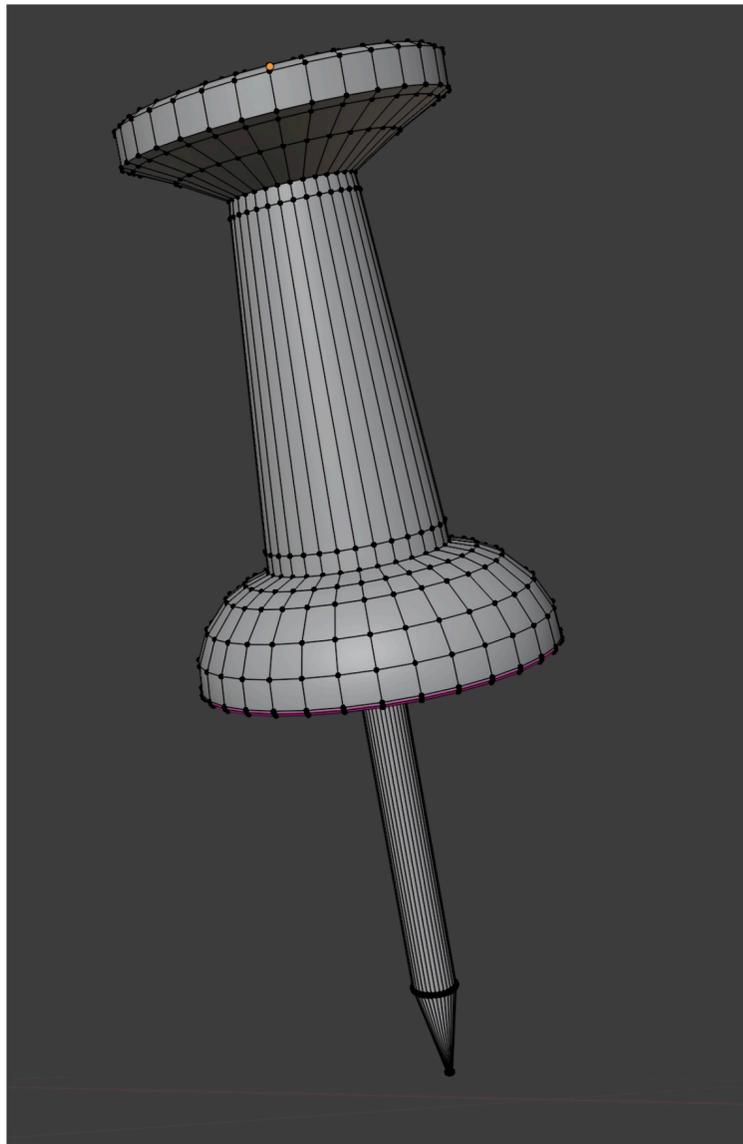
<b>Blender for Scientific Animation:</b>		<b>21-22.8.2025</b>
<b>Time</b>	<b>Thursday</b>	<b>Friday</b>
9:00	Blender-Intro	Geometry Nodes
10:00	UI Navigation & Mesh Manipulation	
11:00		
12:00		
13:00	Lunch break	
14:00	Material & Light	Scientific Extensions
15:00		
16:00		
17:00	Course Ends at 17:00	

# Course Impressions

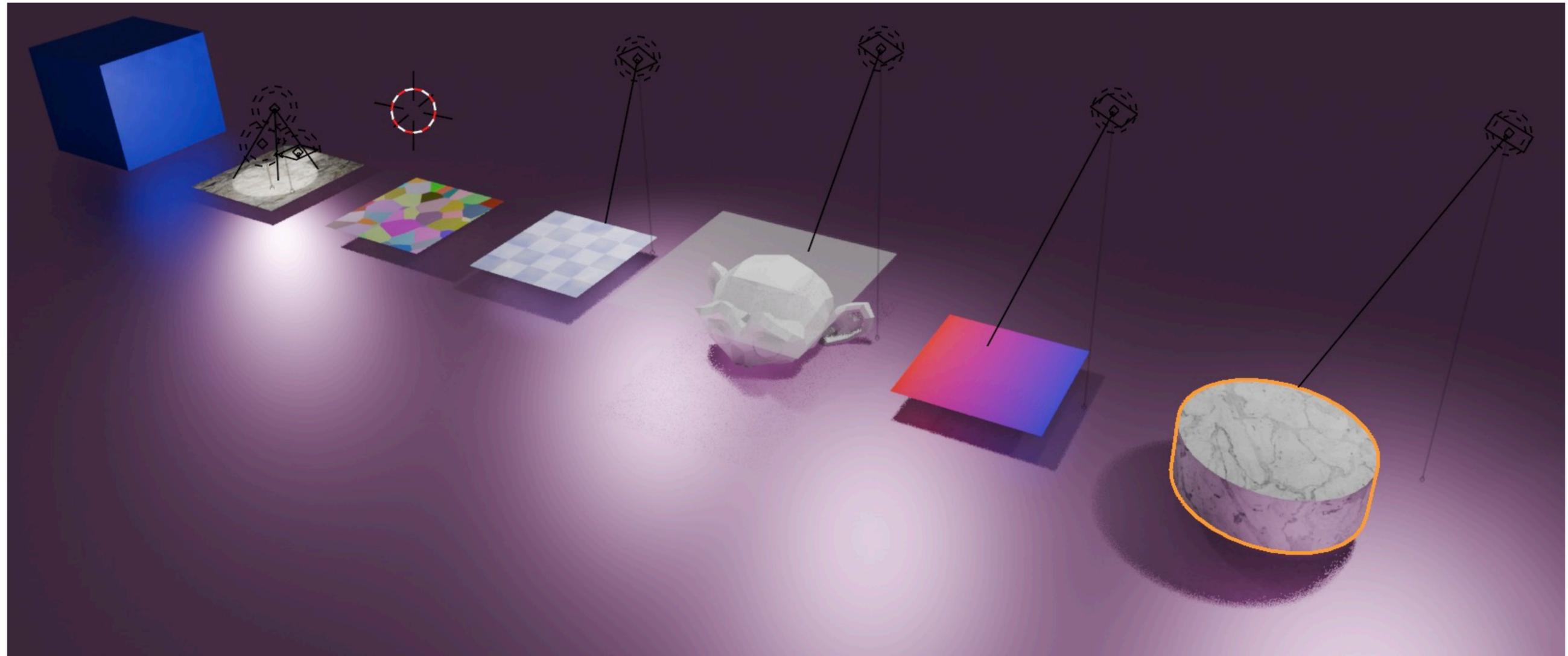


# Course Content

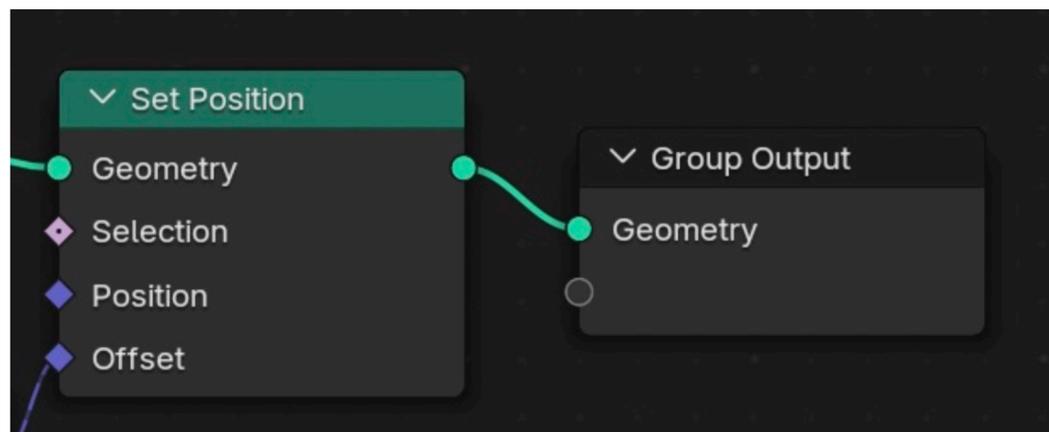
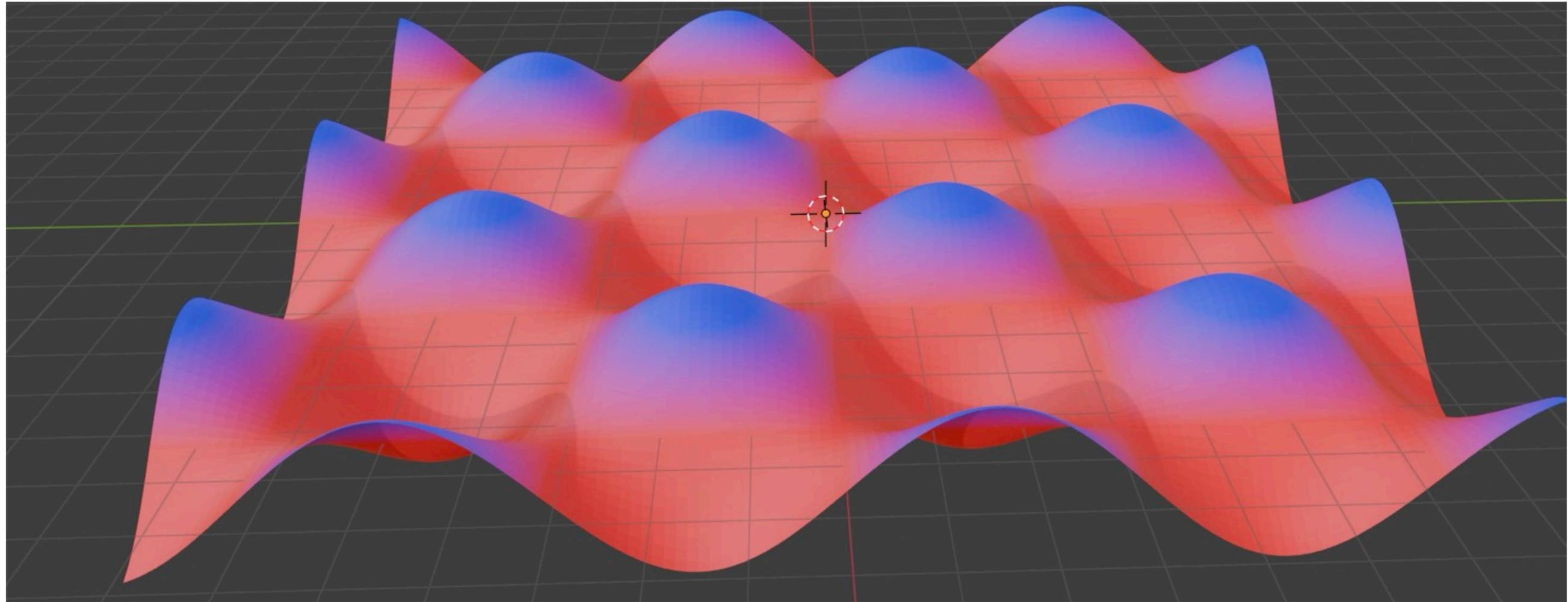
# Interface and mesh manipulation



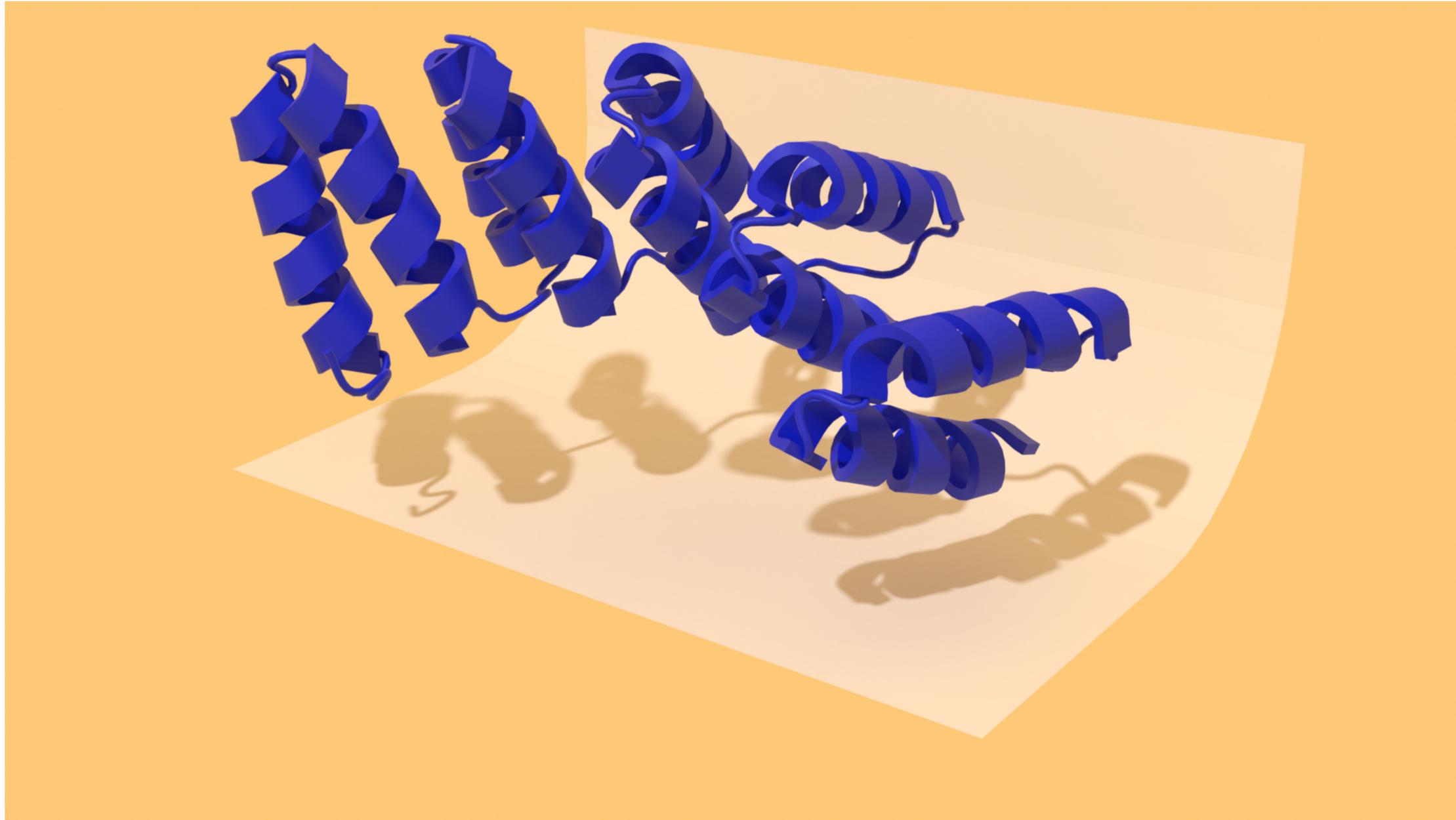
# Shader and Light



# Geometry Nodes



# Scientific Extensions



# Requirements

- Blender 4.5.1: <https://www.blender.org/download/>  
(Blender 4.5.2 released yesterday, will work as well)
- (Optional) PureRef: <https://www.pureref.com/>
- Laptop
- Mouse

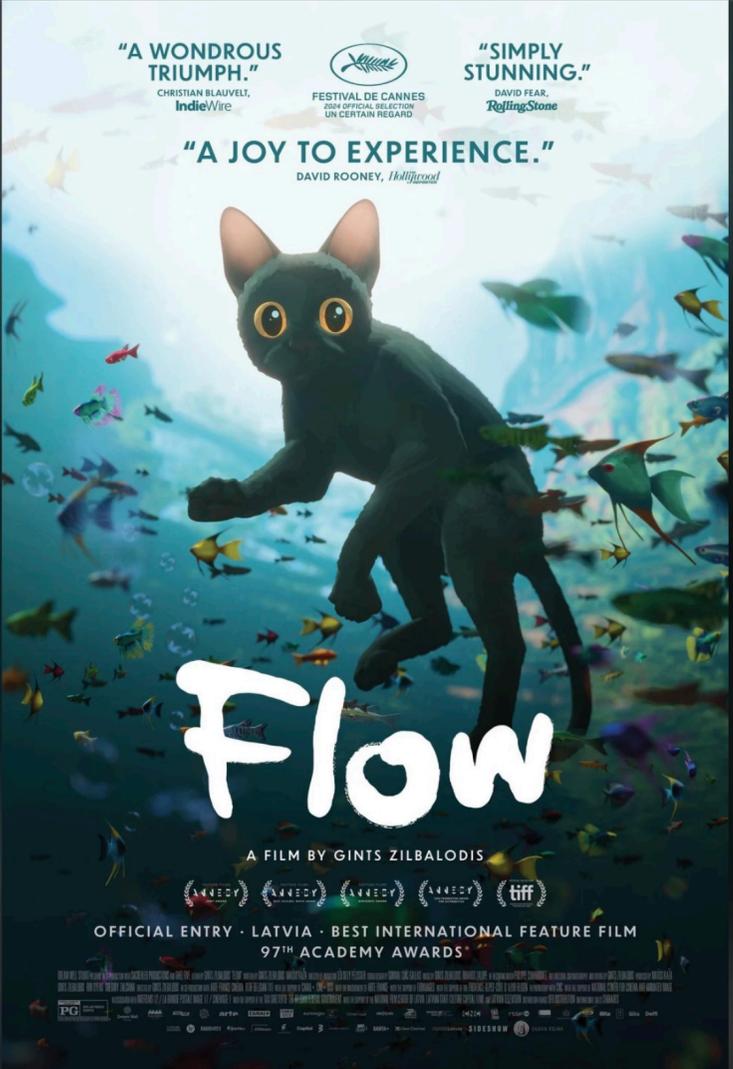
**Why learn Blender?**

# Movies

r/blender • 5 mo. ago  
babuloseo

Flow was made with Blender and just won an Oscar.

News & Discussion



"A WONDEROUS TRIUMPH."  
CHRISTIAN BLAUVELT, IndieWire

FESTIVAL DE CANNES  
2024 OFFICIAL SELECTION  
UN CERTAIN REGARD

"SIMPLY STUNNING."  
DAVID FEAR, RollingStone

"A JOY TO EXPERIENCE."  
DAVID ROONEY, HollywoodReporter

**Flow**

A FILM BY GINTS ZILBALODIS

OFFICIAL ENTRY · LATVIA · BEST INTERNATIONAL FEATURE FILM  
97<sup>TH</sup> ACADEMY AWARDS

17K 306 1 Share Report

Daniel Martínez Lara ♦  
@\_pepeland\_

Grease Pencil was used for certain effects in Spiderman. It is really rewarding after these 10 years of development (together with @antonioya\_blend & @mmendio ) to go to the cinema to see this masterpiece. What an experience!

#SpiderVerse #Greasepencil #b3d #Blender #SpiderMan



# Games

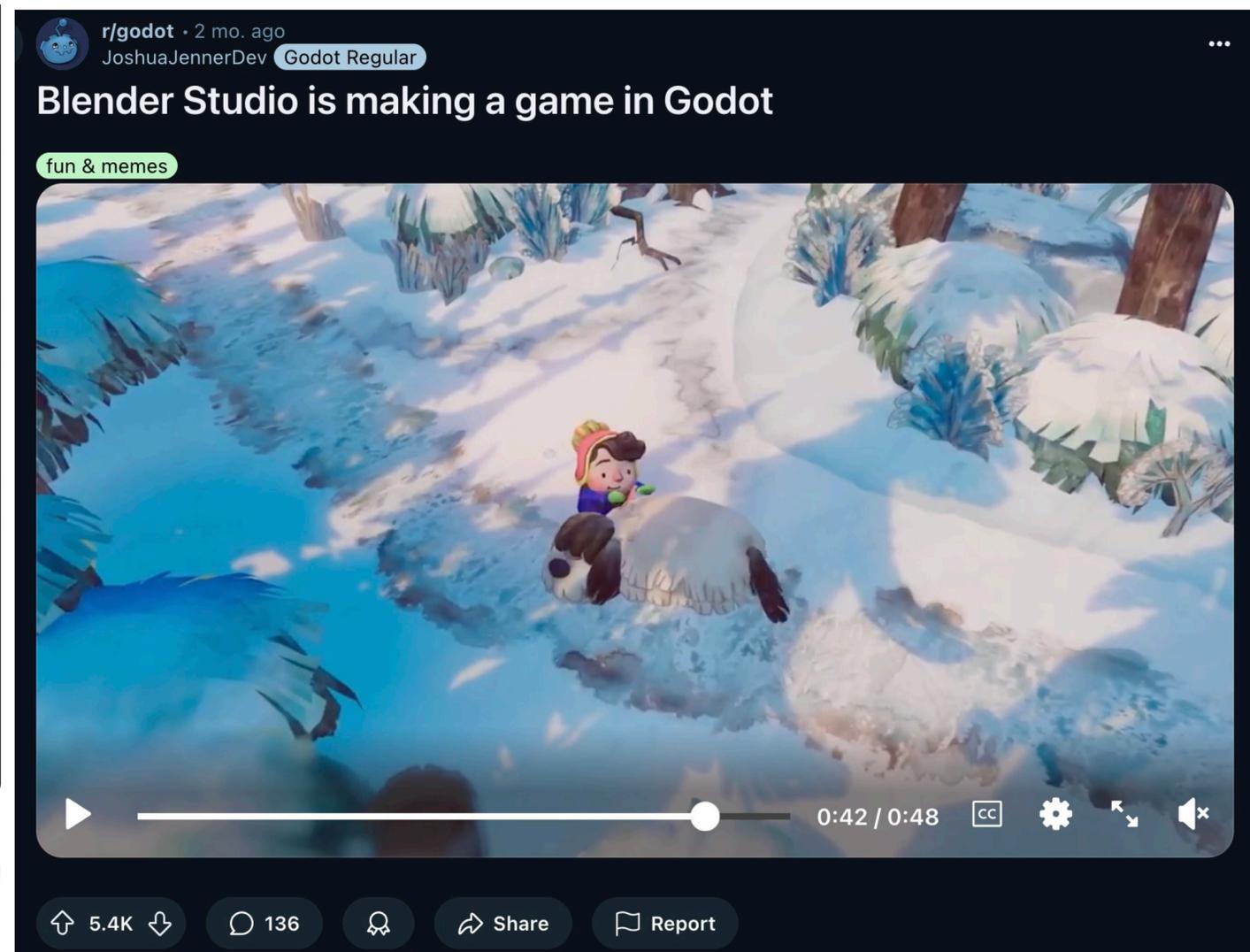


Concept Art for Star Citizen – Blender Conference 2024

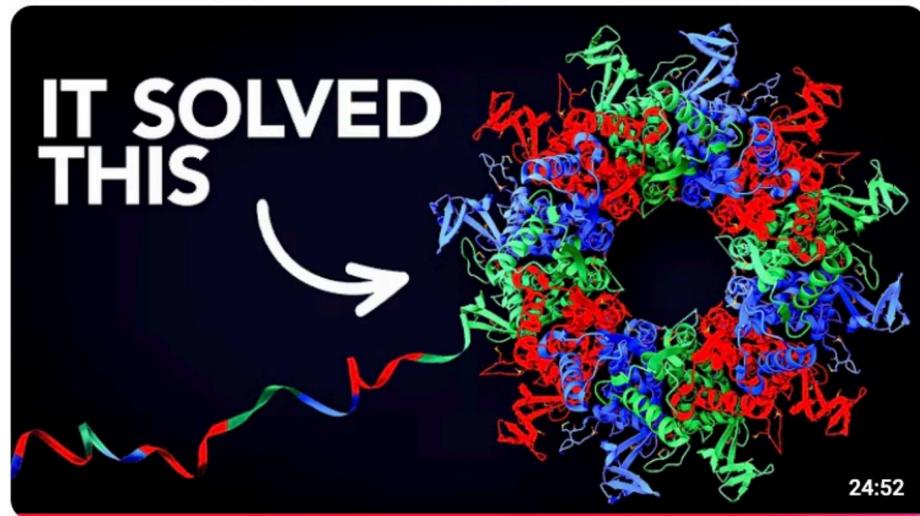
Blender  
1.2M subscribers

Subscribed

2.2K Like Dislike Share Download Clip Save



# Science



## AlphaFold - The Most Useful Thing AI Has Ever Done

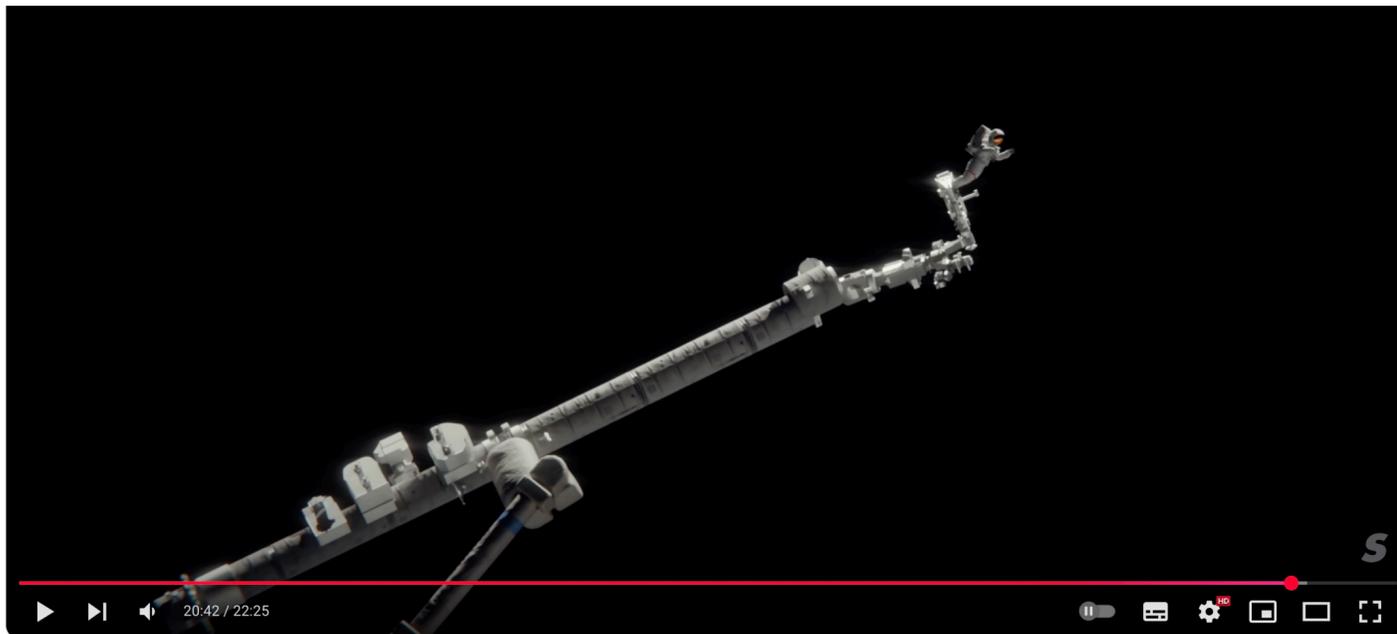
9.1M views · 5 months ago



A huge thank you to John Jumper and Kathryn Tunyasuvunakool at Google Deepmind; and to D:

4K Subtitles

10 chapters How to determine protein structures | Why are proteins so complicat



## Das unglaubliche Design der ISS

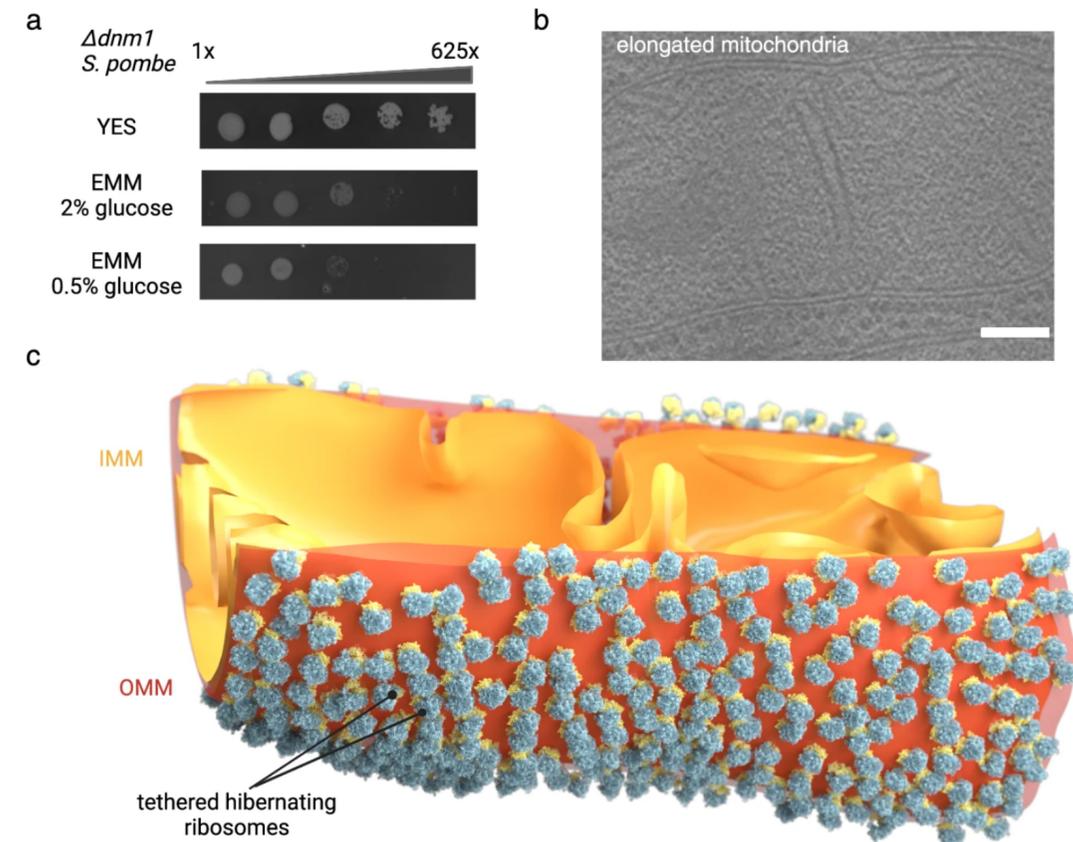


68K Like Share Download Clip Save

1.2M views 2 months ago  
 Checkt die Emma Wohlfühlwochen einfach auf <https://simpli.deals/emma55> aus und spart mit dem Code SIMPLIEMMA zusätzliche 5% auf die bereits bis zu 50% reduzierten Produkte von Emma (Werbung)

## Fig. 4: Ribosome tethering is independent of Dnm-1 mediated mitochondrial fragmentation.

From: [Ribosomes hibernate on mitochondria during cellular stress](#)



**a** Viability assays of *S. pombe* WT and  $\Delta dnm1$  strains cultured at 30 °C in either YES or EMM with high (2%) or low (0.5%) glucose concentration and imaged after 3 days of growth. **b** Computational slice through a representative cryo-ET reconstruction of a mitochondrion from a  $\Delta dnm1$  cell imaged at day 7 of glucose depletion. Scale bar 100 nm. **c** Segmentation of the mitochondrion shown in (b), superimposed with the position and orientation of OMM-bound ribosomes aligned by STA. The OMM is depicted in red, and the IMM and its cristae are shown in orange. Ribosomal proteins and RNAs of the LSU and SSU are colored cyan and yellow, respectively.

# Education - Contest



## CCeMMP 2nd Annual Bench to Art 2025

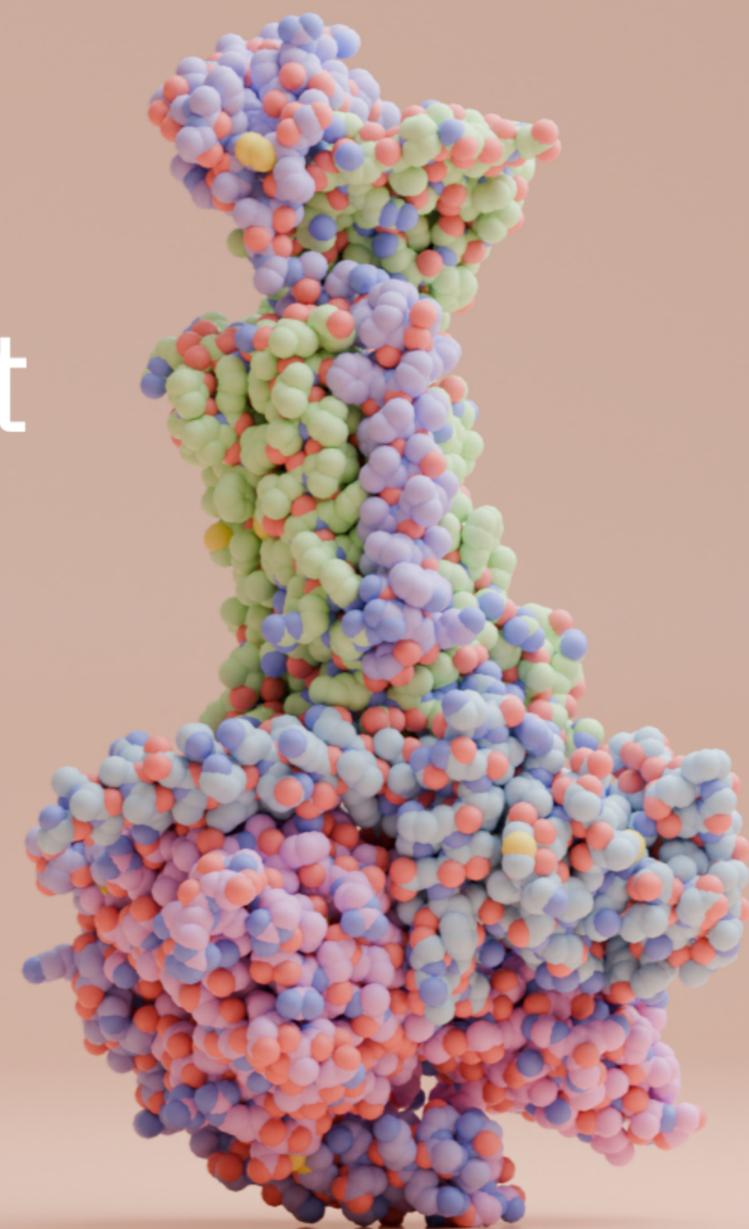
Virtual Art Exhibition  
9 - 26 August, 2025

Prizes for best & most  
popular artwork

Submit  
yours!



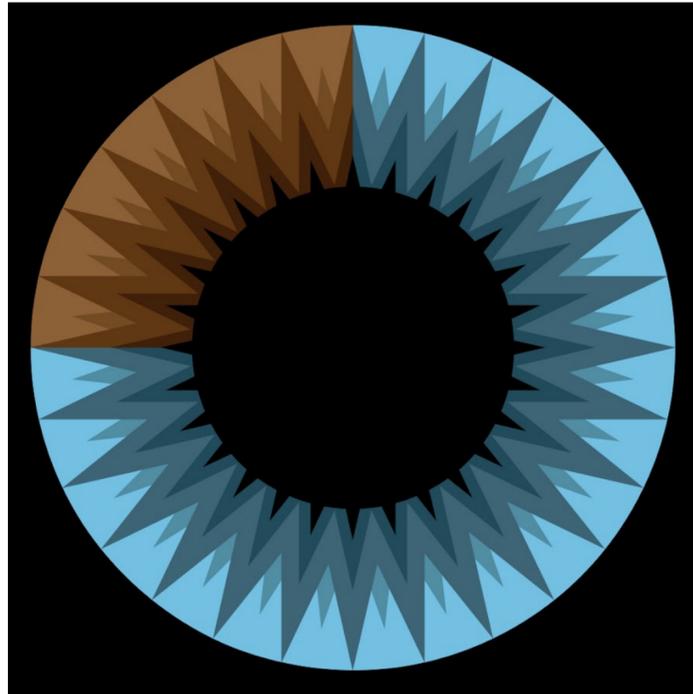
Submission  
deadline, Aug 7<sup>th</sup>,  
2025



Australian Government  
Australian Research Council

# Education - Contest

<https://some.3b1b.co/>



## Summer of Math Exposition

SoME4, summer 2025

The Summer of Math Exposition (SoME) is an annual competition fostering the creation of excellent math content online. You can participate as either a creator or judge. [Learn more](#)

### Timeline

The competition unfolds in three phases:

- **Phase 1: Join and create** current

From 01 Jun, 14:00 to 02 Sept, 13:59

Sign up as a participant or a judge. Creators begin working on their projects and can share progress, find collaborators, or ask for help in the Discord server.

Join in →

- **Phase 2: Peer Review and Voting**

From 03 Sept, 14:00 to 17 Sept, 14:00

This is the heart of the event. You'll be shown a series of entries to review, vote on, and give constructive feedback. It's a chance to reflect, learn, and help others improve.

- **Phase 3: Results and Feedback**

From 15 Sept, 16:00

The top entries and full rankings are revealed, along with the feedback that was shared.

# Forever Open Source & Free

The screenshot shows a web browser window with the address bar displaying 'blender.org/about/'. The page has a dark header with a navigation menu containing links for 'About', 'Blender Foundation', 'Blender Institute', 'Blender Studio', 'Roles', 'People', 'License', 'History', 'Logo', 'Credits', and 'Website'. Below the header is a large hero image of a 3D-rendered industrial interior. Overlaid on this image is the main heading 'The Freedom to Create' and the subtext 'Blender is Free and Open Source software, forever.' Below the hero image are three white text boxes. The first box is titled 'More than Software' and describes Blender as a community project. The second box is titled 'Mission' and states the goal of providing 3D CG technology to artists. The third box is titled 'Vision' and describes the goal of free access to 3D CG content. At the bottom is a fourth box titled 'Activities' which describes the community-driven development process.

About > Blender Foundation Blender Institute Blender Studio Roles People License History Logo Credits Website

Trademark Policy

## The Freedom to Create

Blender is Free and Open Source software, forever.

### More than Software

Blender is a community project coordinated by the Blender Foundation, primarily funded by [donations](#).

At its core is the Blender software, to which thousands of people have contributed, and that millions use daily.

### Mission

Get the world's best 3D CG technology in the hands of artists as free/open source software.

### Vision

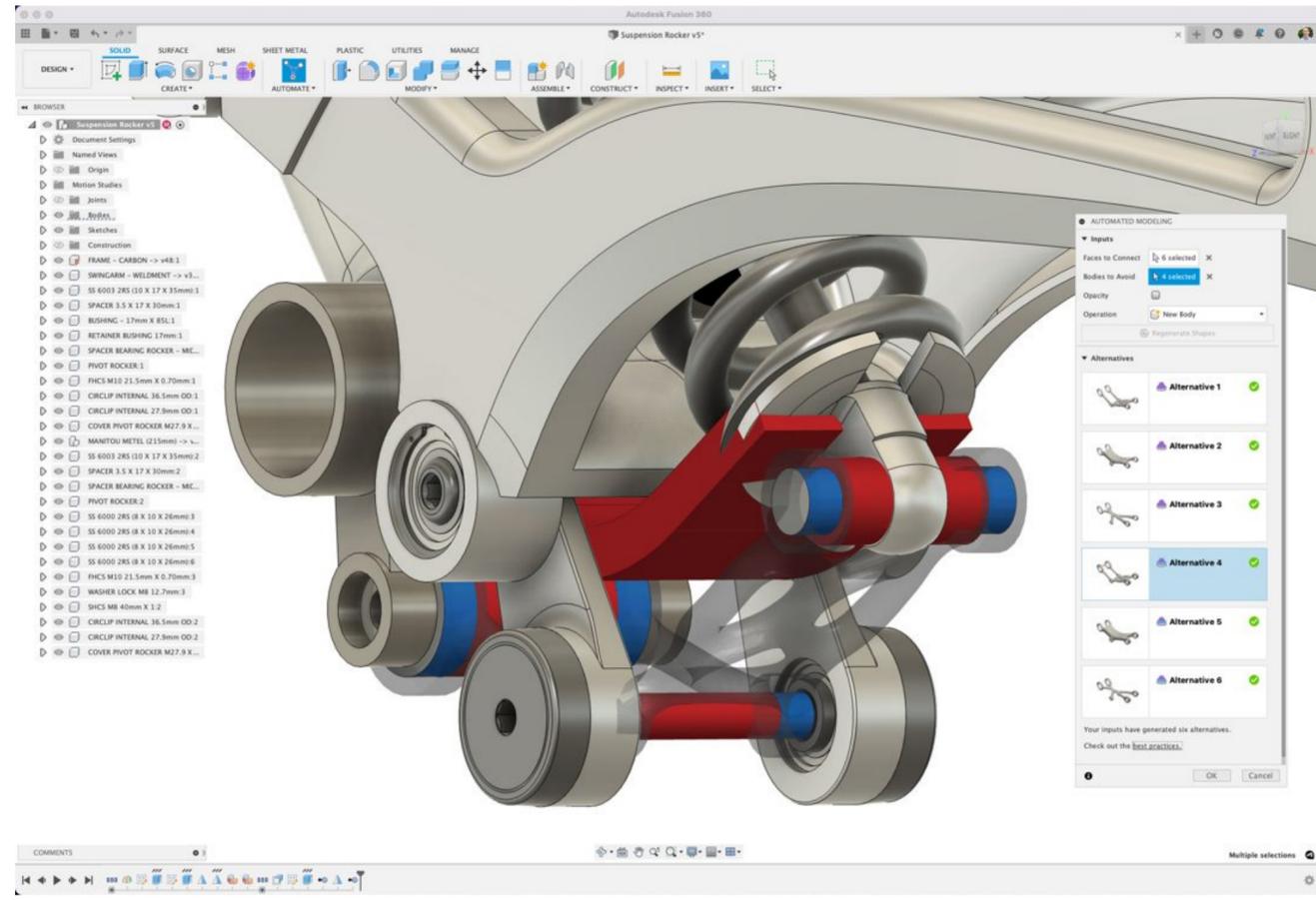
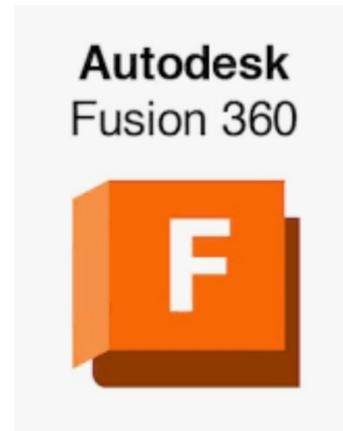
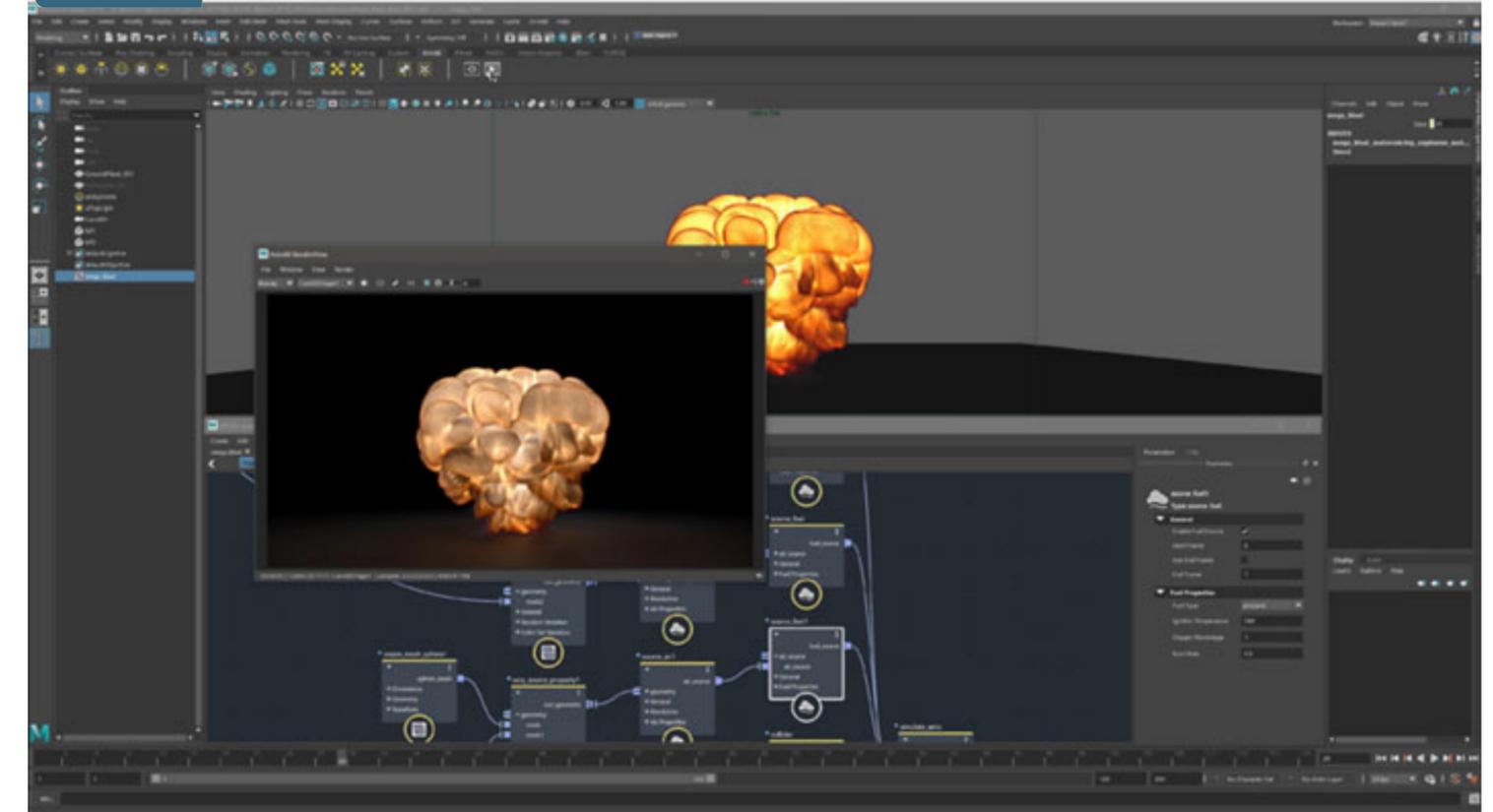
Everyone should be free to create 3D CG content, with free technical and creative production means and free access to markets.

### Activities

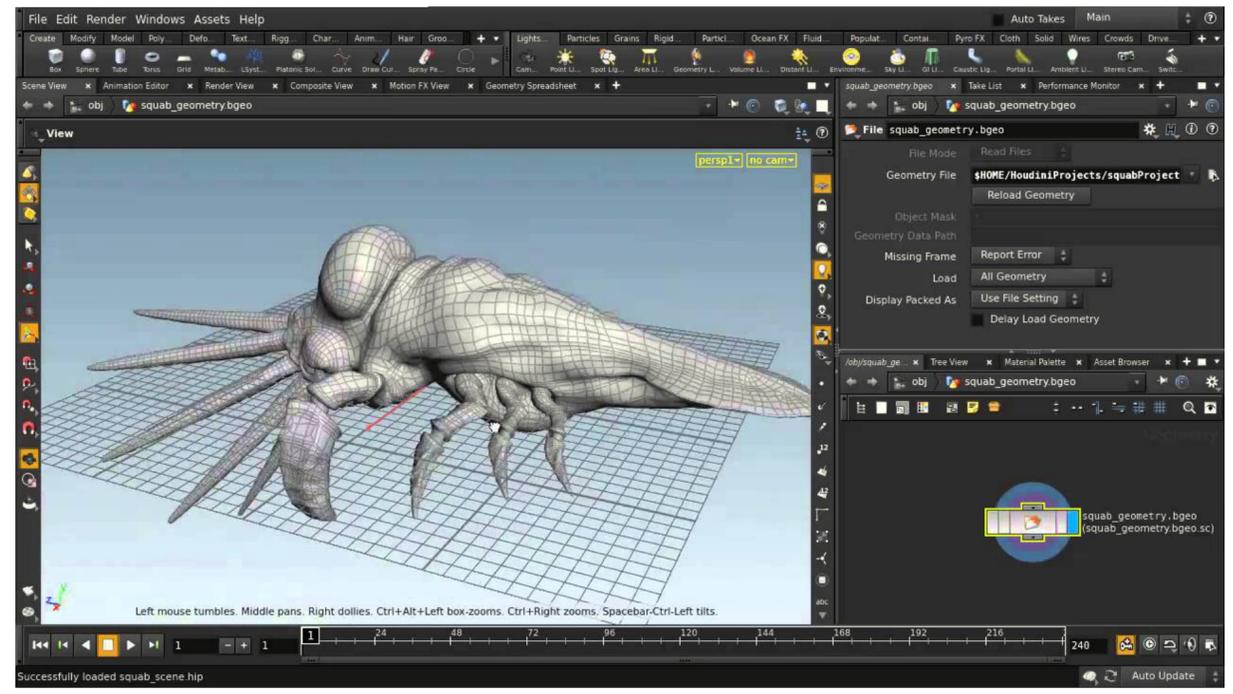
As a community-driven project under the [GNU General Public License \(GPL\)](#), the public is empowered to make small and large changes to the code base, which leads to new features, responsive bug fixes, and better usability.

More help is always welcome! From developing and improving Blender to writing documentation, etc, there are a number of different things you can do to [get involved](#).

# Alternatives



# Houdini



# Alternatives (Table made with GPT 4o)

 CAD vs Mesh Modeling Software – Features & Pricing Overview

Software	Type	Best For	Parametric	Sculpting	Animation	File Types	Price	Notes
Fusion 360	CAD	Product design, engineering	✓	✗	✗	STEP, STL, IGES, DXF	€540/year (free for hobbyists)	Cloud-based, includes CAM tools
SolidWorks	CAD	Mechanical engineering	✓	✗	✗	STEP, IGES, STL	€3,000+/year	High-end engineering tool
AutoCAD	CAD	2D plans, architecture	✓ (limited)	✗	✗	DWG, DXF	€2,000+/year	Focus on drafting and schematics
FreeCAD	CAD	Open-source parametric modeling	✓	✗	✗	STEP, STL, OBJ	Free	Open source, community-driven
Rhino 3D	CAD / NURBS	Architecture, industrial design	✓ (via Grasshopper)	✗	✗	3DM, IGES, STL, OBJ	€995 one-time	Excellent NURBS and scripting support
Blender	Mesh Modeling	Animation, games, visualization	✓ (via Geometry Nodes)	✓	✓	BLEND, FBX, OBJ, STL	Free	Open source; procedural and sculpting combined
Maya	Mesh Modeling	Film, TV, character animation	✗	✓	✓	MB, FBX, OBJ	€2,200/year	Industry standard in animation
3ds Max	Mesh Modeling	Game assets, architectural viz	✗	✓	✓	MAX, FBX, OBJ	€2,200/year	Widely used in AAA game and archviz pipelines
Cinema 4D	Mesh Modeling	Motion graphics, visual effects	✗	✓	✓	C4D, FBX, OBJ	€850/year or €3,000 one-time	Excellent for motion design and MoGraph
ZBrush	Sculpting	Digital sculpting (characters)	✗	✓✓✓	✗	ZTL, OBJ, FBX	€370 one-time	Best for detailed organic sculpting
Modo	Mesh Modeling	Modeling, rendering, animation	✗	✓	✓	LXO, FBX, OBJ	€1,800/year	Known for fast and intuitive modeling workflow
Wings 3D	Mesh Modeling	Simple polygon modeling	✗	✗	✗	OBJ, STL	Free	Lightweight and beginner-friendly polygon modeler
SketchUp	Hybrid (CAD-like)	Architecture, interior design	✓ (basic intuitive)	✗	✗	SKP, DAE, STL	Free basic / €335+/year	Easy to learn, widely used in architecture

**What about AI?**

The research monkey trade roils  
the island of Mauritius p. 1248

Babies can store episodic  
memories pp. 1253 & 1316

A trapped-atom quantum  
processor pp. 1255 & 1301

# Science

\$15  
21 MARCH 2025  
science.org

AAAS

## MAKING ATP

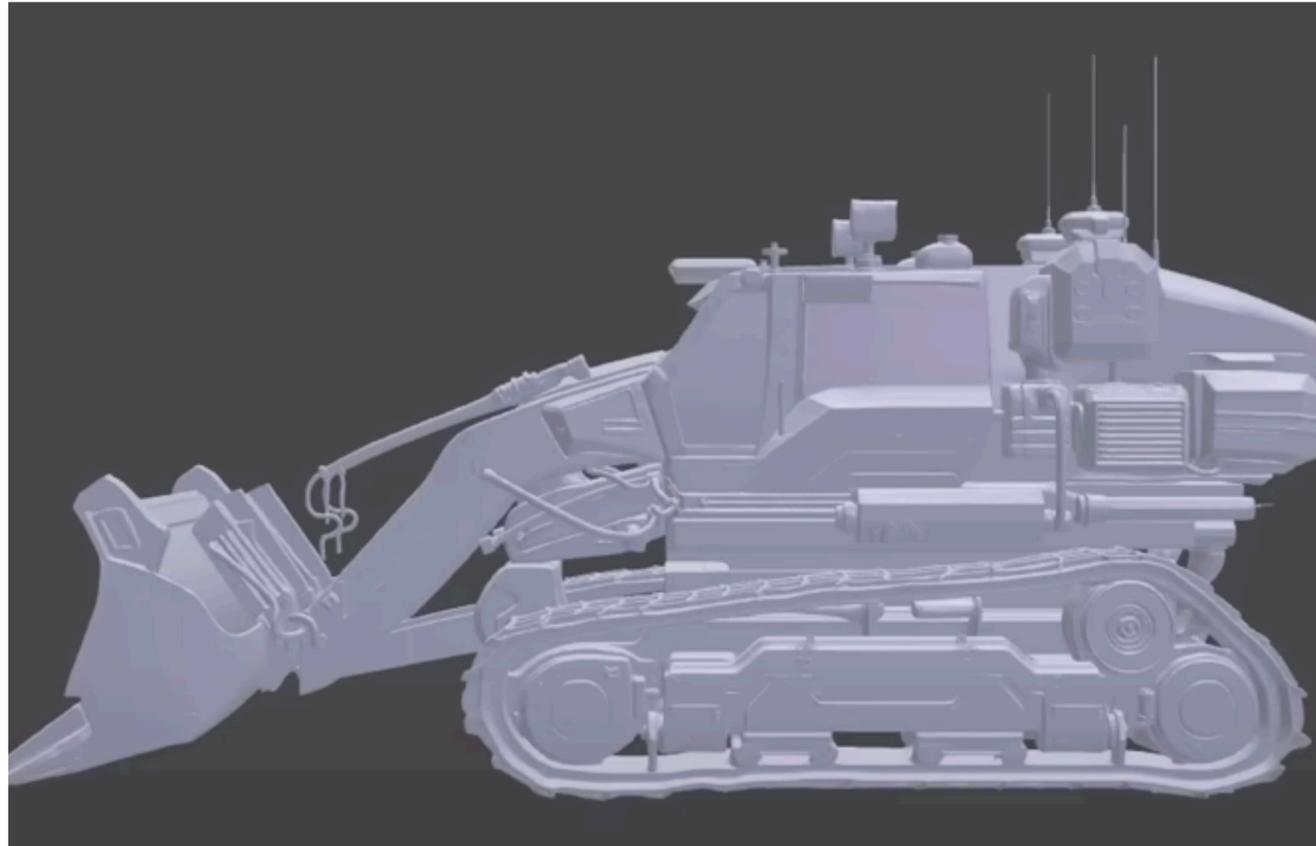
In-cell architecture of the  
mitochondrial respiratory  
chain p. 1296



create an photorealistic image of this scene for a journal  
cover:

In-cell architecture of the mitochondrial respiratory chain





## Are We Screwed? (A New Hi-res 3D Shape From Image Method)



Gleb Alexandrov  
232K subscribers

Subscribed

7.2K | Dislike | Share

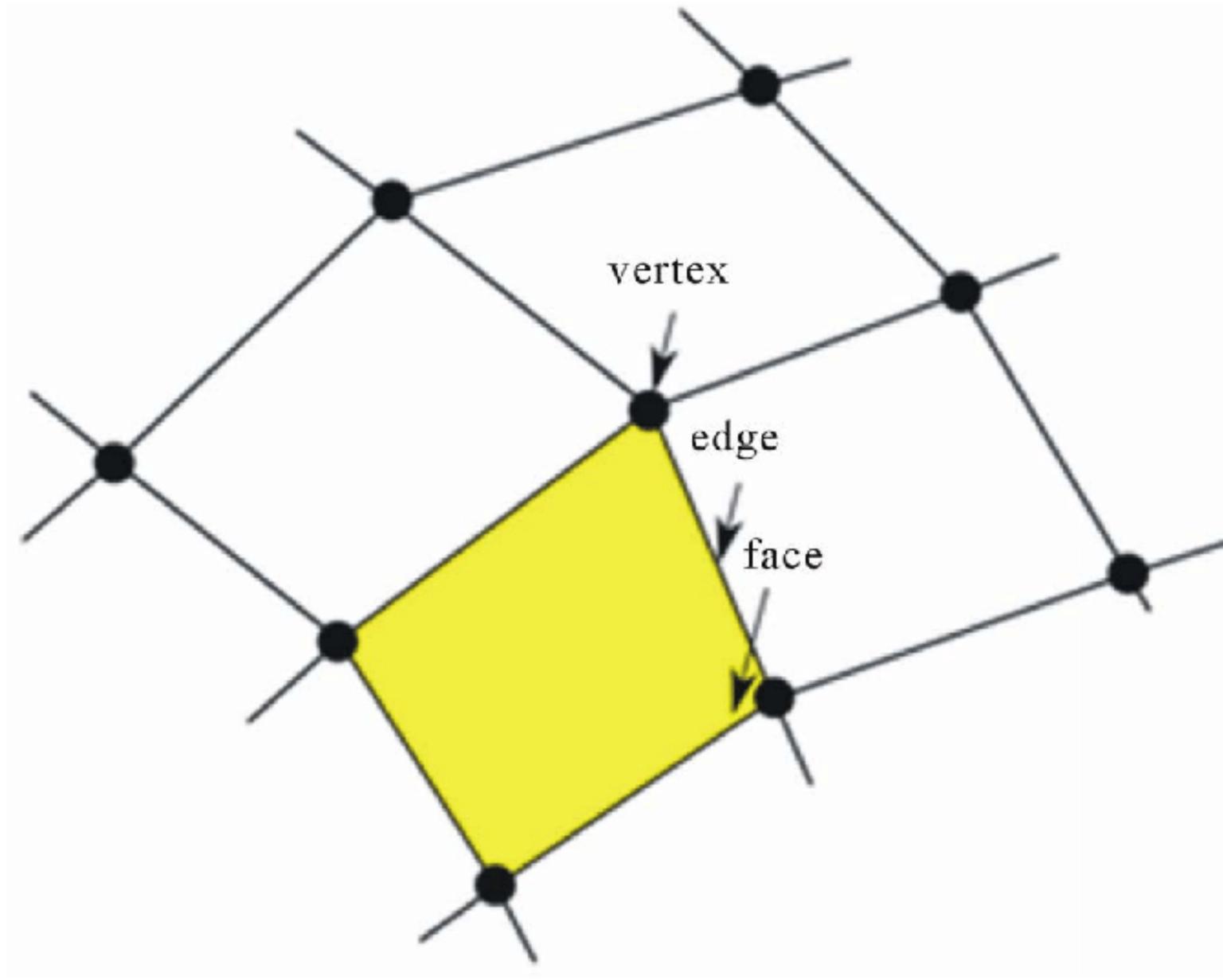
151K views 1 month ago

# Interface & Mesh Manipulation

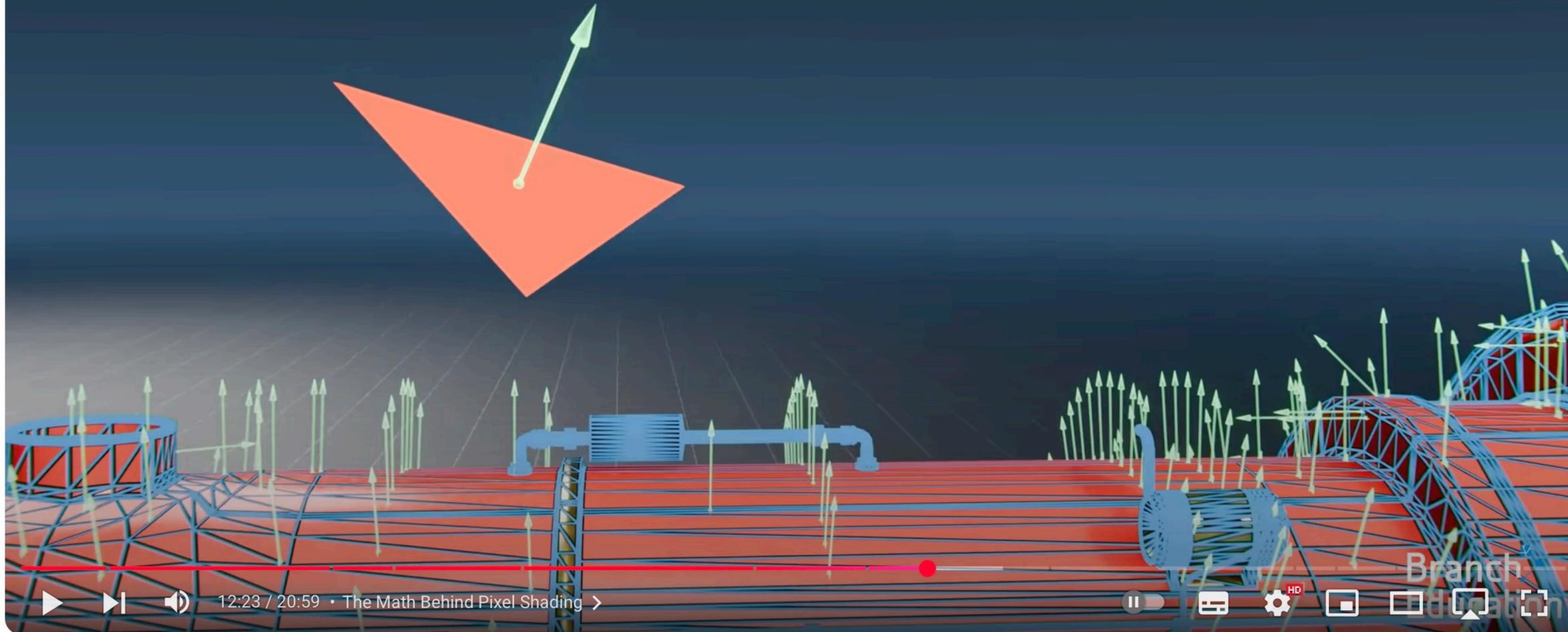
Jan-Hendrik Müller  
Blender 4.5.1

August 2025

# Vertex, edge face



# Surface Normal



## How do Video Game Graphics Work?

 Branch Education ✓  
2.46M subscribers

Join

 Subscribed ▾

 289K



 Share

 Thanks

 Clip

 Save



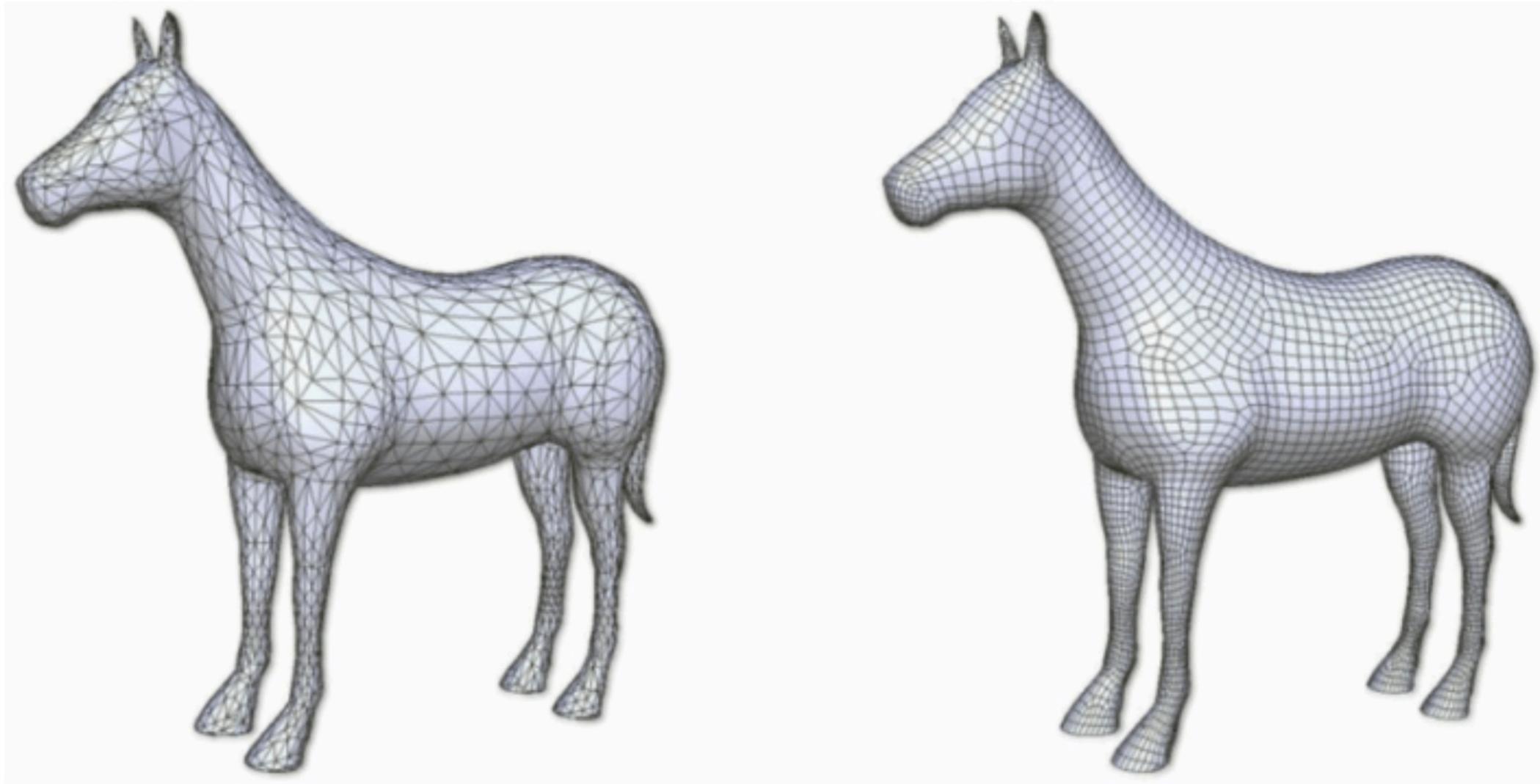
4.6M views 1 year ago #GPU #Algorithm #Graphics

<https://www.youtube.com/watch?v=C8YtdC8mxTU>

Figure 3 - uploaded by [Sara Farrag](#)  
Content may be subject to copyright.

Download

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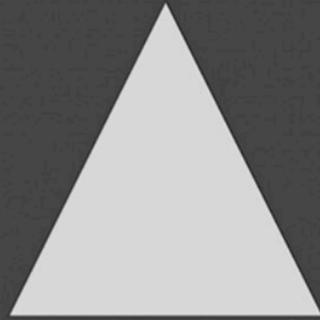
**(a)**

**(b)**

6: Triangle Mesh (a)-Quad Mesh (b)[35].

# Single Polygon

Tri



1 polygon

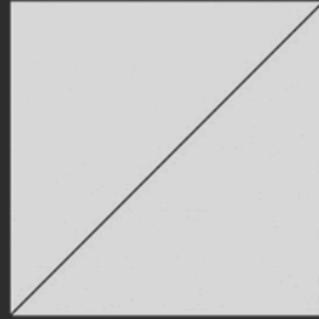


1 tri

Quad

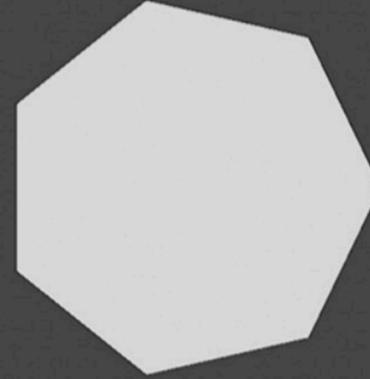


1 polygon

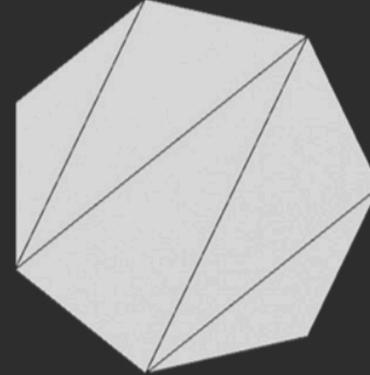


2 tris

N-Gon (7-sided)



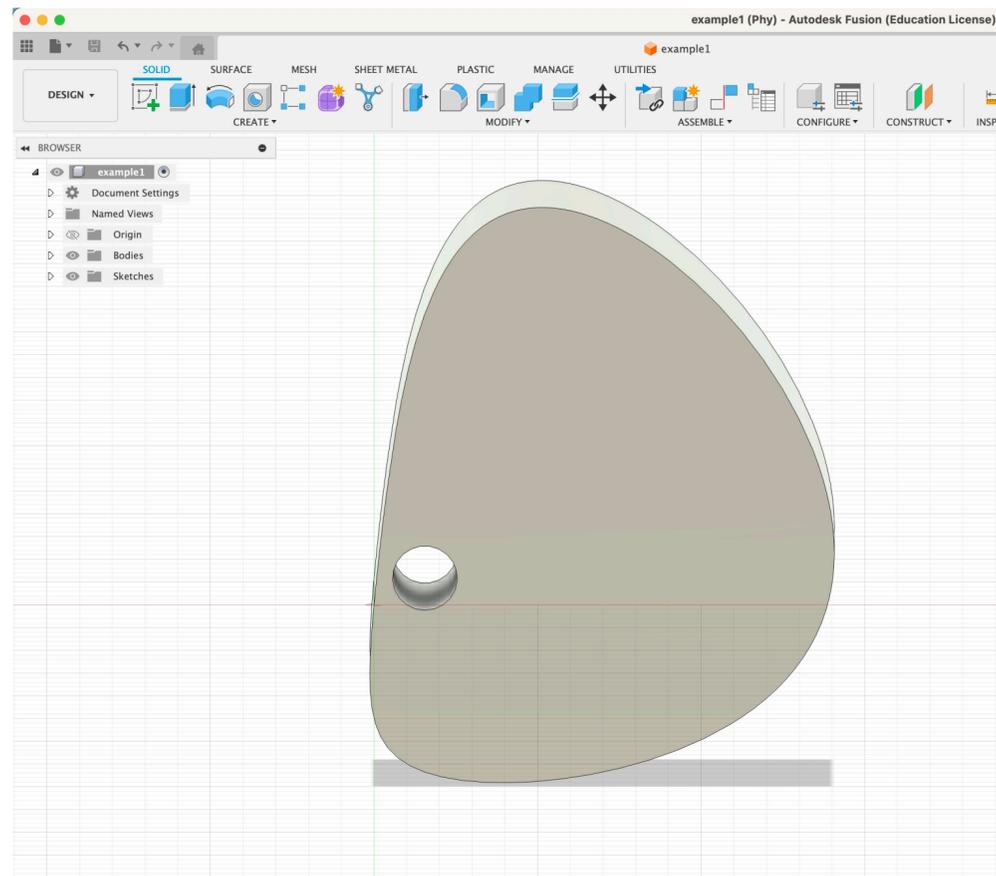
1 polygon



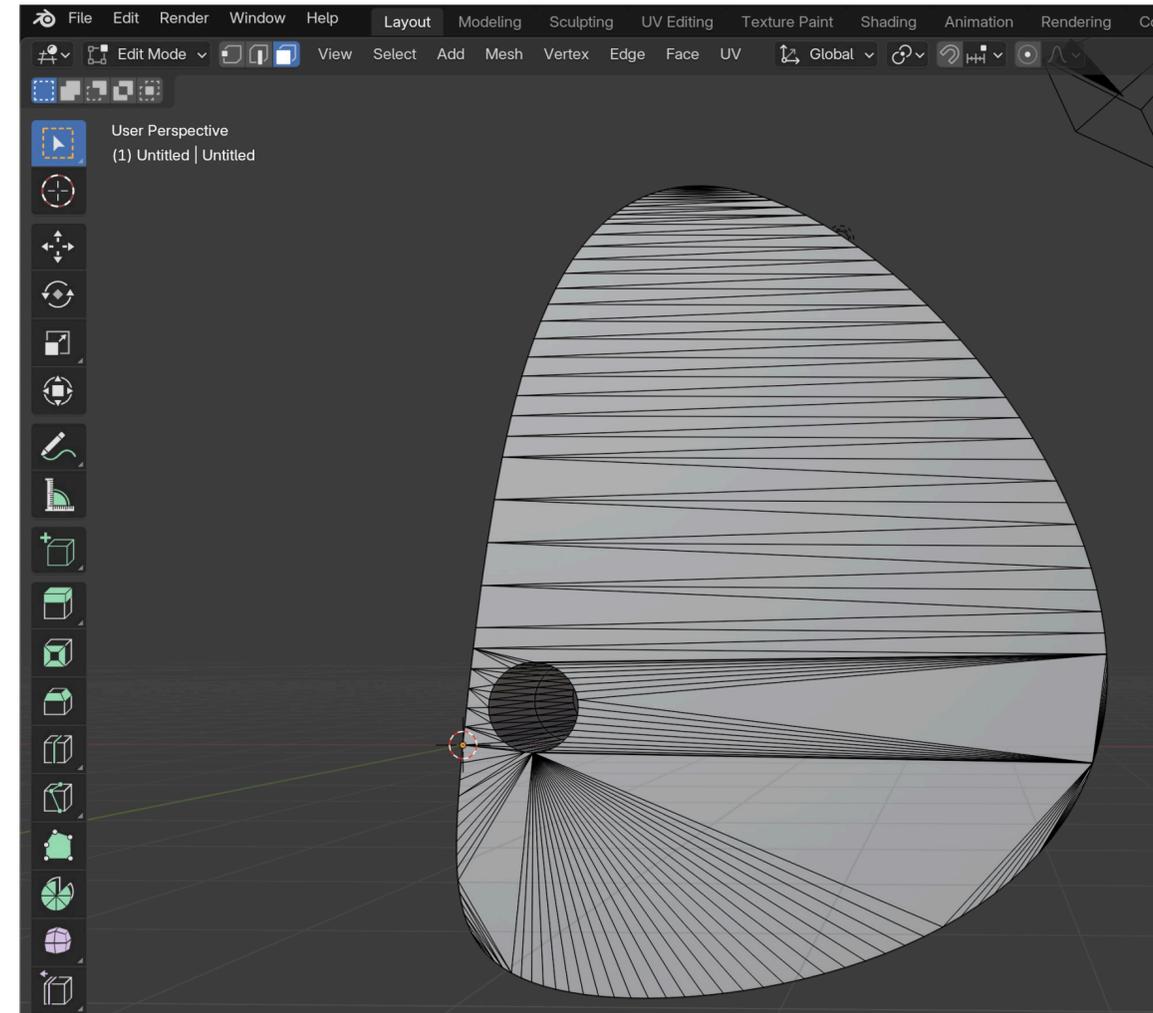
5 tris



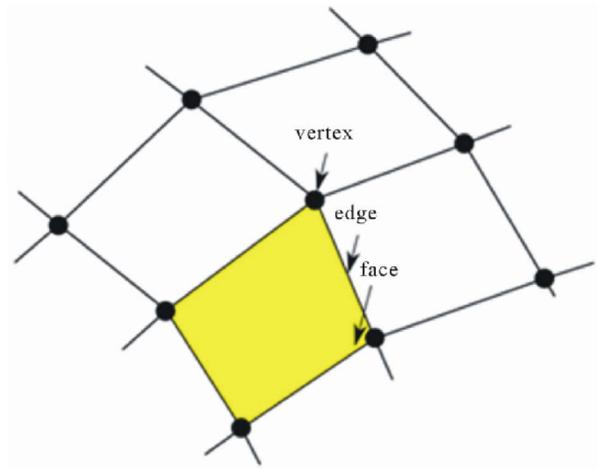
# AutoDesk Fusion



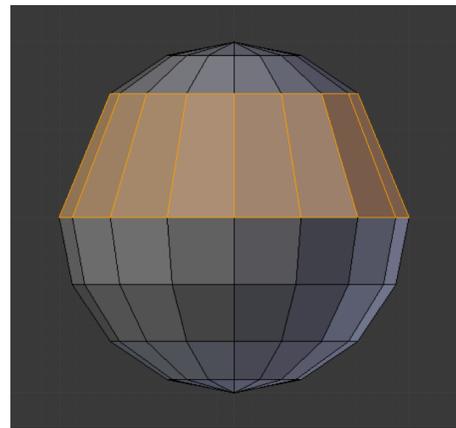
# Blender



# Vertex, edge face

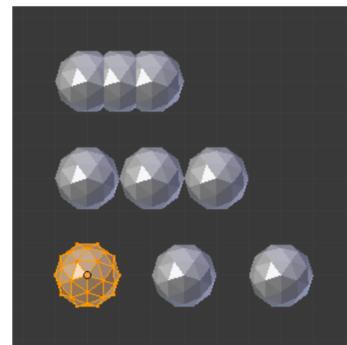


Mesh editing

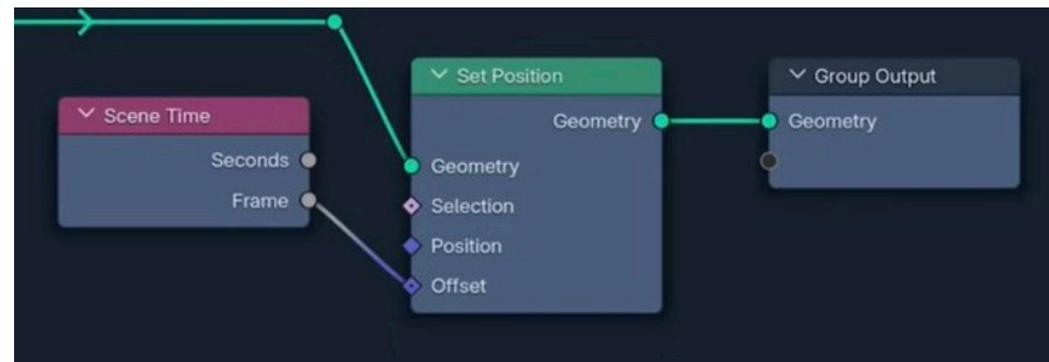


Mesh Manipulation

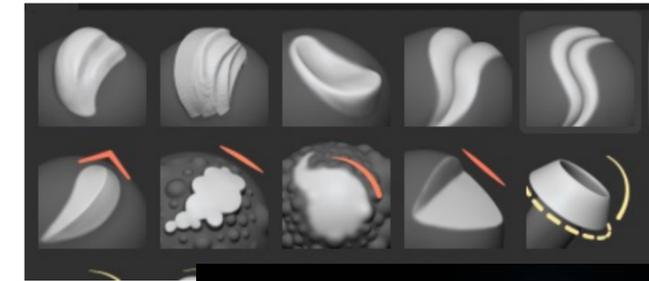
Modifier



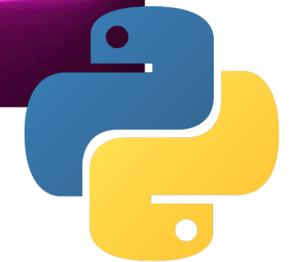
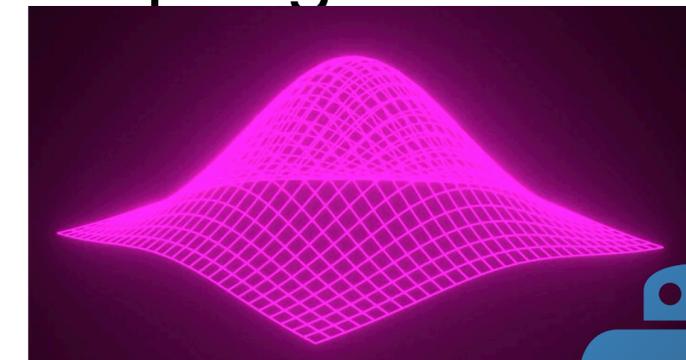
Geometry Nodes



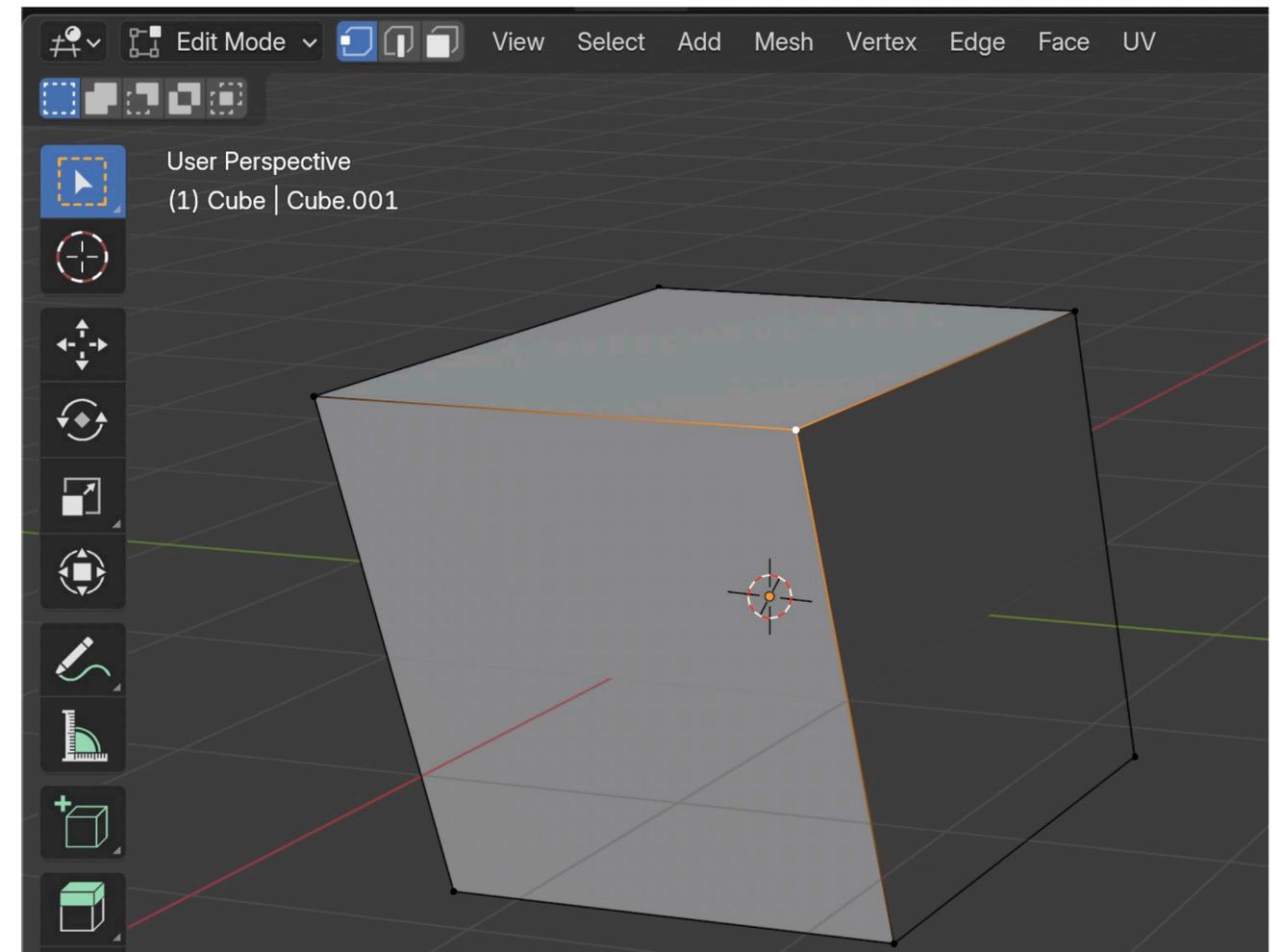
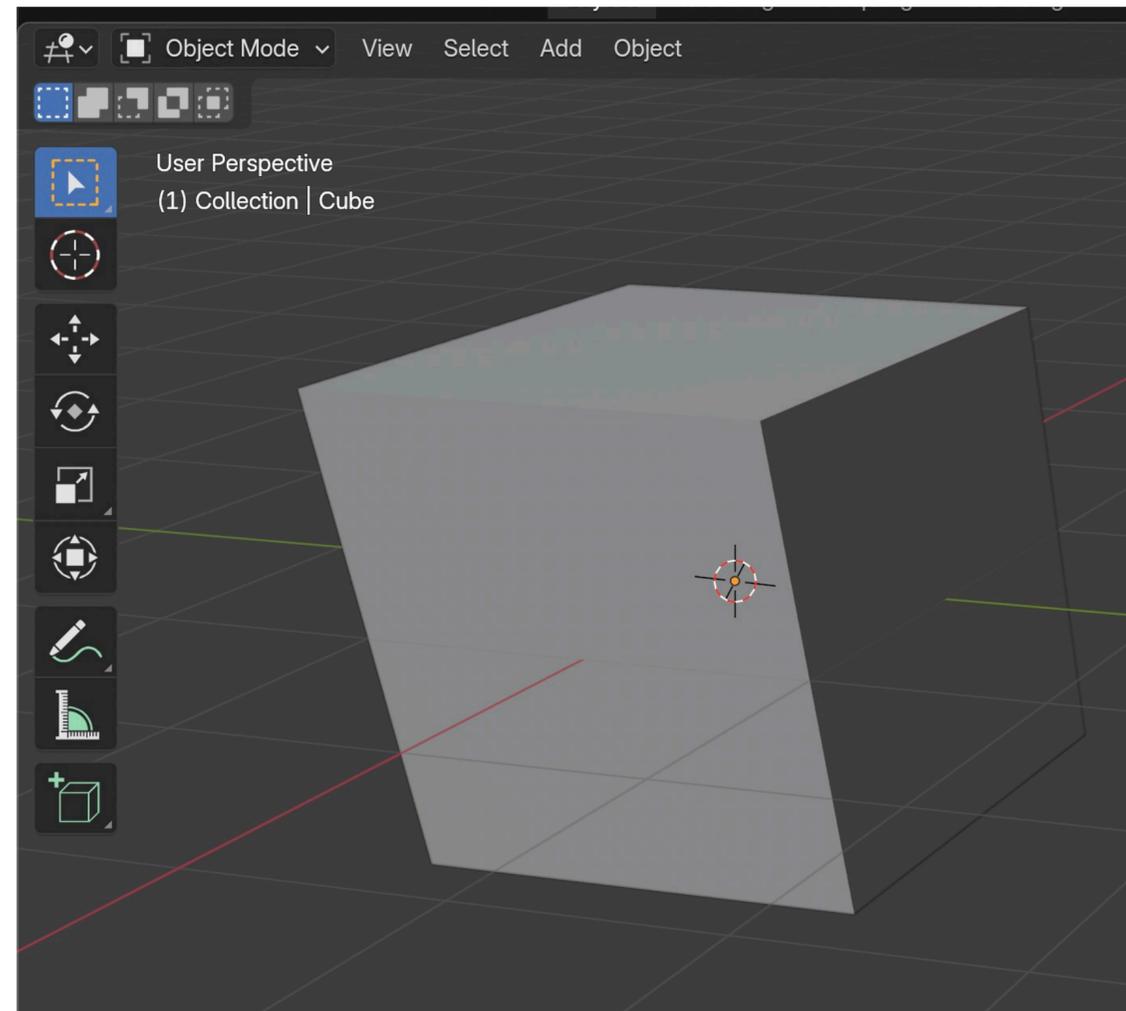
Sculpting



Scripting

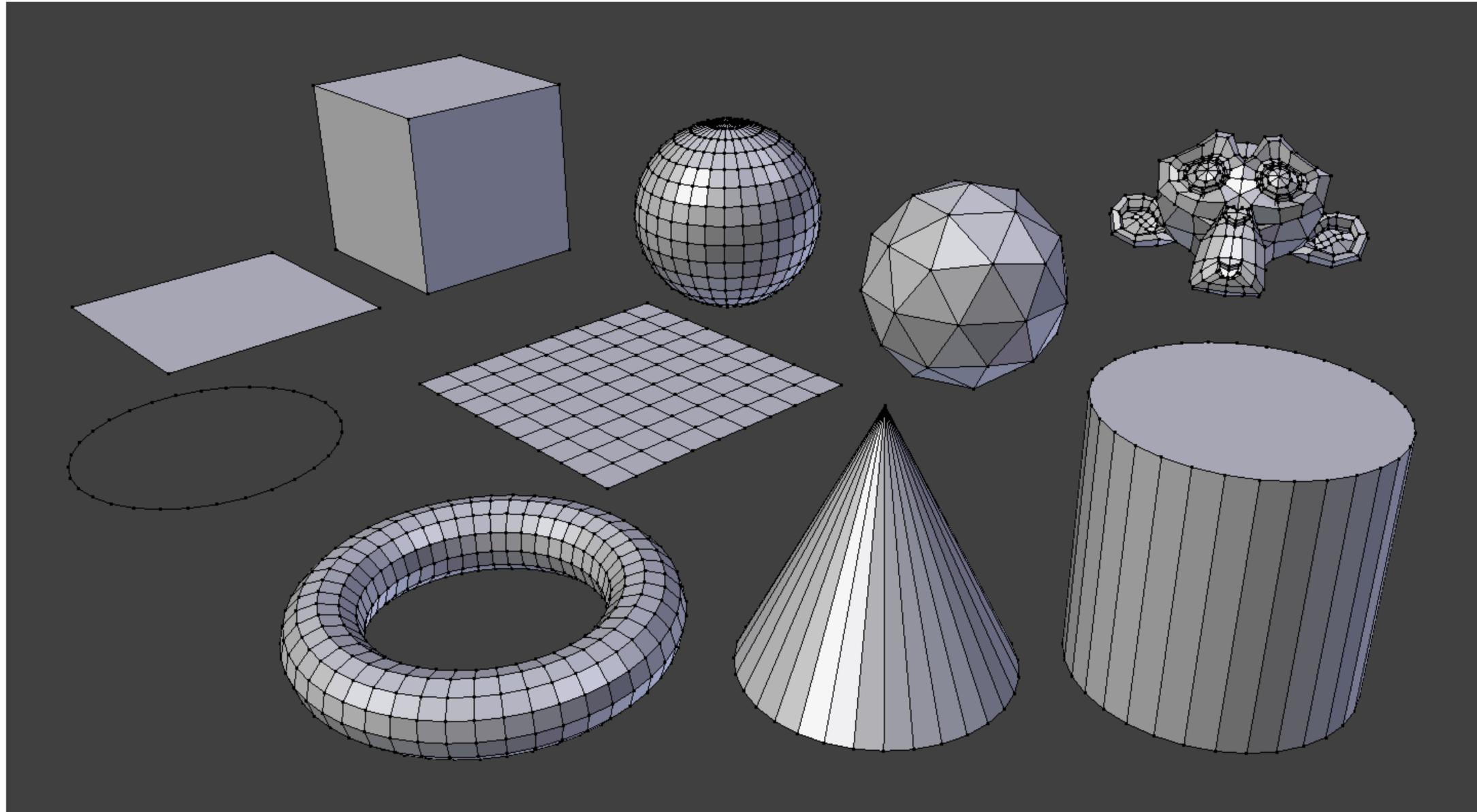


# Object Mode, Edit Mode



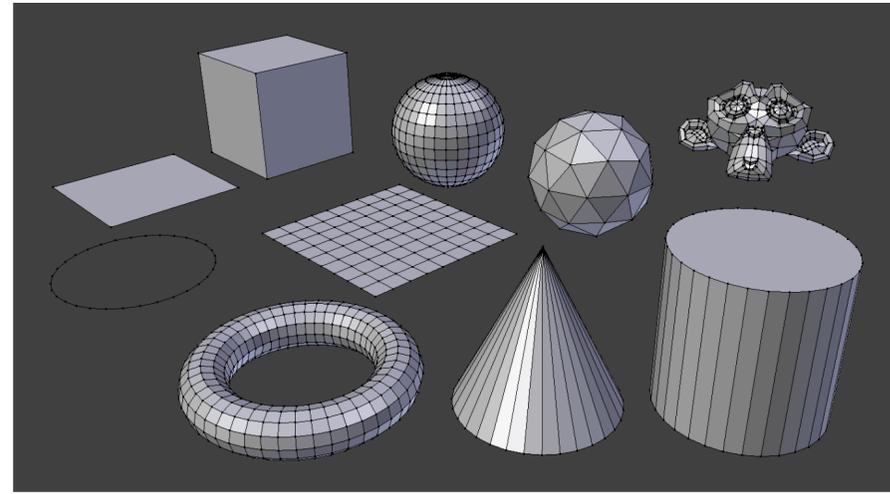
**<- Tab to change ->**

# Default meshes

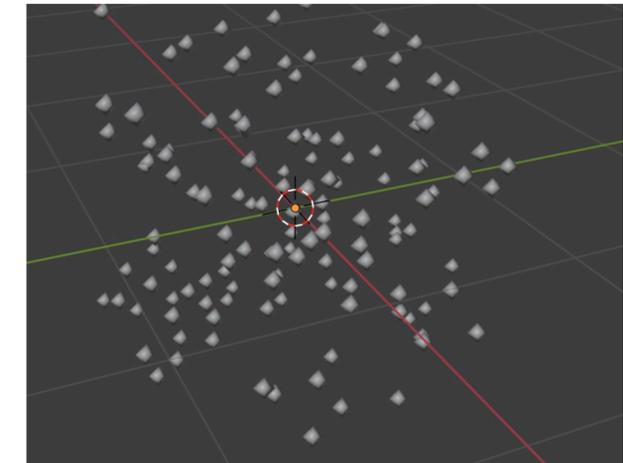


<https://docs.blender.org/manual/en/latest/modeling/meshes/primitives.html>

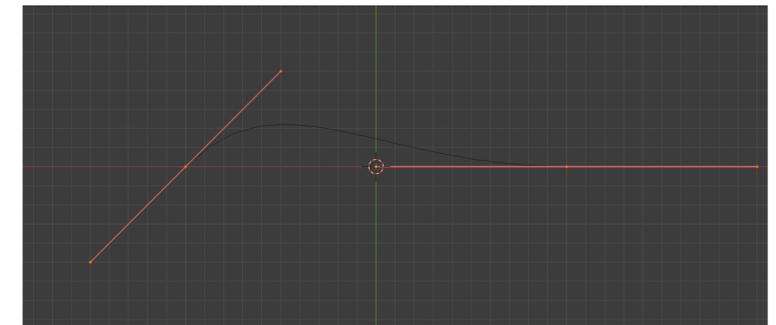
# Blender Objects



- Mesh – Vertices, edges, faces (for 3D models)
- Point Cloud – Unconnected points, used in simulations



- Curve – Smooth shapes defined by control points

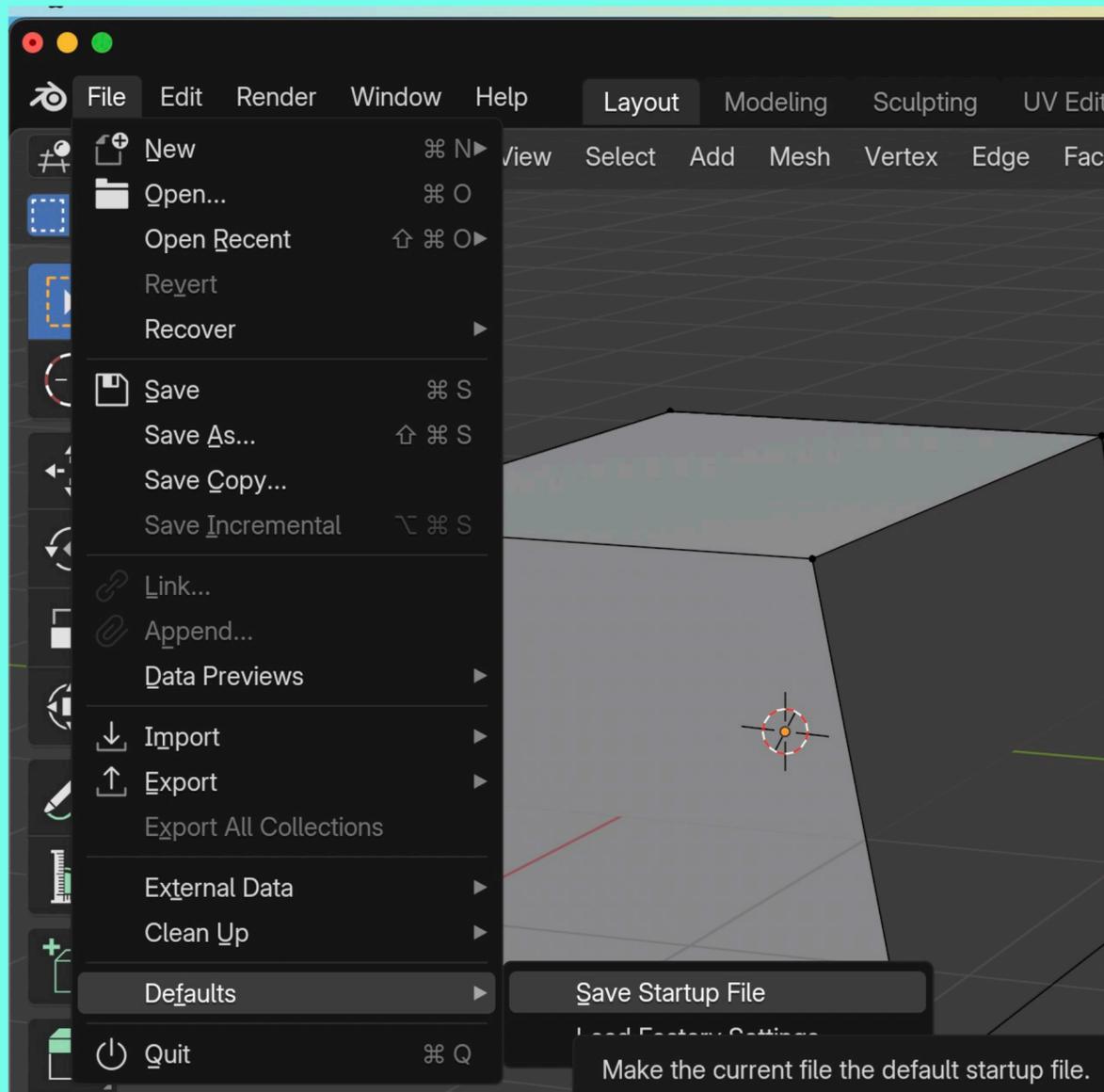


- Grease Pencil – 2D/3D strokes for drawing and animation



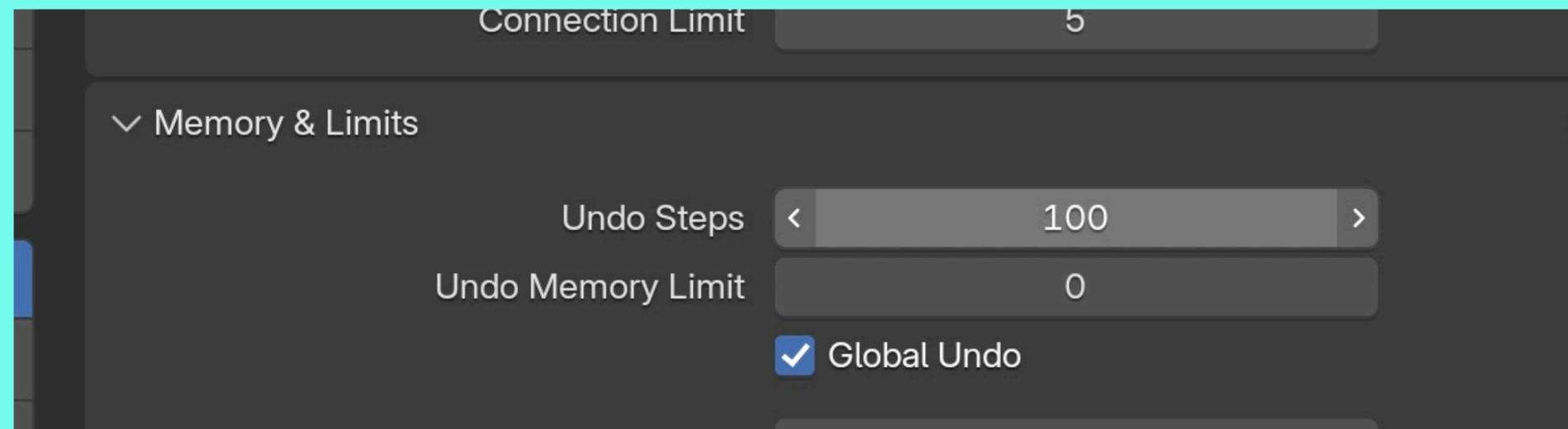
# Task 1

- Open „hello\_blender.blend“
- Save it as startup file.



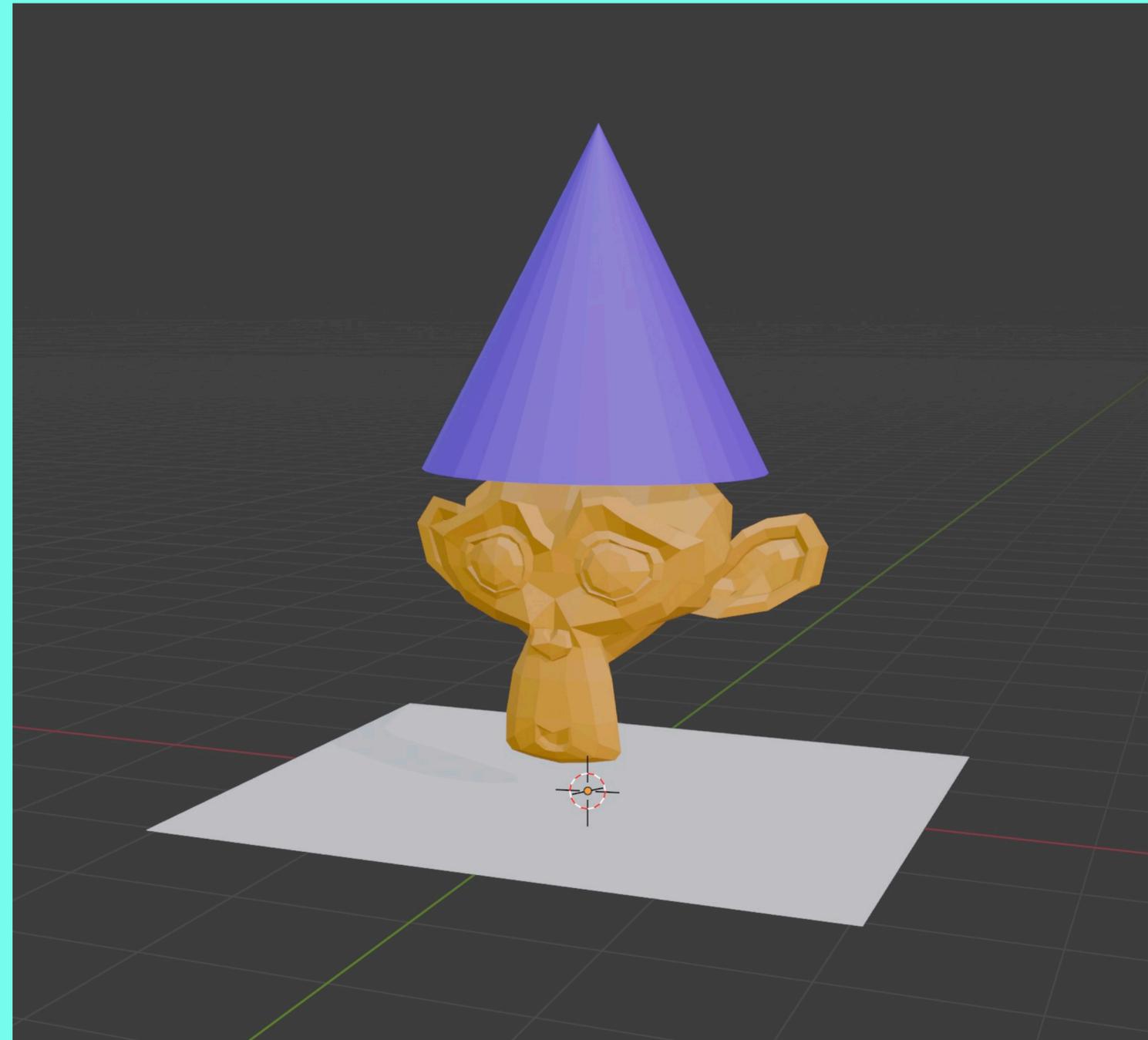
## What Changed?

- Most tabs closed.  
Only („Layout“, „Shading“ and „Geometry Nodes“) remain
- „Timeline“ panel hidden
- Undo Steps to 100
- Save as startup file



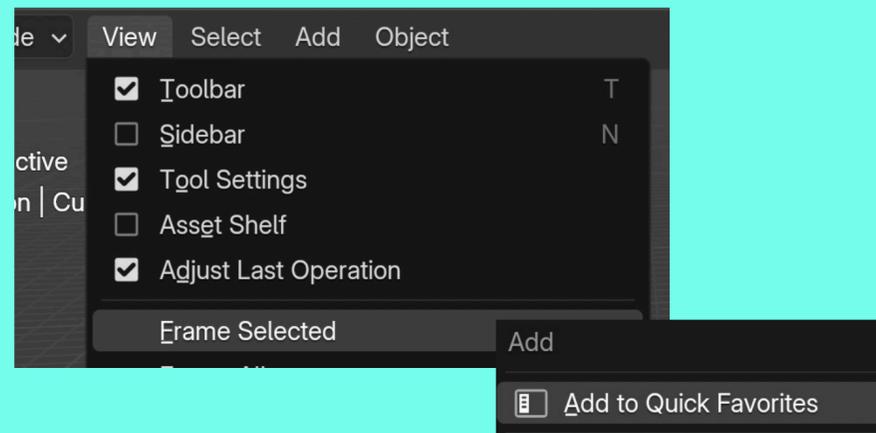
# Task 2

- Add Objects
  - Shortcut: Shift A or „Search“ and add objects.
- Add a Plane, A Monkey, and a cone
- Grab objects with „G“
- Scale objects with „S“

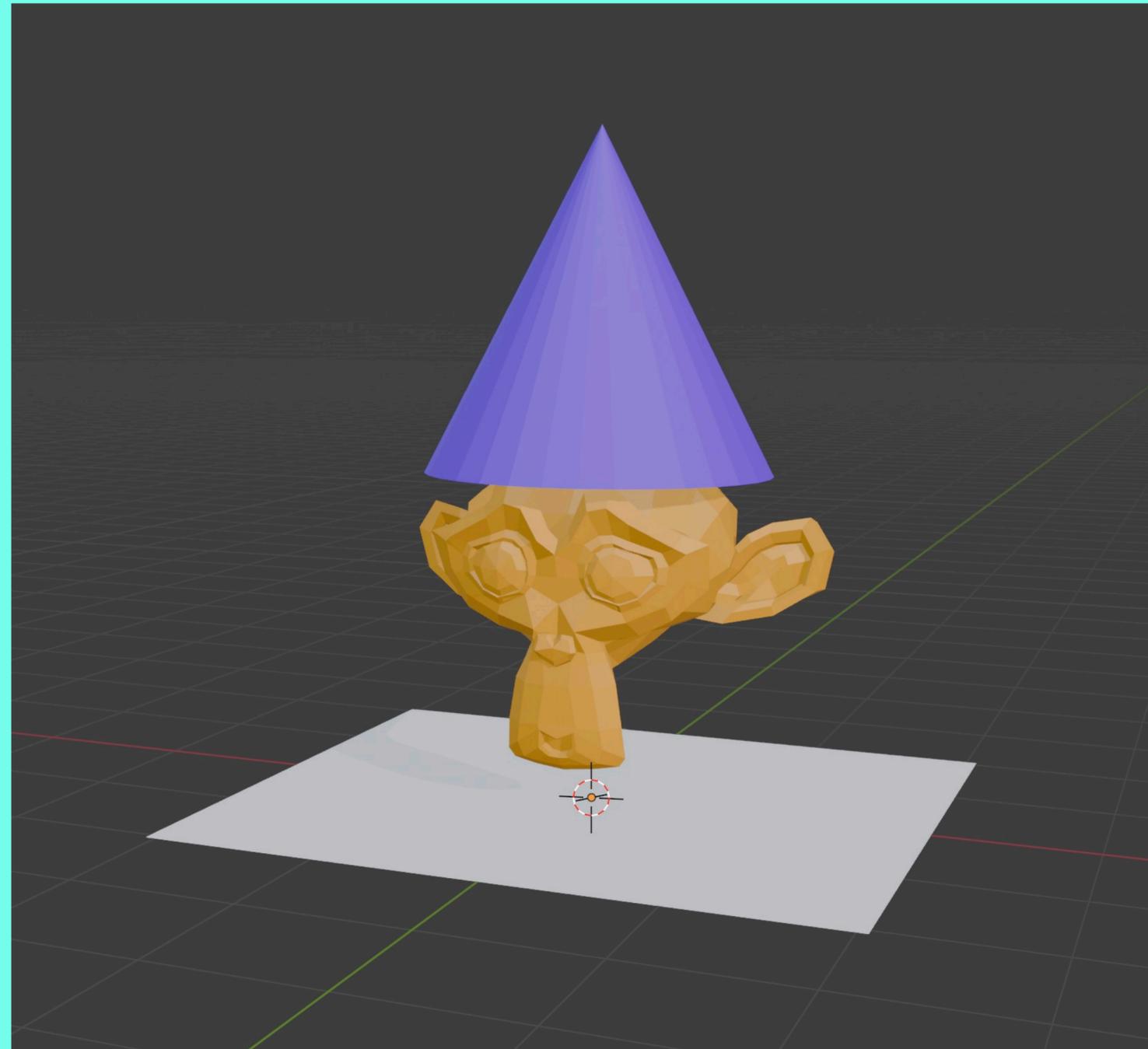
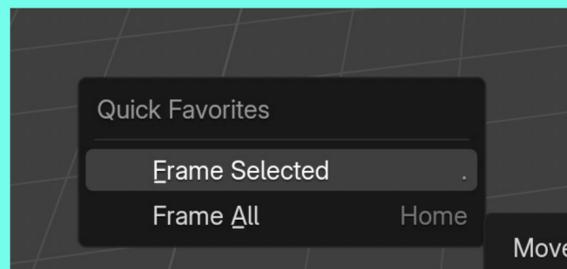


# Task 2 B

- Add „Quick Favorit“



- Press Q

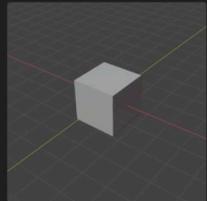
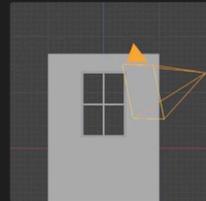
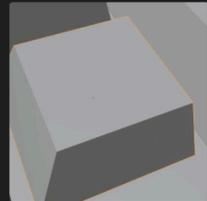
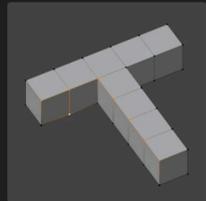
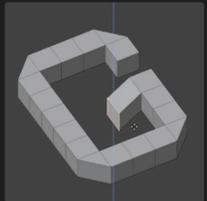
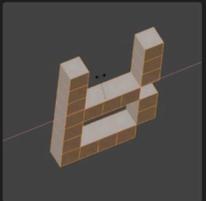
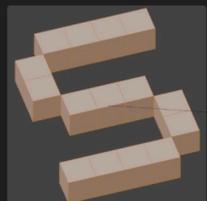
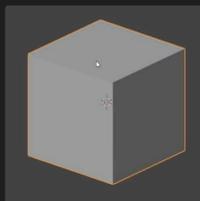
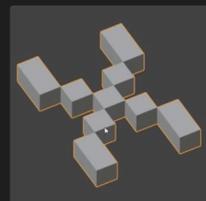
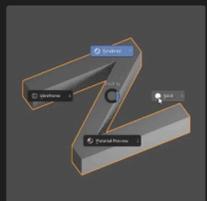
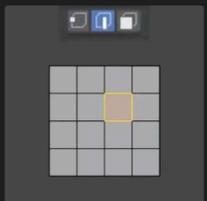


# Important Shortcuts

**Blender Shortcuts**

This website provides a selection of useful default shortcuts in **Blender**. For the best user experience, a mouse with a wheel and a keyboard with a numpad are recommended.

Suggest changes to this website via [Github](#).

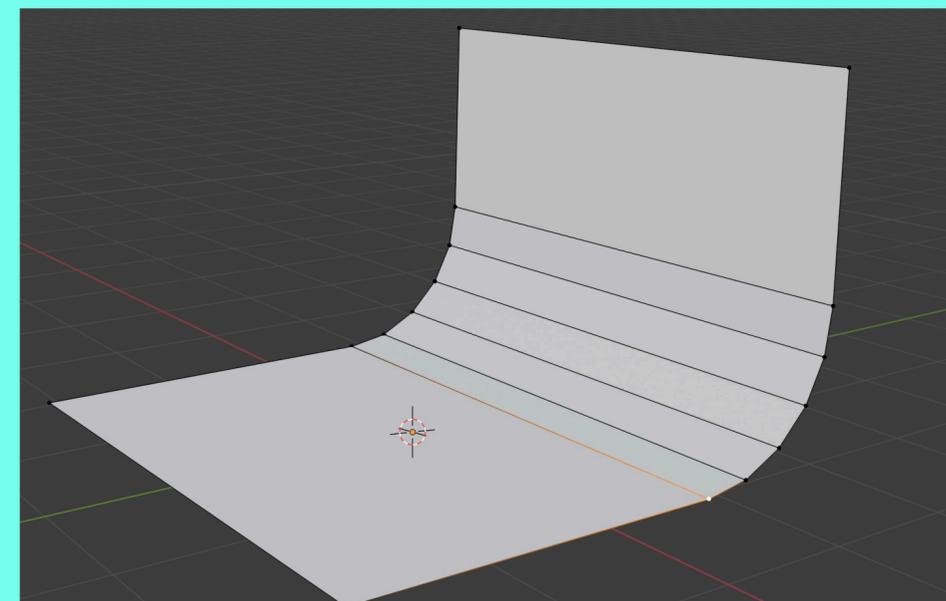
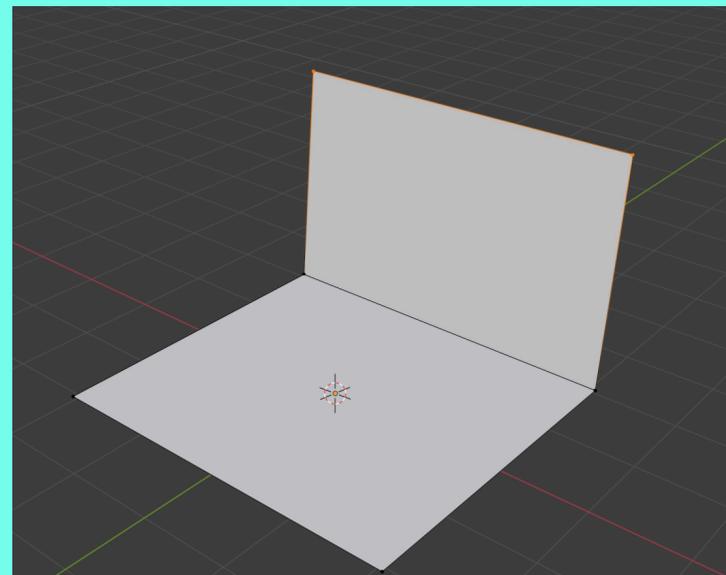
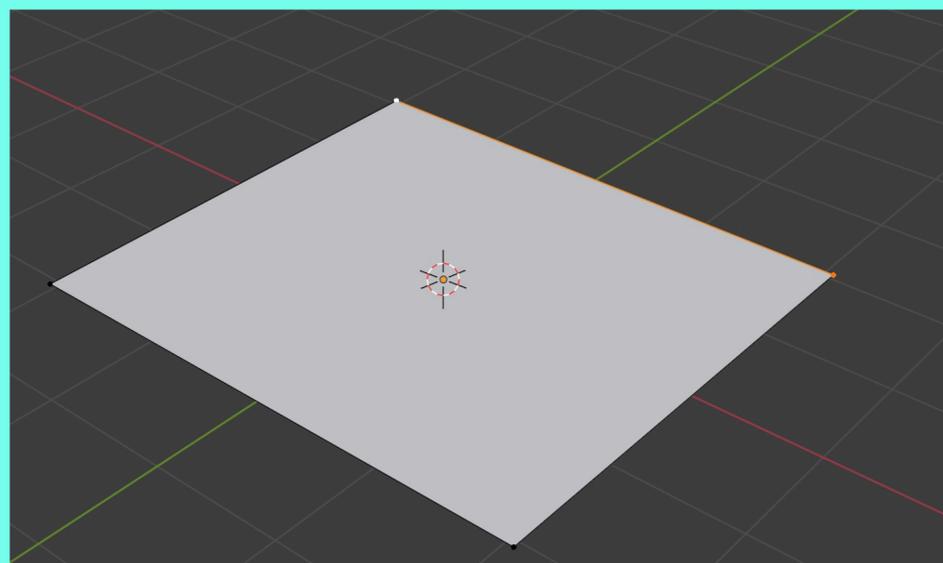
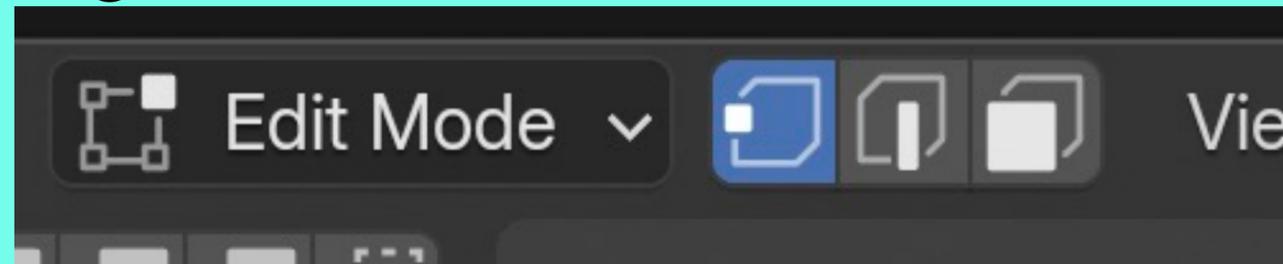
<p><b>Change View</b></p> <p>Middle Mouse</p> 	<p><b>Axis View</b></p> <p>Numpad 1-9</p> 	<p><b>Camera View</b></p> <p>Numpad 0</p> 	<p><b>Frame Selected</b></p> <p>Numpad .</p> 	<p><b>Change Mode</b></p> <p>Ctrl + Tab</p> 	<p><b>Switch Object</b></p> <p>Alt + Q</p> 	<p><b>Move</b></p> <p>G</p> 	<p><b>Rotate</b></p> <p>R</p> 
<ul style="list-style-type: none"><li>• Drag <b>Middle Mouse</b> to Rotate the view. It rotates around an invisible Point of Interest.</li><li>• Hold <b>Shift</b> and drag to Move the point of interest.</li><li>• Hold <b>Ctrl</b> and drag or roll the <b>Mouse Wheel</b> to Zoom in and out</li></ul>	<ul style="list-style-type: none"><li>• <b>Num 1</b>, <b>Num 3</b> &amp; <b>Num 7</b> to view from Front, Side &amp; Top.</li><li>• <b>Num 9</b> to Invert the current view direction.</li><li>• <b>Num 5</b> to toggle Orthographic view.</li><li>• <b>Num 2</b>, <b>Num 4</b>, <b>Num 6</b>, <b>Num 8</b> to Rotate the view in 15° steps.</li></ul>	<ul style="list-style-type: none"><li>• <b>Numpad 0</b> to align the view with the scene camera.</li><li>• <b>Ctrl</b> + <b>Numpad 0</b> to align the view with the selected camera and make it the scene camera.</li><li>• <b>Ctrl</b> + <b>Alt</b> + <b>Numpad 0</b> to align the scene camera with the current view.</li></ul>	<ul style="list-style-type: none"><li>• <b>Numpad .</b> to set the Point of Interest to the current selection.</li><li>• <b>Numpad /</b> to toggle Local View which also hides all but the selected object.</li></ul>	<ul style="list-style-type: none"><li>• <b>Ctrl</b> + <b>Tab</b> to see all available modes.</li><li>• <b>Tab</b> to toggle Edit mode directly.</li><li>• If the cursor is hovering a timeline, <b>Ctrl</b> + <b>Tab</b> to toggle graph view.</li></ul>	<ul style="list-style-type: none"><li>• <b>Alt</b> + <b>Q</b> to switch to the hovered object without changing modes.</li><li>• Works with all modes, including <b>Pose Mode</b> on Armature objects.</li></ul>	<ul style="list-style-type: none"><li>• Press <b>X</b>, <b>Y</b> or <b>Z</b> to lock to an axis. Press twice to switch from global to local axes.</li><li>• <b>Shift</b> + <b>X</b>, <b>Y</b> or <b>Z</b> to exclude an axis.</li><li>• In Edit Mode, press <b>G</b> twice to slide along existing edges.</li></ul>	<ul style="list-style-type: none"><li>• Press <b>X</b>, <b>Y</b> or <b>Z</b> to lock to an axis. Press twice to switch from global to local axes.</li><li>• <b>Shift</b> + <b>X</b>, <b>Y</b> or <b>Z</b> to exclude an axis.</li><li>• Press <b>R</b> twice to switch to gimbal mode.</li></ul>
<p><b>Scale</b></p> <p>S</p> 	<p><b>Add</b></p> <p>Shift + A</p> 	<p><b>Delete</b></p> <p>X</p> 	<p><b>Hide</b></p> <p>H</p> 	<p><b>Duplicate</b></p> <p>Shift + D</p> 	<p><b>Change Shading</b></p> <p>Z</p> 	<p><b>Selection Modes</b></p> <p>1, 2, 3</p> 	<p><b>Snap</b></p> <p>Shift + S</p> 
<ul style="list-style-type: none"><li>• Press <b>X</b>, <b>Y</b> or <b>Z</b> to lock to an axis. Press twice to switch</li></ul>	<ul style="list-style-type: none"><li>• <b>Shift</b> + <b>A</b> adds new data.</li></ul>	<ul style="list-style-type: none"><li>• Press <b>X</b> in Object Mode to delete selected objects.</li></ul>	<ul style="list-style-type: none"><li>• <b>H</b> to hide the selection.</li></ul>	<ul style="list-style-type: none"><li>• <b>Shift</b> + <b>D</b> to duplicate the selection.</li></ul>	<ul style="list-style-type: none"><li>• <b>Shift</b> + <b>Z</b> to toggle Wireframe and X-ray, to see</li></ul>	<ul style="list-style-type: none"><li>• <b>1</b> for vertex select.</li></ul>	<ul style="list-style-type: none"><li>• Move one thing precisely to another, especially useful to</li></ul>

<https://hollisbrown.github.io/blendershortcuts/#ChangeMode>

# Task 3

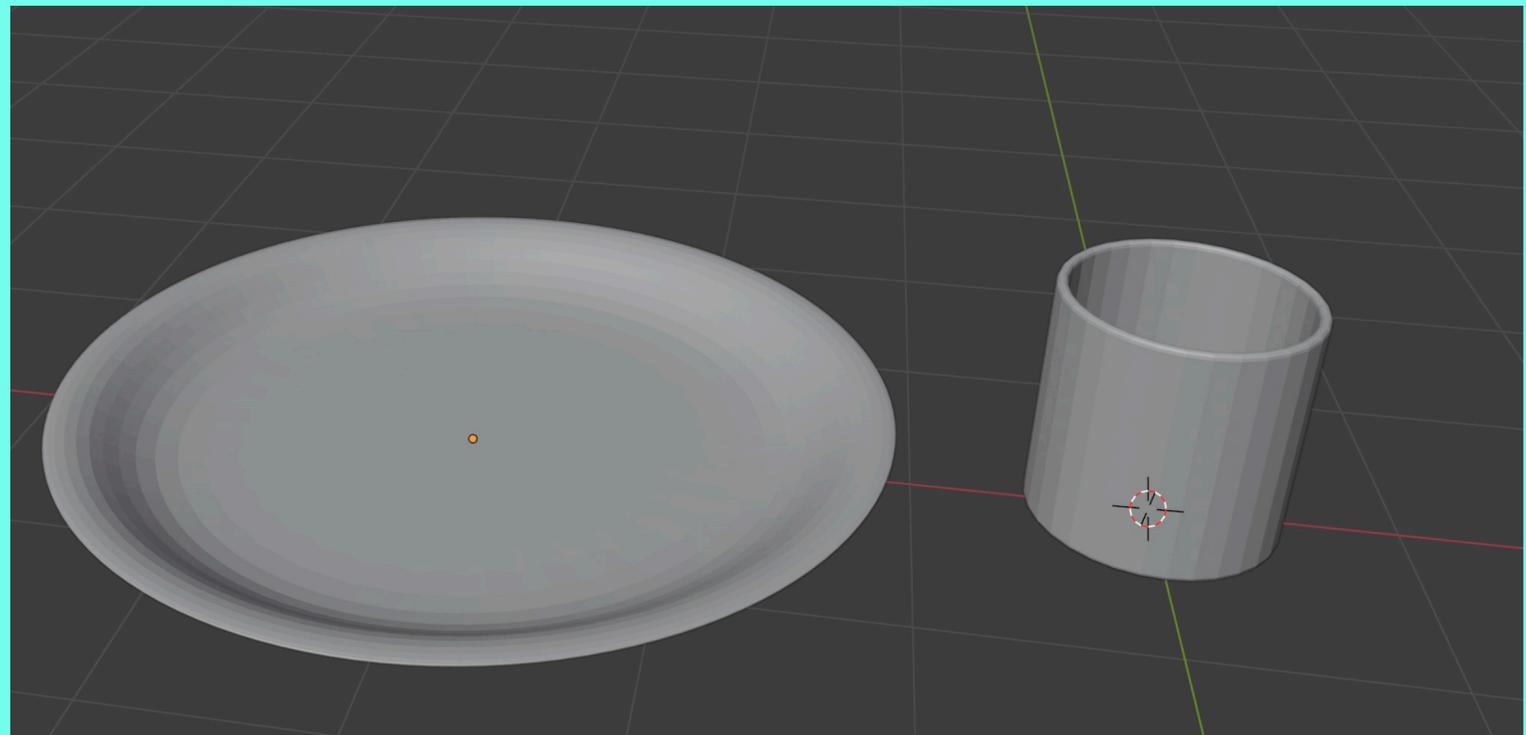
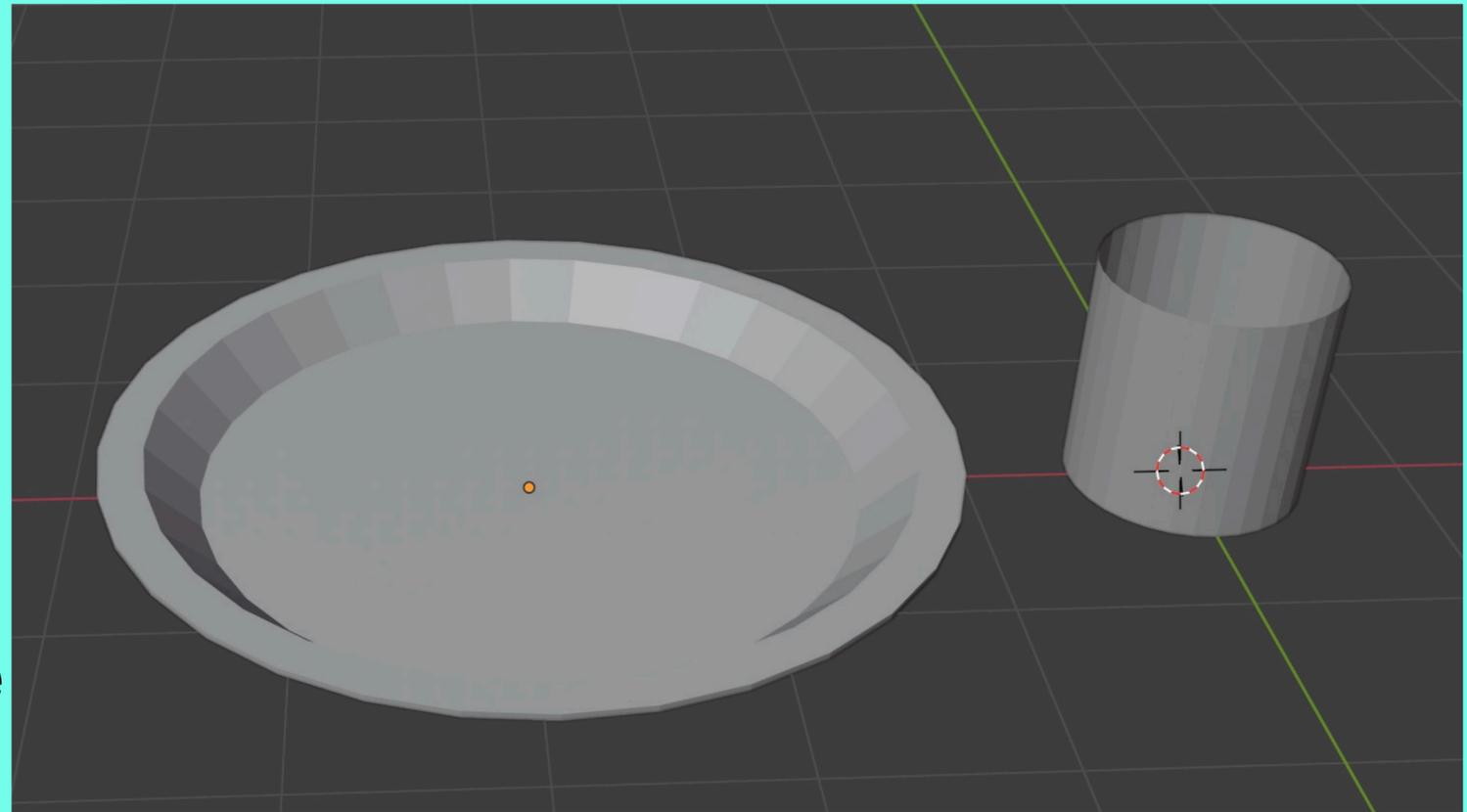
- Create a „BackDrop“
- Start with a Plane
- Select Edge. Next use keys: E (Extrude), G (Grap), Z (axis)
- Control+B „Bevel“
- Shade Smooth

Change selection with 1, 2, 3



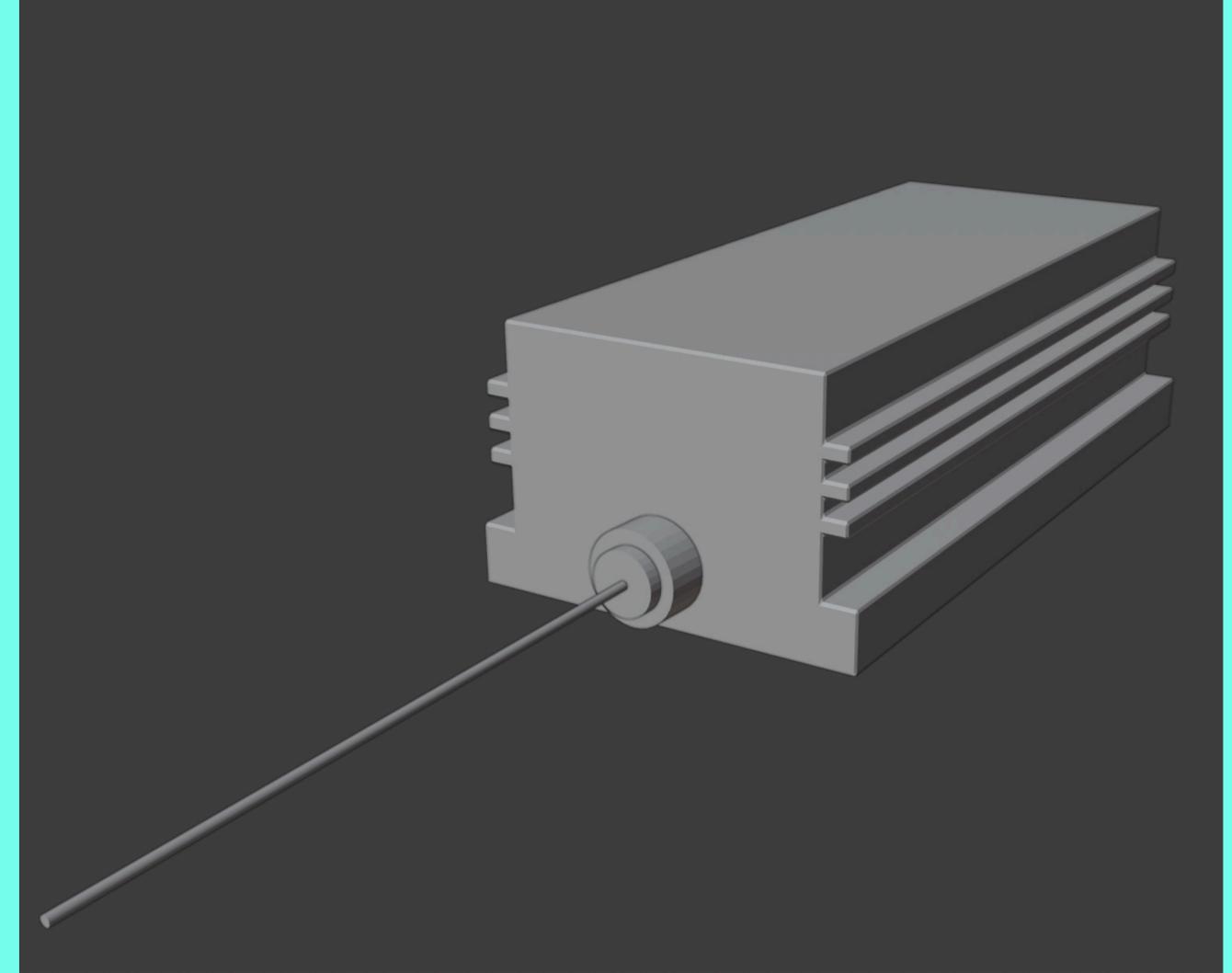
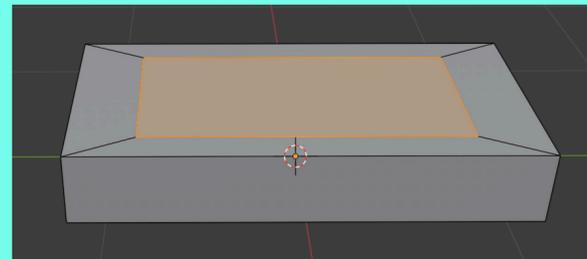
# Task 4

- Model a plate & a cup
- Start with circle or cylinder
  - In edit mode, use „e“ extrude
  - **Solidify Modifier**
  - **Bevel Modifier**



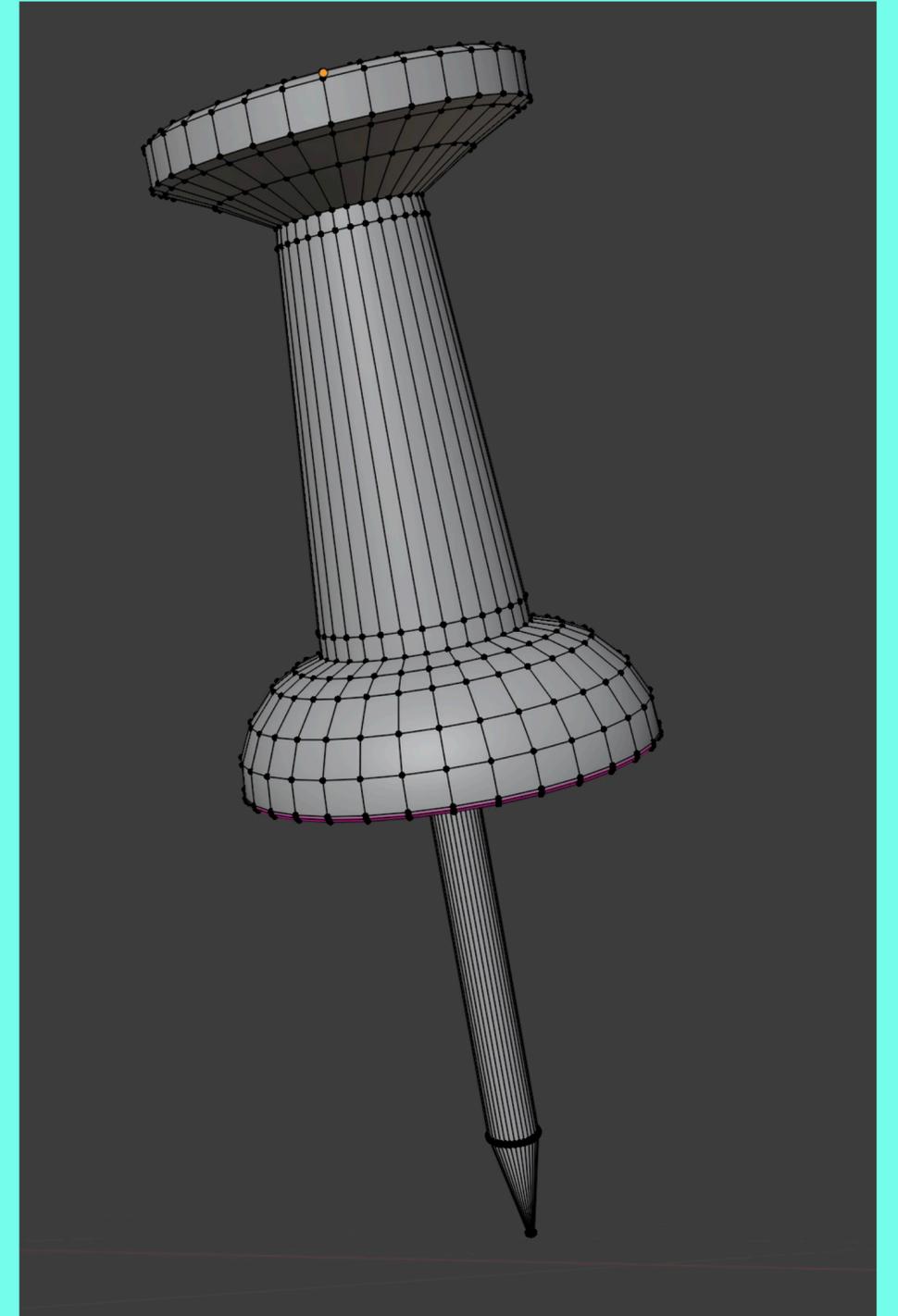
# Task 5

- Model a laser
- Start with a plane
  - Insert Plane (i)
  - **Loop Cuts**
  - **Mirror Modifier**



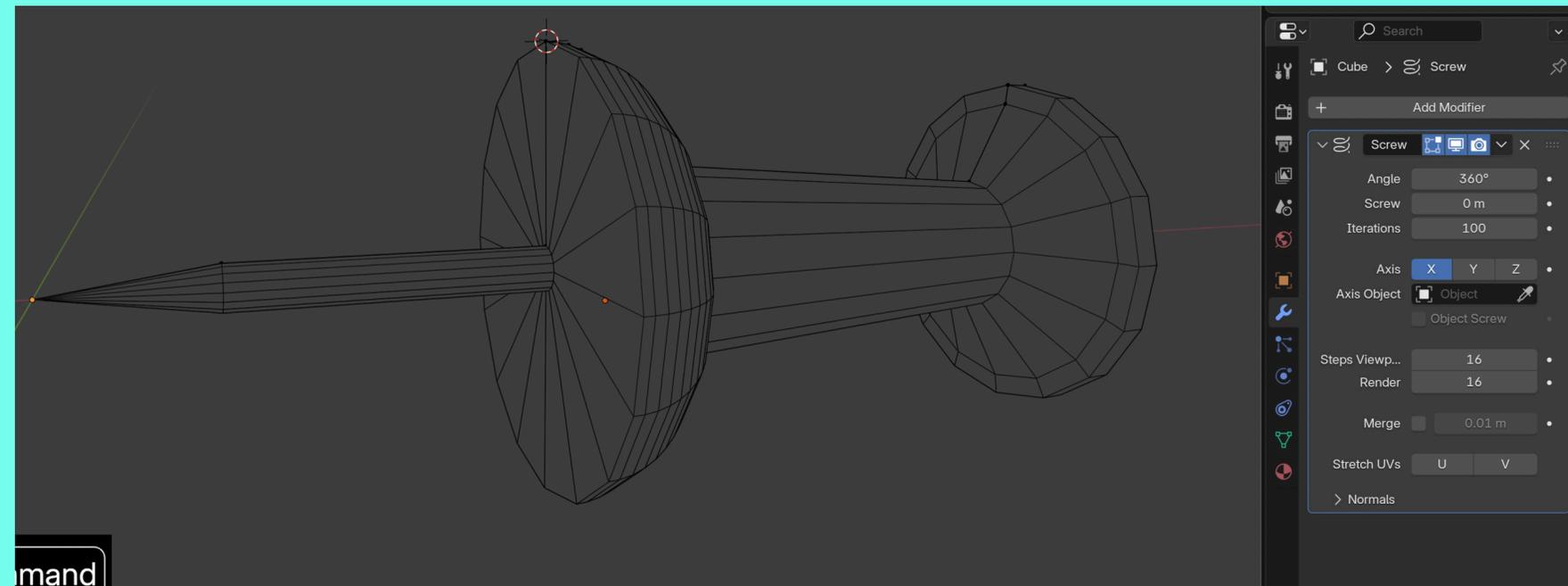
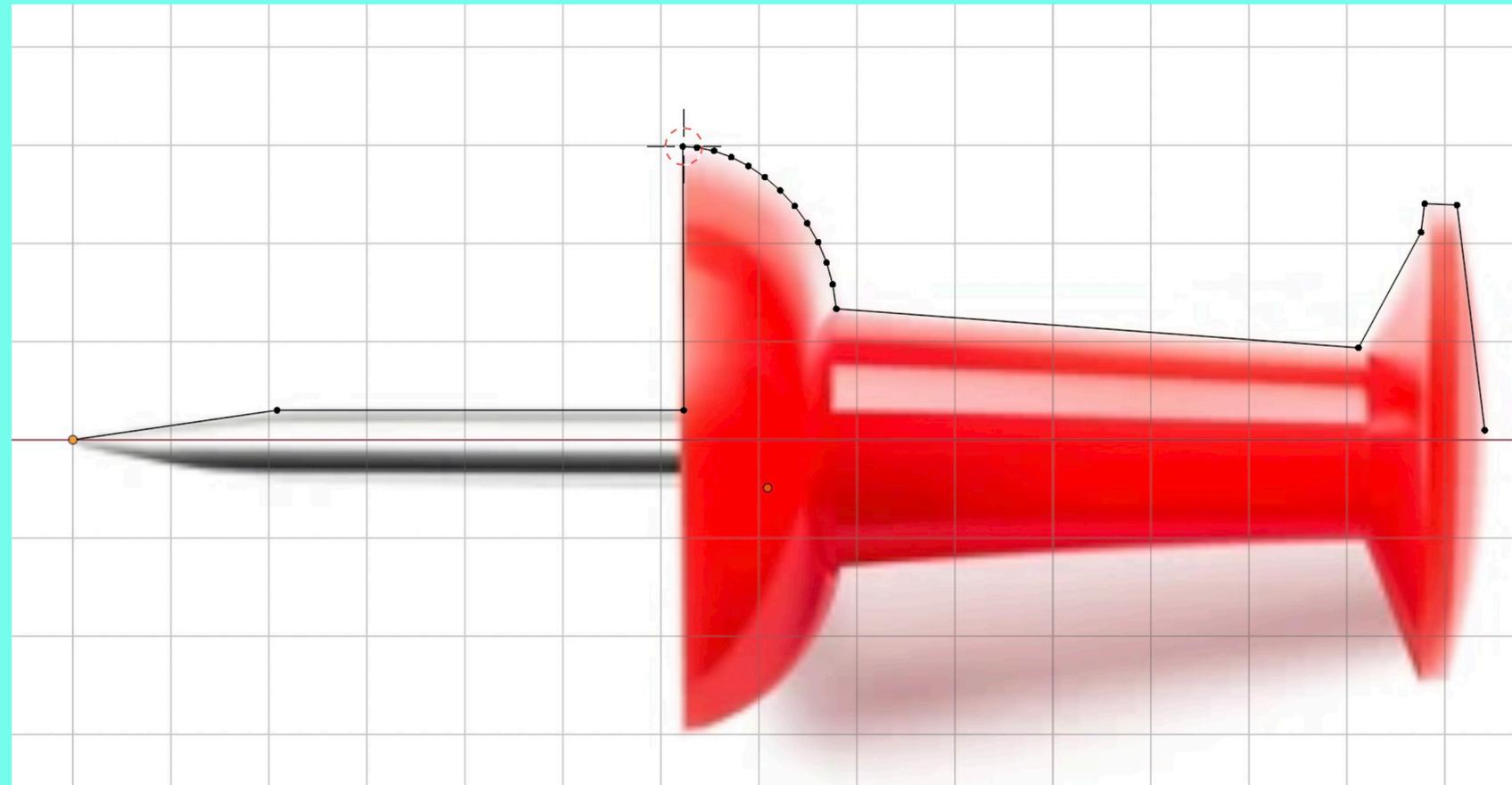
# Task 6

- Model a pin



# Task 6

- Model a pin



# Task 8 - Use assets

<https://scoollab.web.cern.ch/laserlab3D>

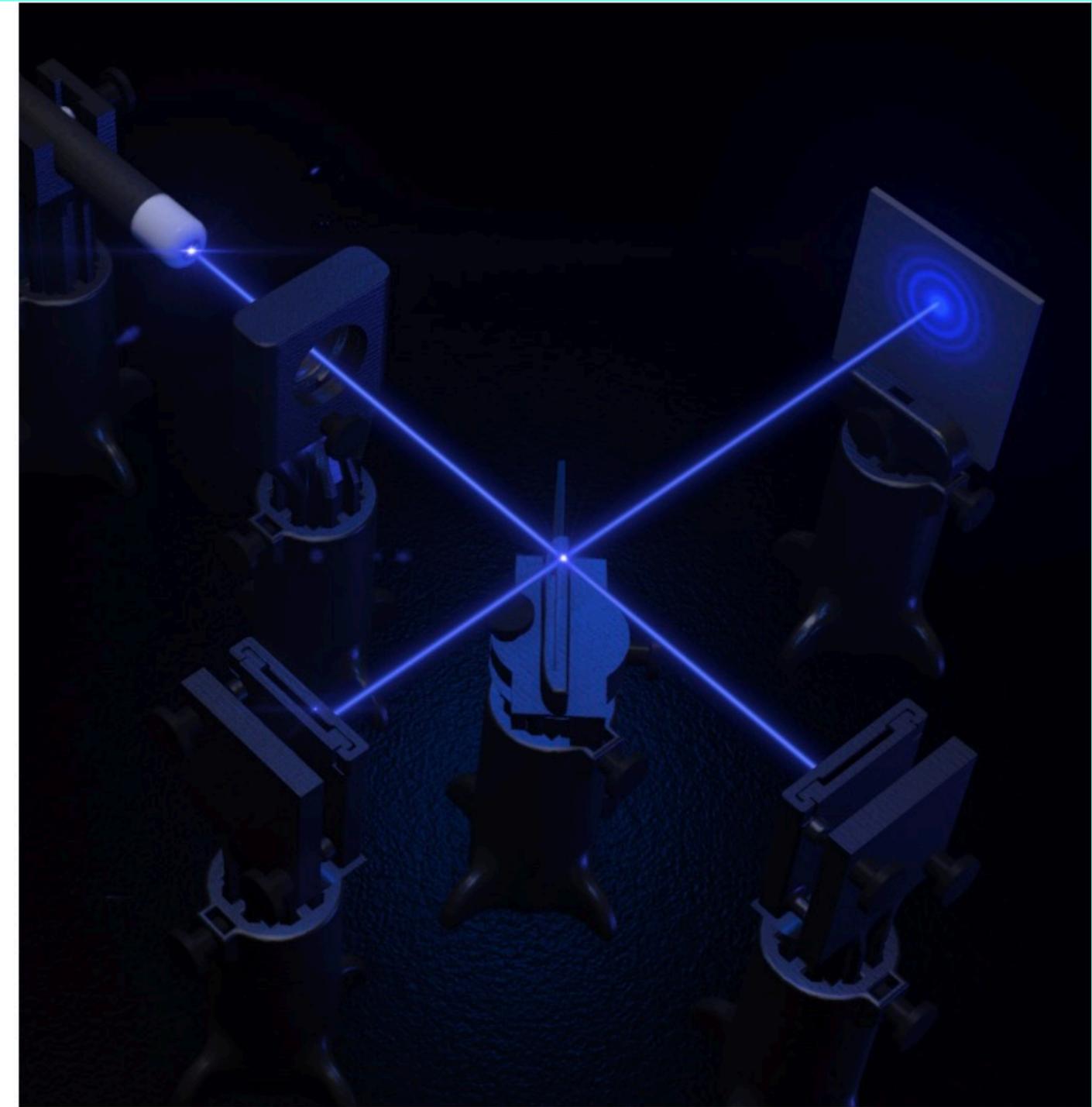
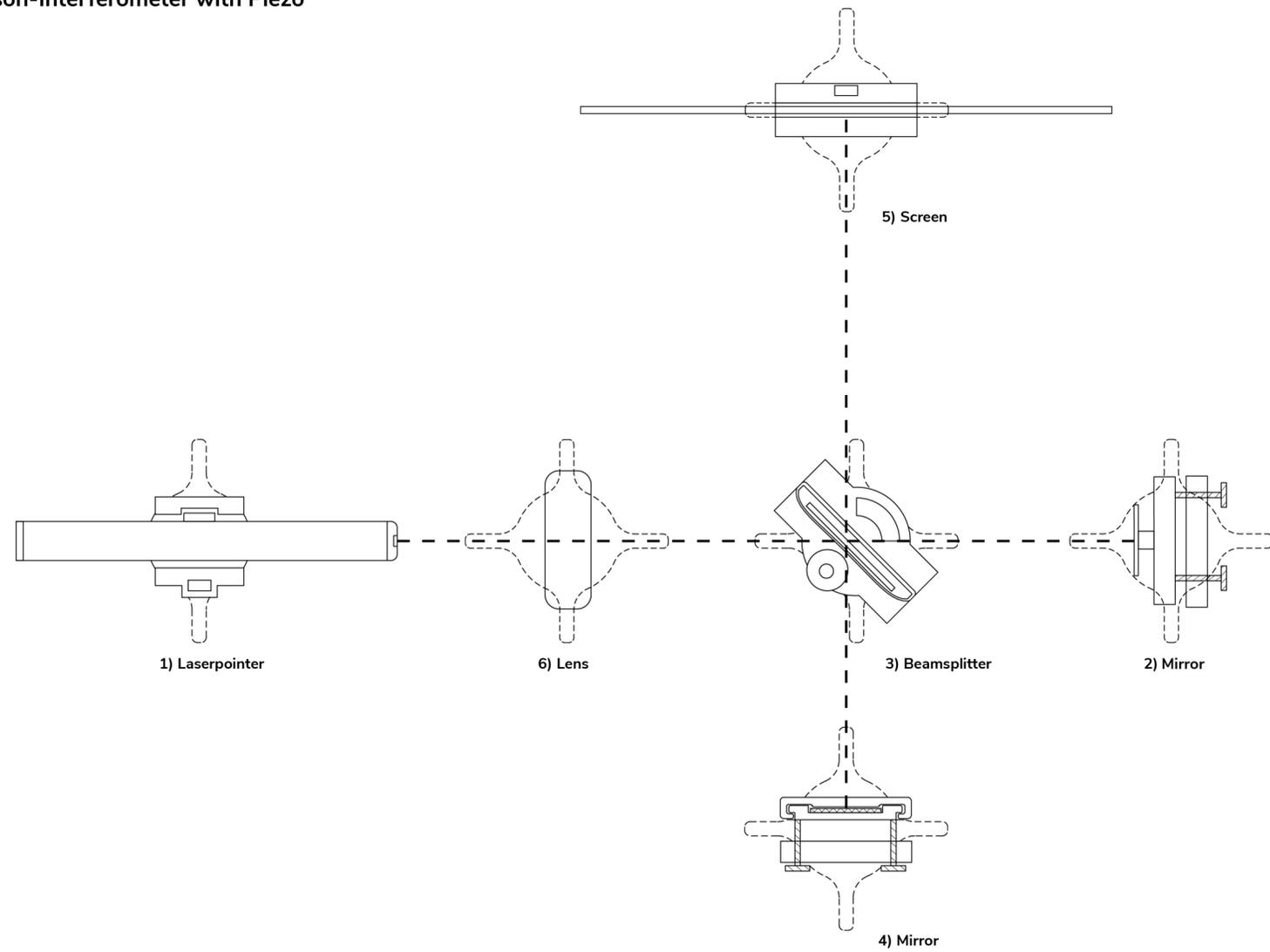


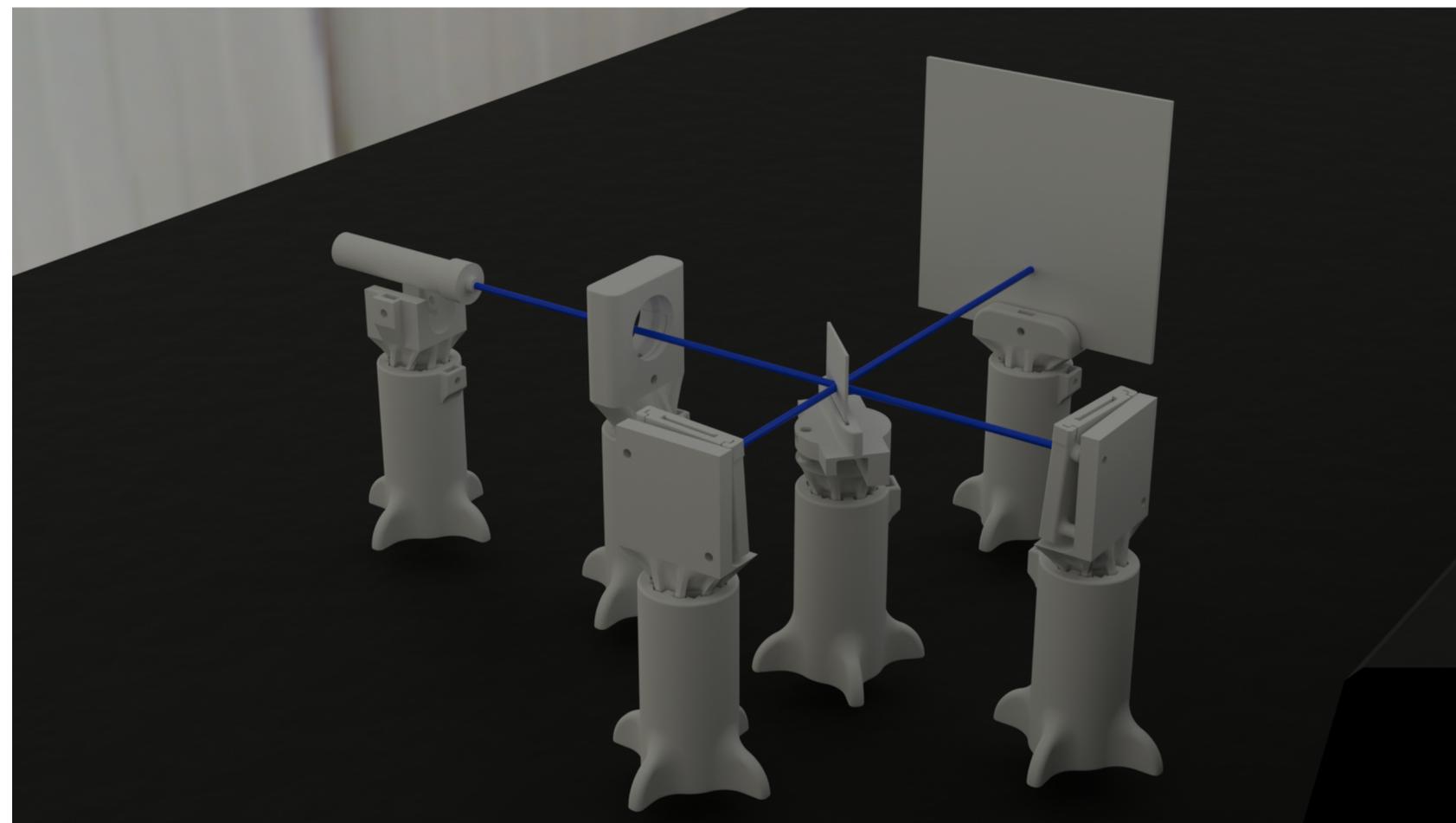
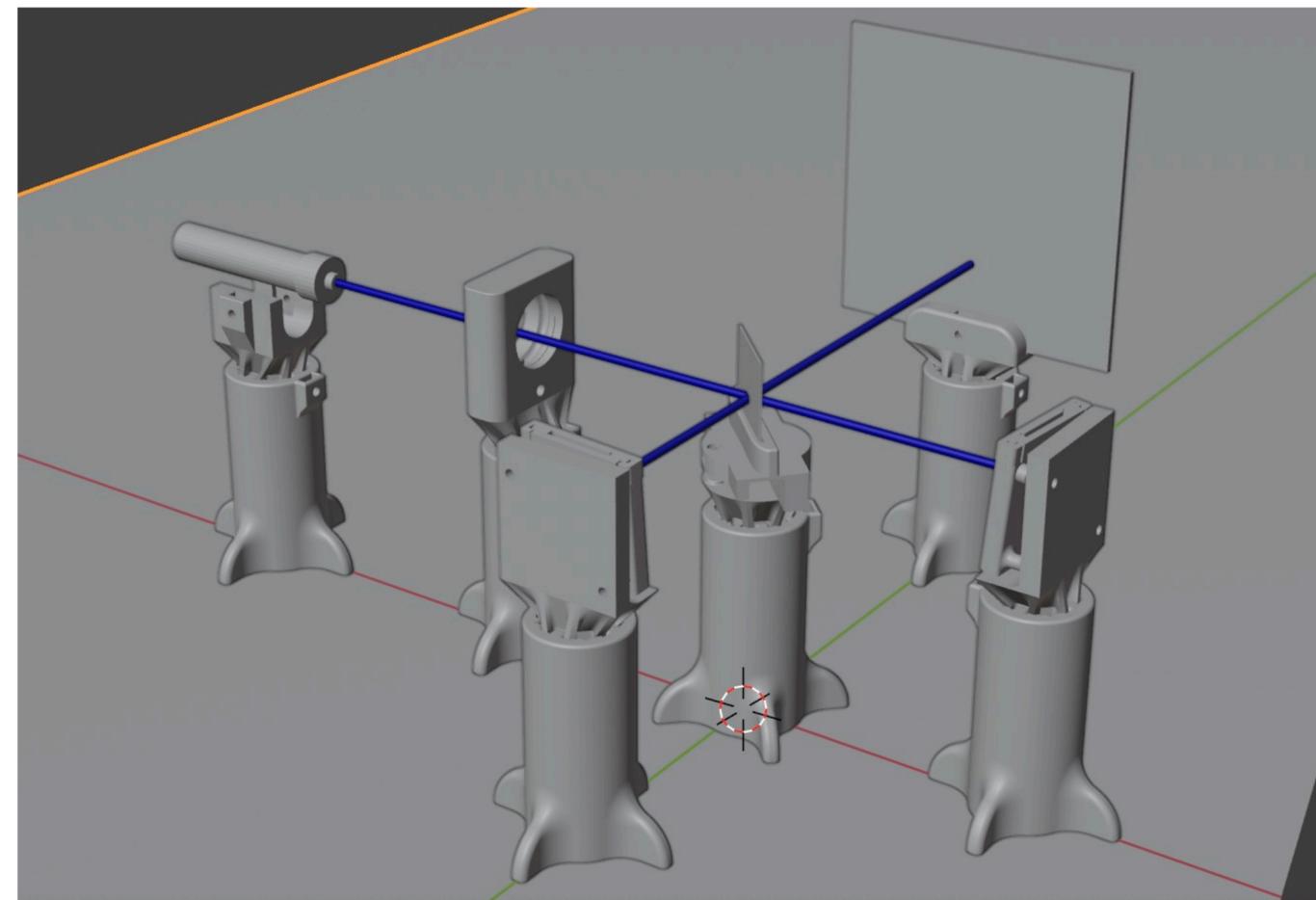
<https://www.cgfigures.ca/assetlibrary>



# Task 8 - Use assets

Michelson-Interferometer with Piezo





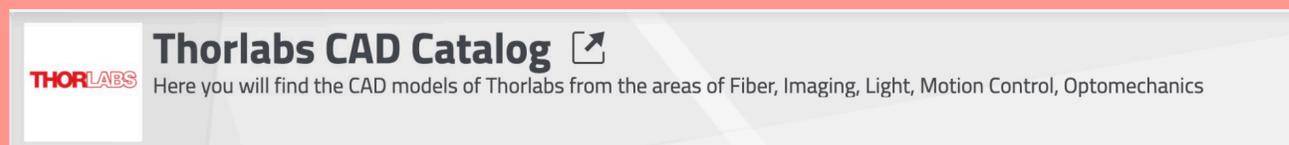
# KeyFrames



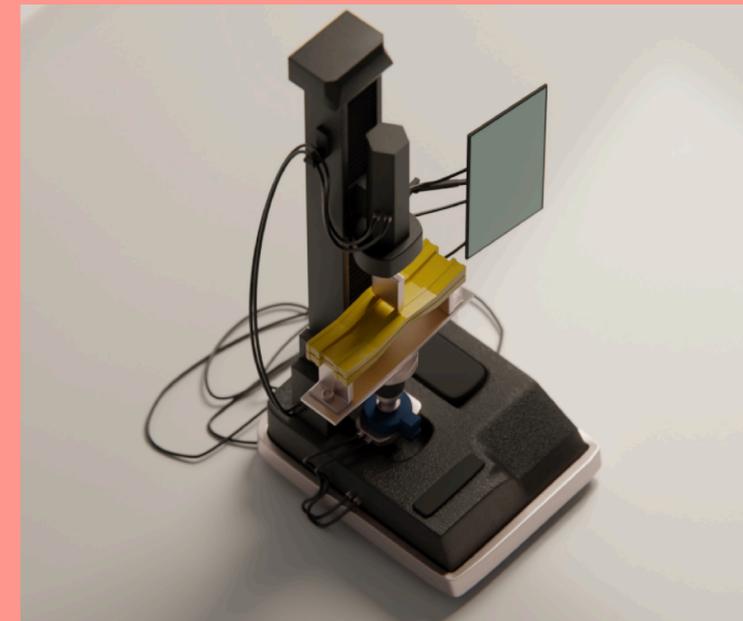
# Further assets resources



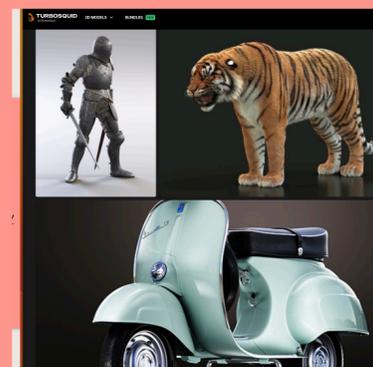
<https://polyhaven.com/>



<https://www.thorlabs.de/>



<https://www.blendswap.com/>  
(Sometimes low quality)



<https://www.turbosquid.com/>  
Always very high quality (\$\$\$)

# Further resources



<https://www.youtube.com/watch?v=QeAQx-MgQtQ>



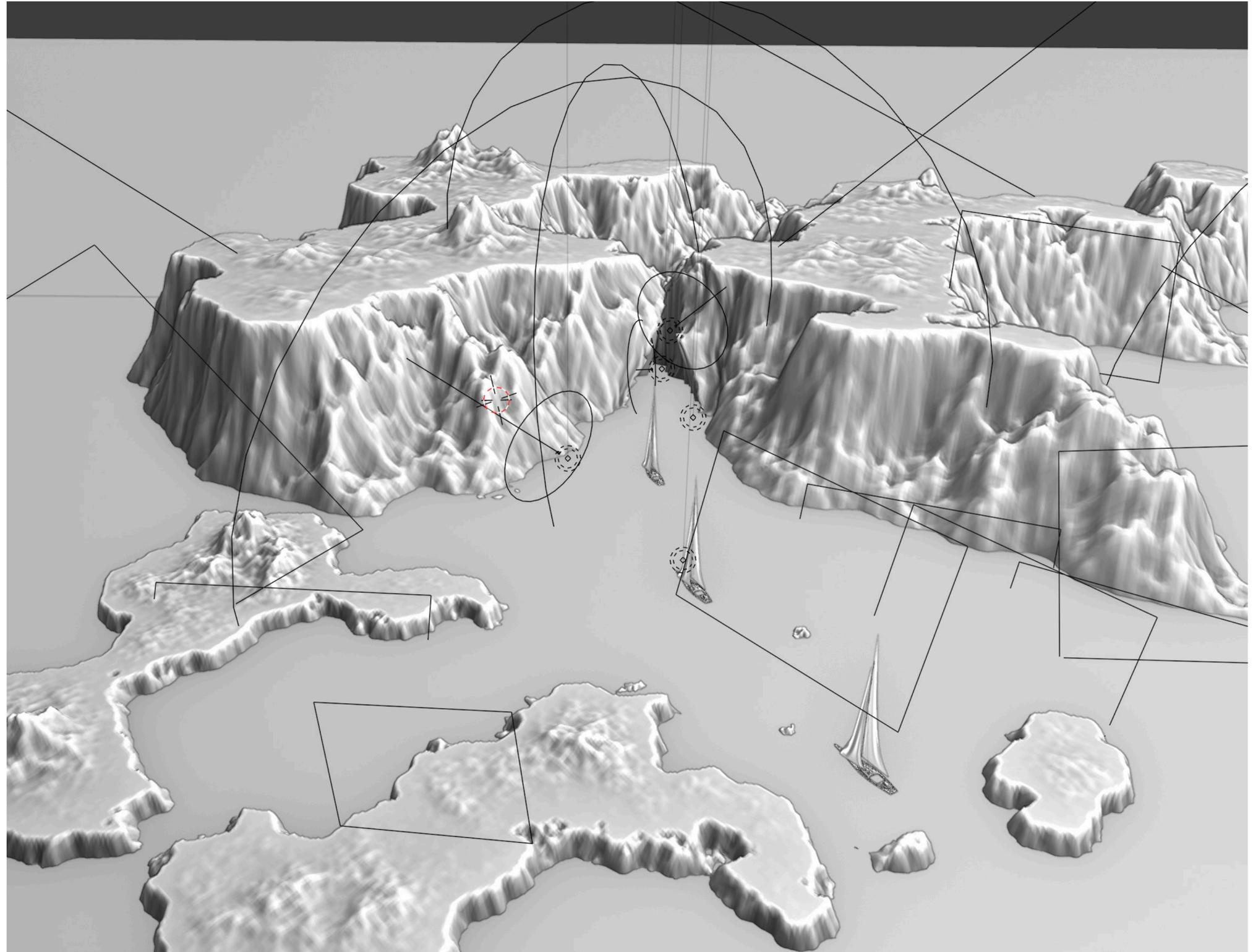
<https://cgcookie.com/lessons/modeling-a-sci-fi-crate-c7f9187f3995deb8>

# Materials & Light

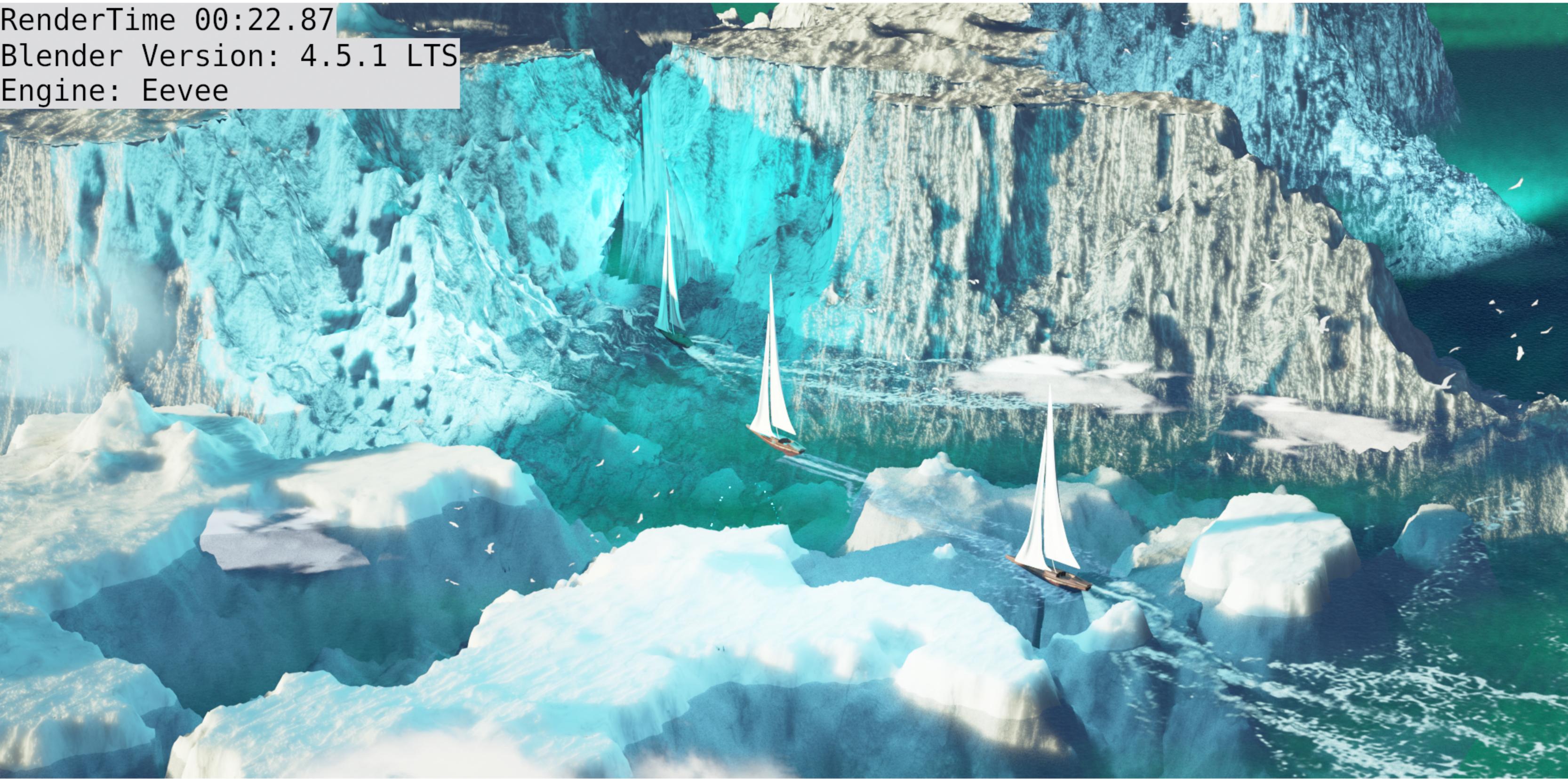
Jan-Hendrik Müller  
Blender 4.5.1

August 2025

# Motivation



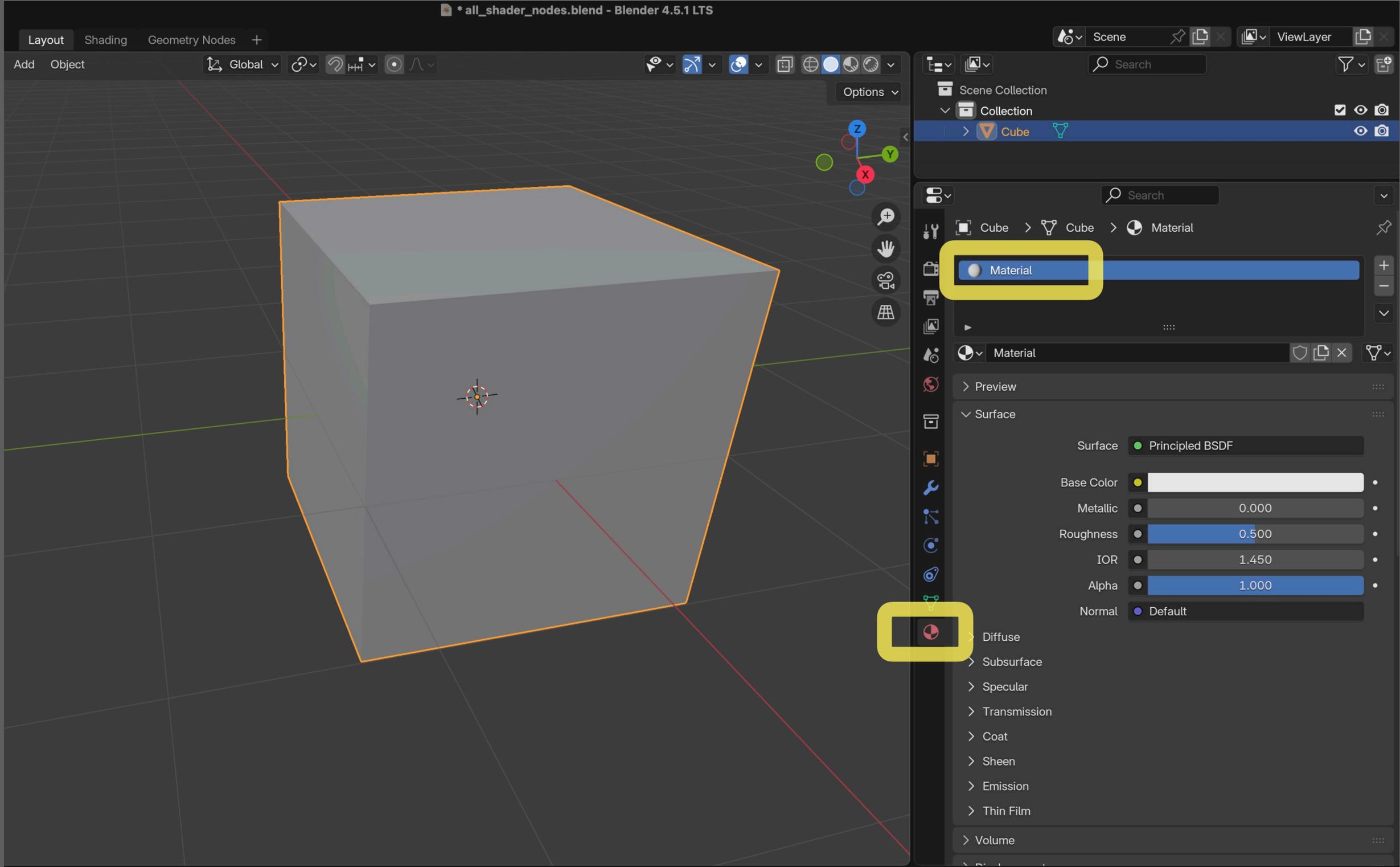
RenderTime 00:22.87  
Blender Version: 4.5.1 LTS  
Engine: Eevee



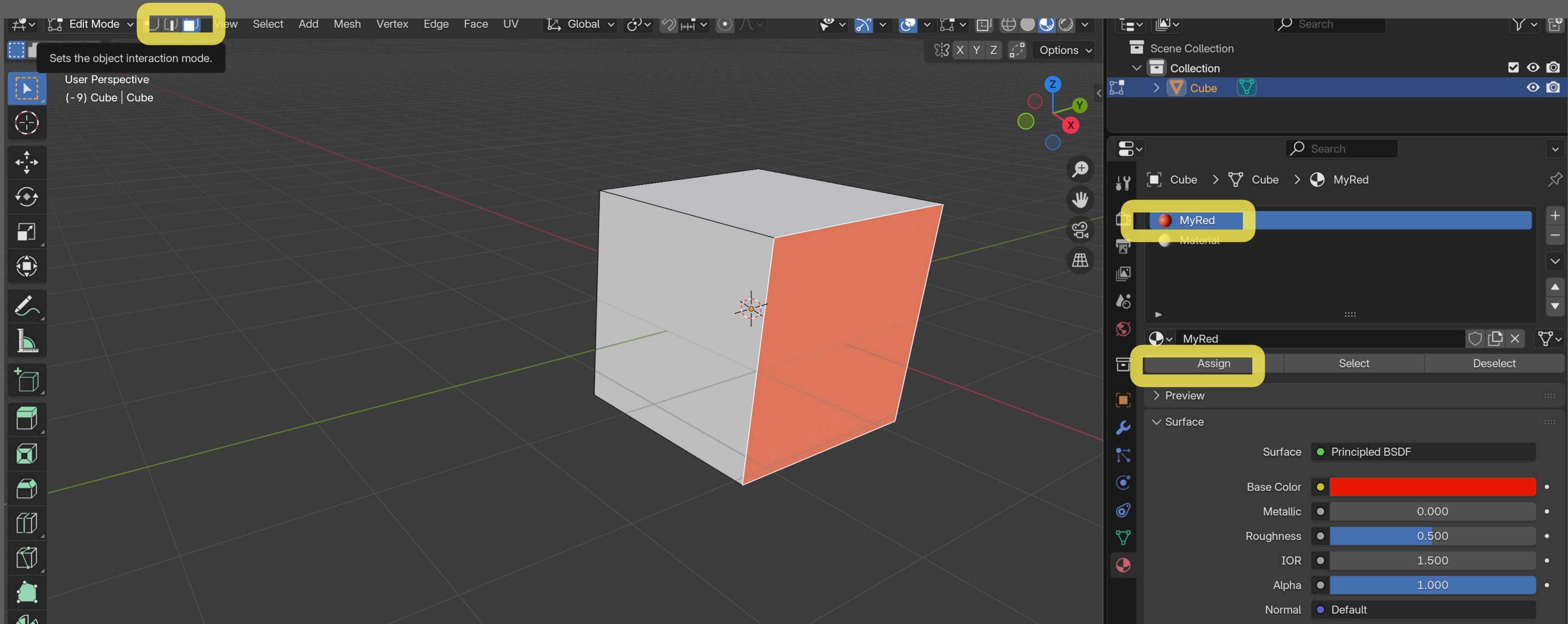
RenderTime 08:35.67  
Blender Version: 4.5.1 LTS  
Engine: Cycles



# Material

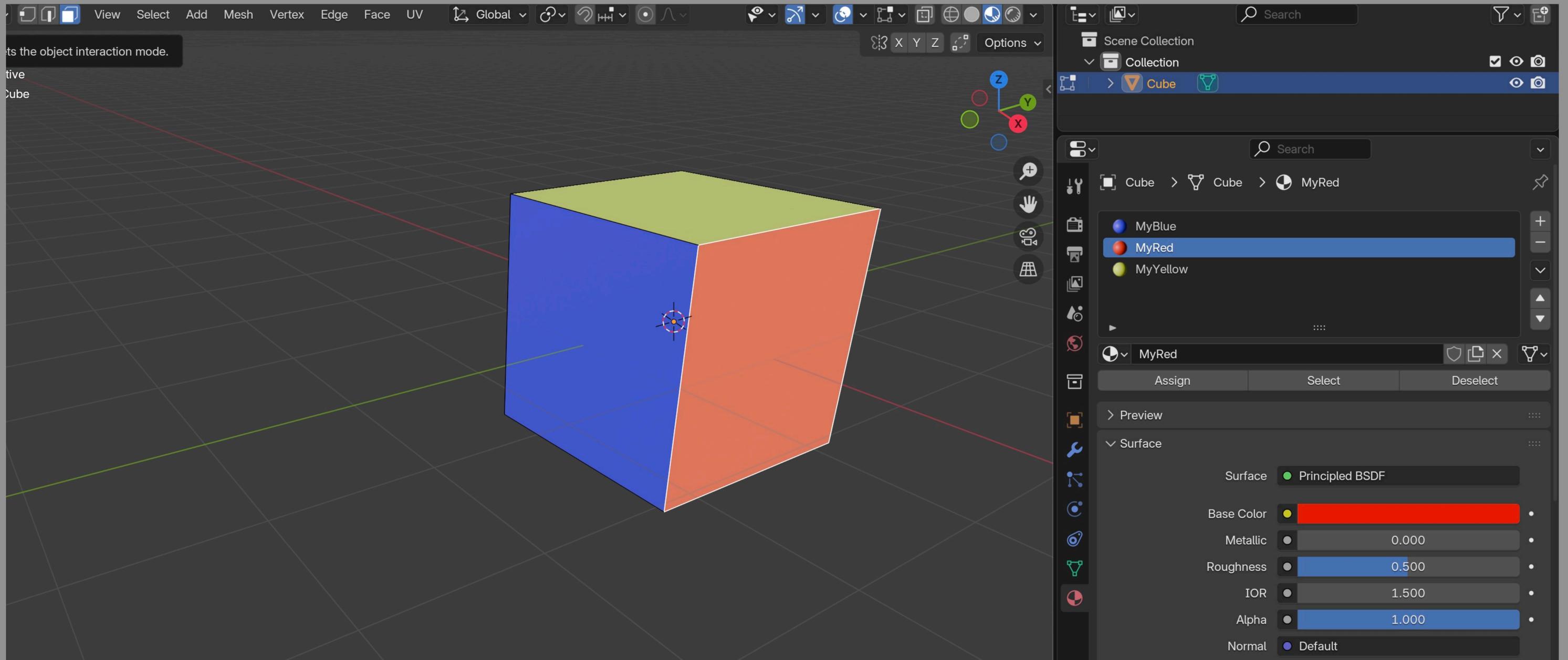


# Material - Assign to Face



# Material - Assign to Face

**Task :** Create a cube with 3 materials



# Material Nodes Location (Shading)

The image displays the Blender 4.5.1 LTS interface in Object Mode. The top menu bar includes File, Edit, Render, Window, Help, Layout, and Shading (highlighted with a yellow box). The main viewport shows a blue cube with a wireframe overlay and a black triangle. The right sidebar contains the Outliner and Properties panels. The Properties panel is set to 'Material' and shows the 'Principled BSDF' node with the following settings:

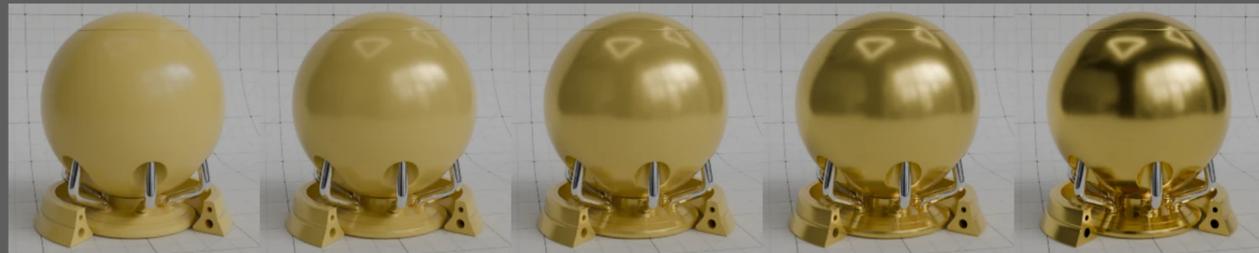
Property	Value
Base Color	[Blue]
Metallic	0.000
Roughness	0.500
IOR	1.450
Alpha	1.000

The 'Material Output' panel is also visible, showing the 'Surface' output selected. The bottom status bar indicates 'Slot 1' and 'Material'.

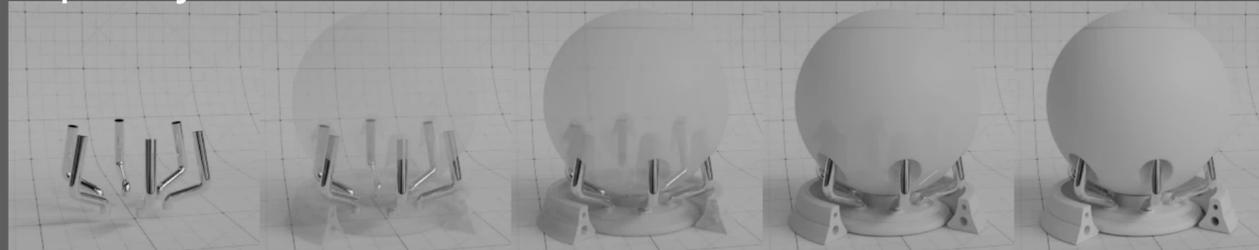
# PrincipledBSDF

- A BSDF (*Bidirectional Scattering Distribution Function*) describes how light is reflected, refracted, or scattered when it hits a surface.

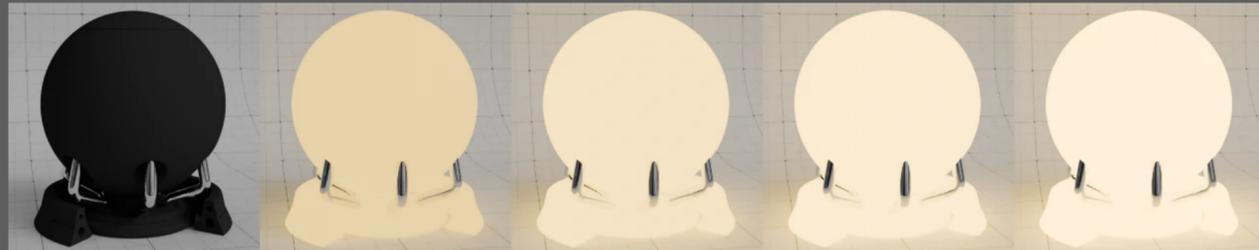
Metallic from 0.0 to 1.0



Opacity from 0.0 to 1.0



Emission from 0.1 to 1.0



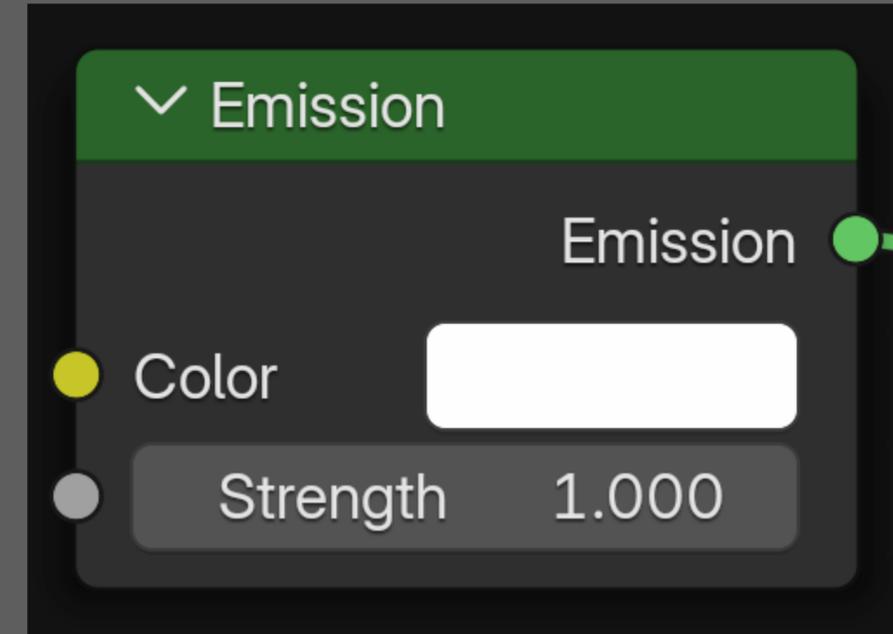
Principled BSDF

BSDF

- Base Color
- Metallic 0.000
- Roughness 0.500
- IOR 1.500
- Alpha 1.000
- Normal
  - > Diffuse
  - > Subsurface
  - > Specular
  - > Transmission
  - > Coat
  - > Sheen
  - > Emission
  - > Thin Film

# Emission

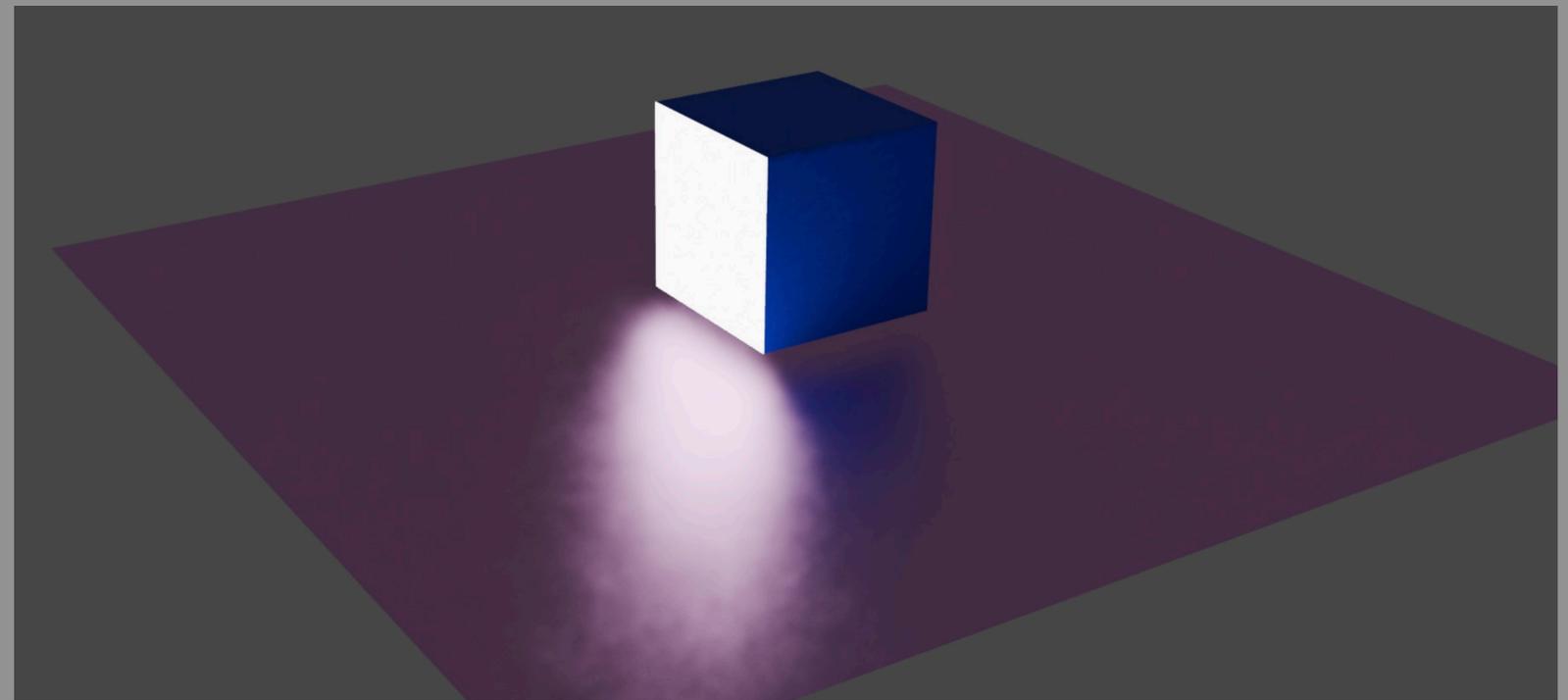
- Make object “shadeless” (strength = 1)
- Emits light and can be used as illumination
- Not affected by other lights



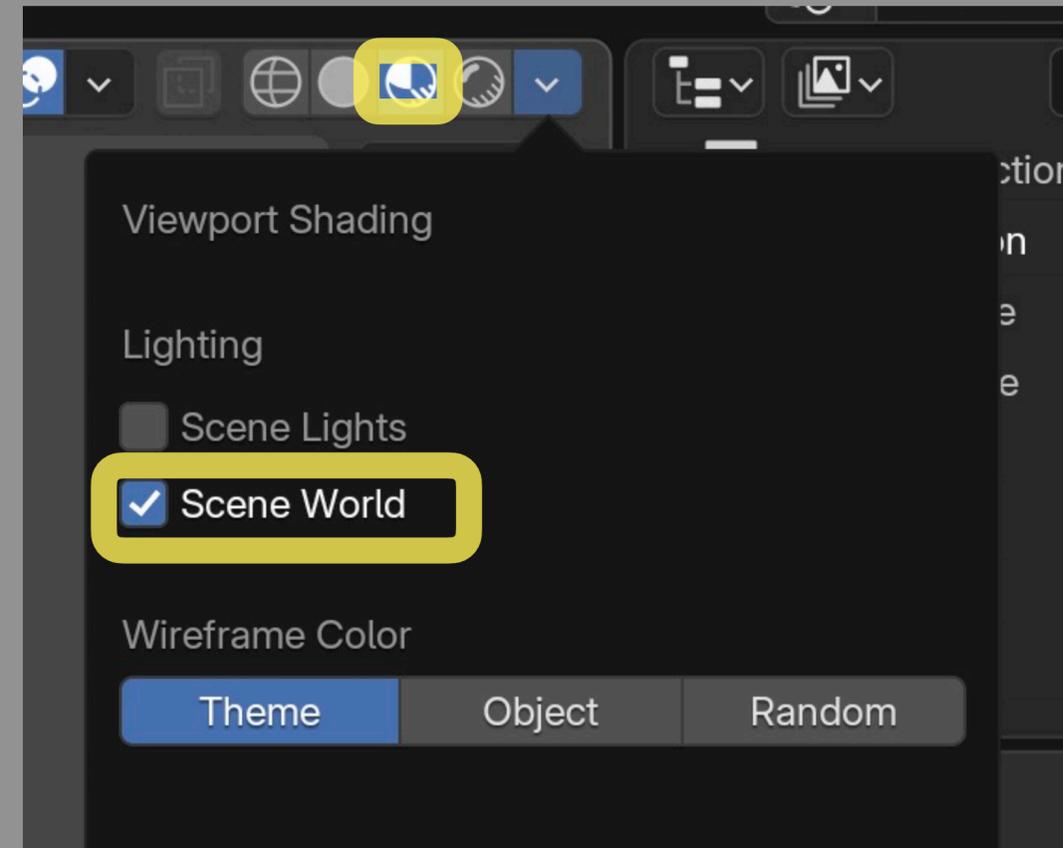
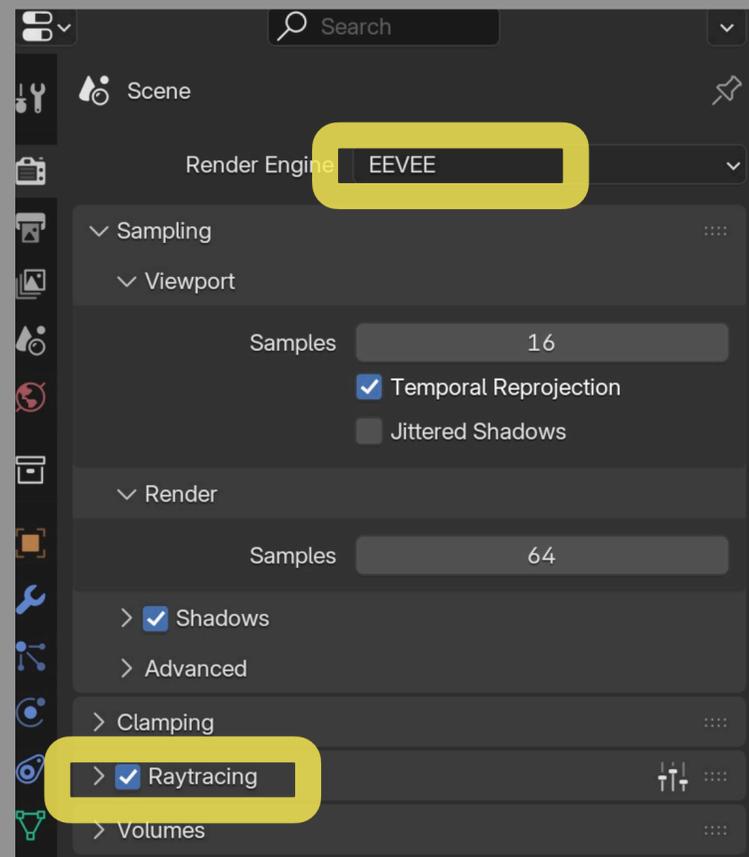
# Material Scene

## Task

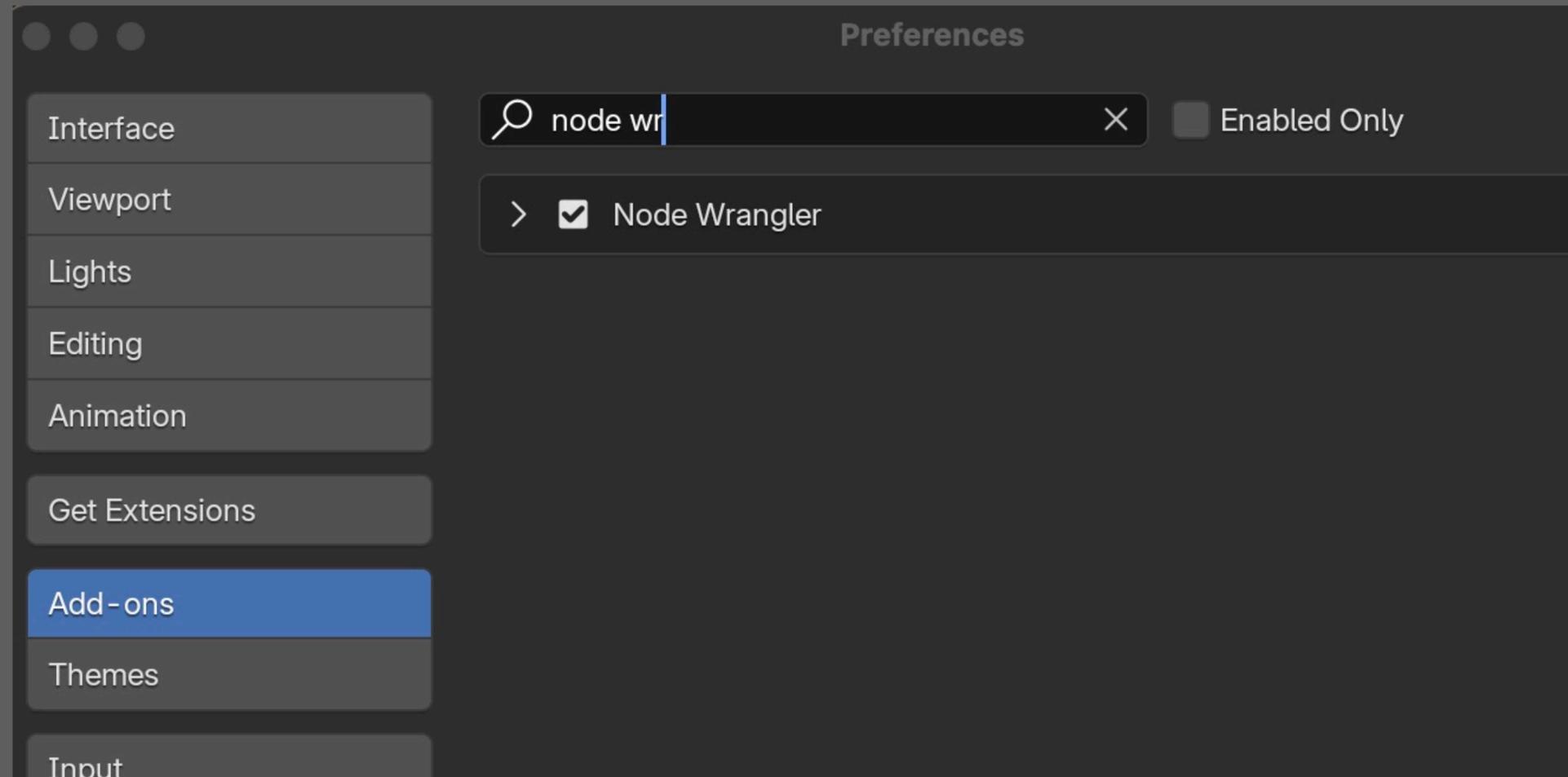
- Reflective surface
- Cube that emits light from one side



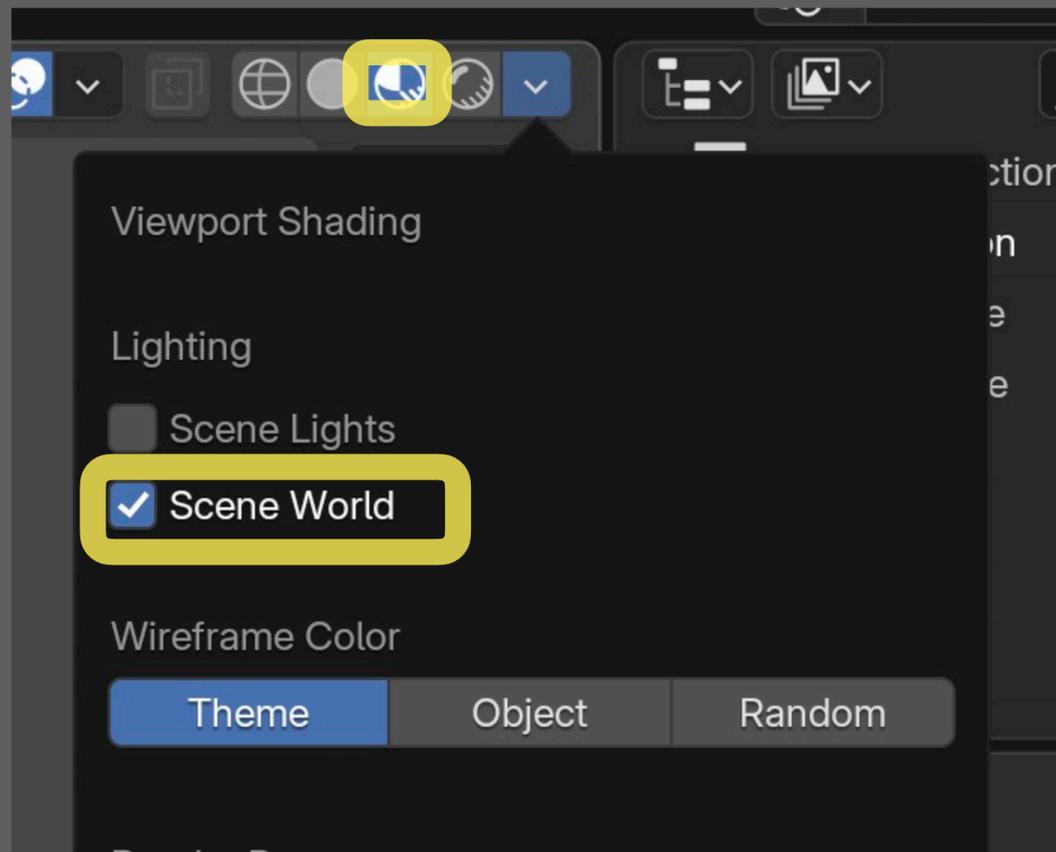
## Settings



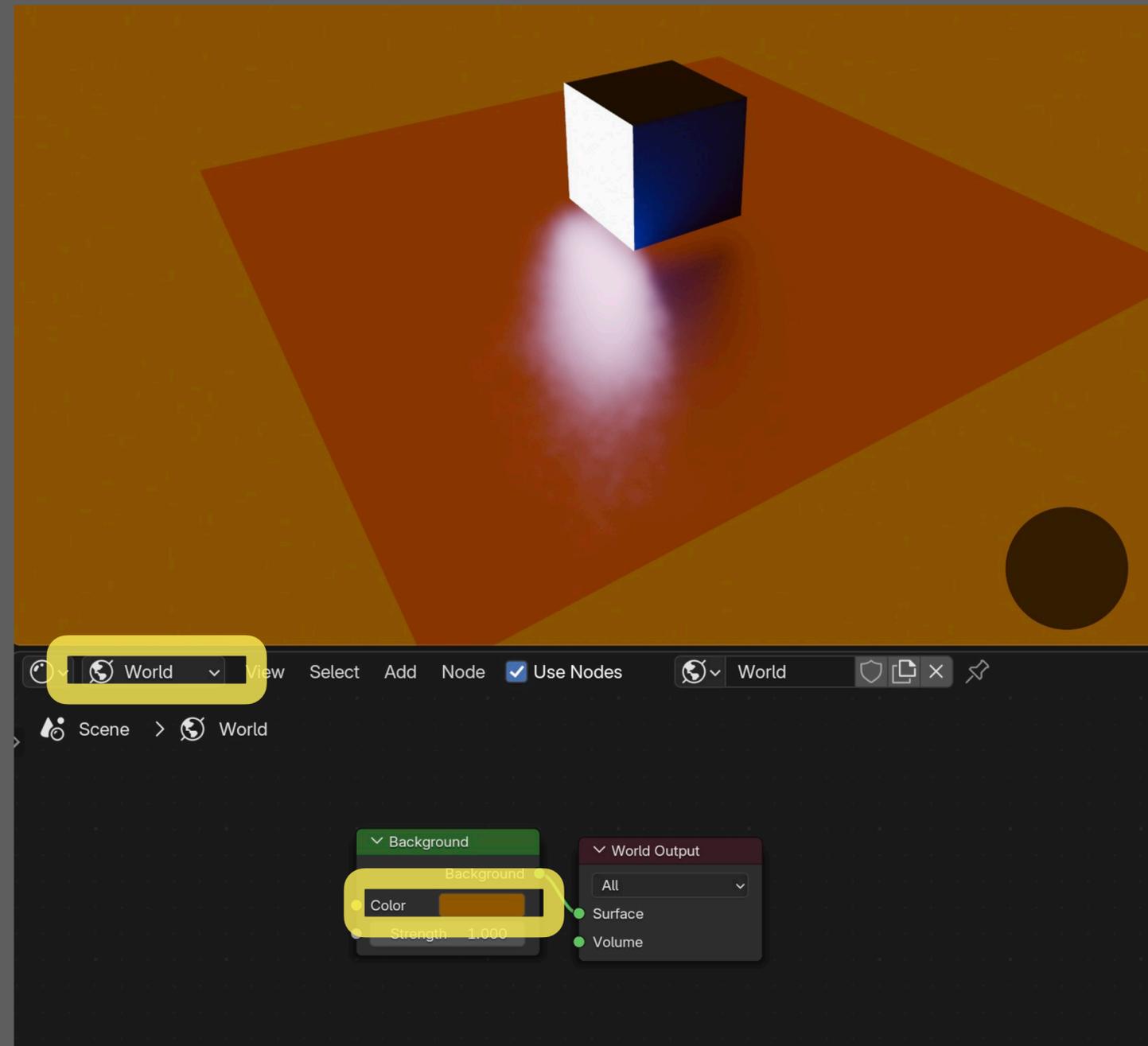
# Node Wrangler Extension



# Scene World lighting



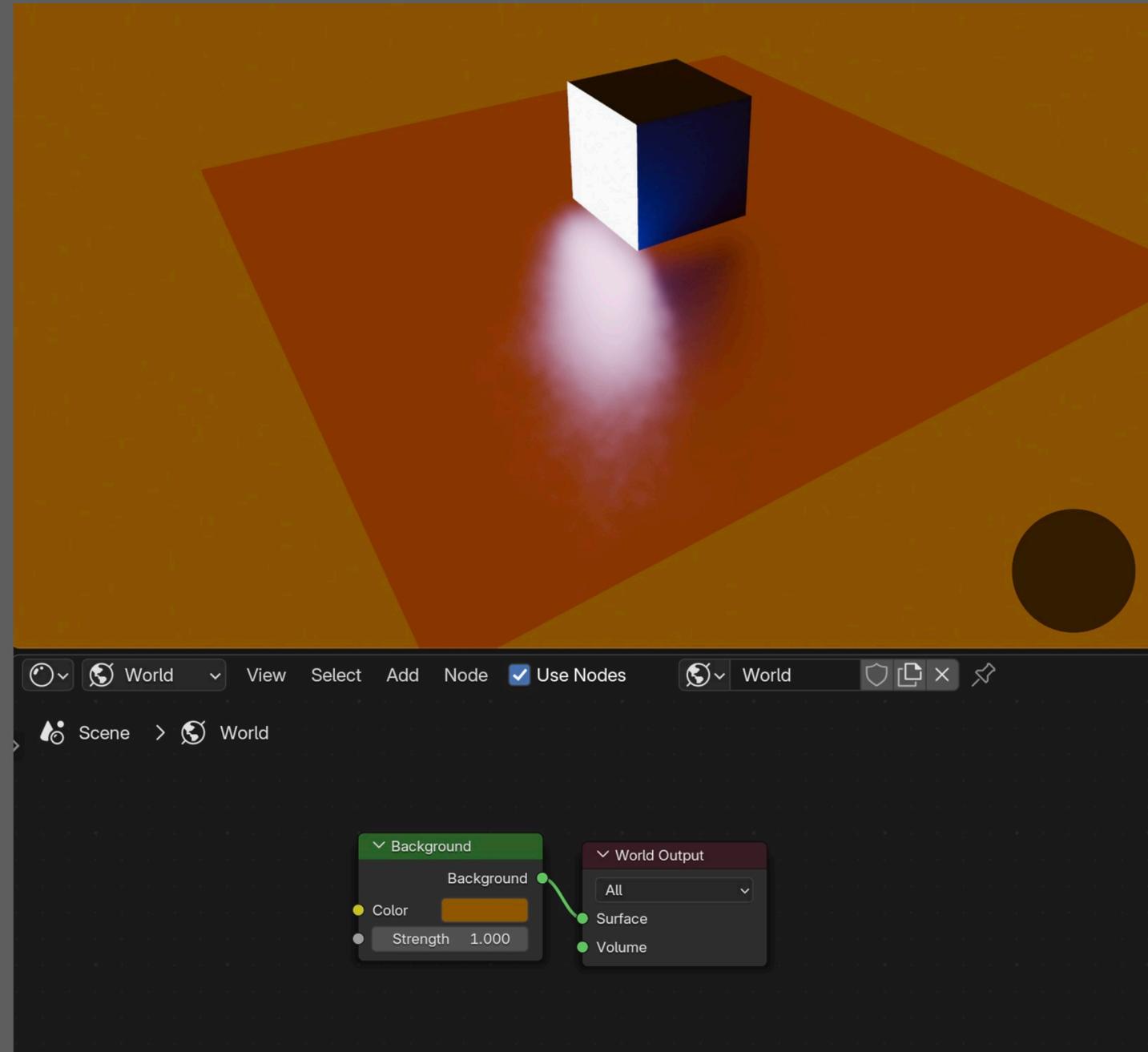
Task:  
Create this scene



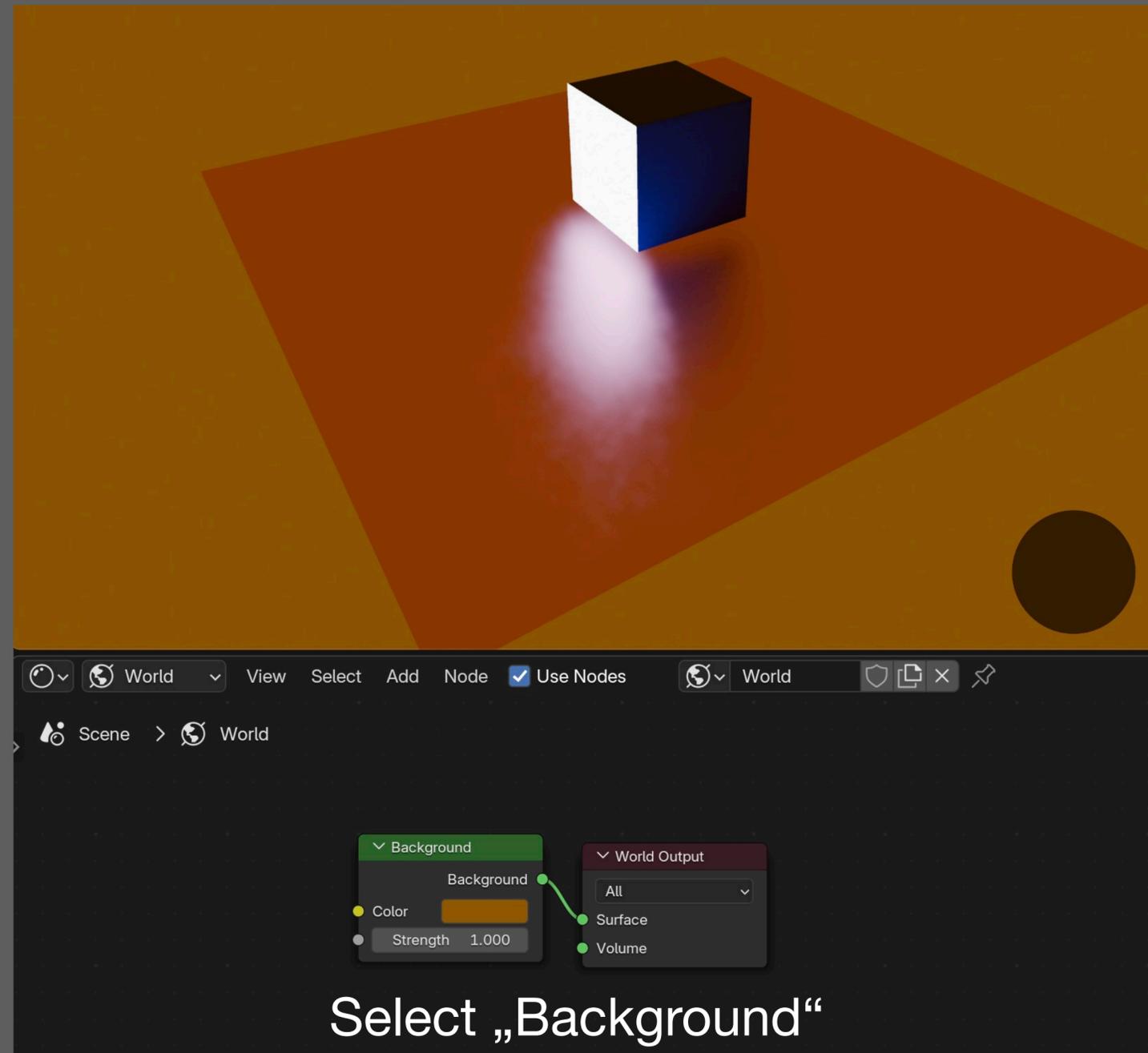
# Use Environment Texture

## Task:

Create this scene



# Use Environment Texture



Select „Background“

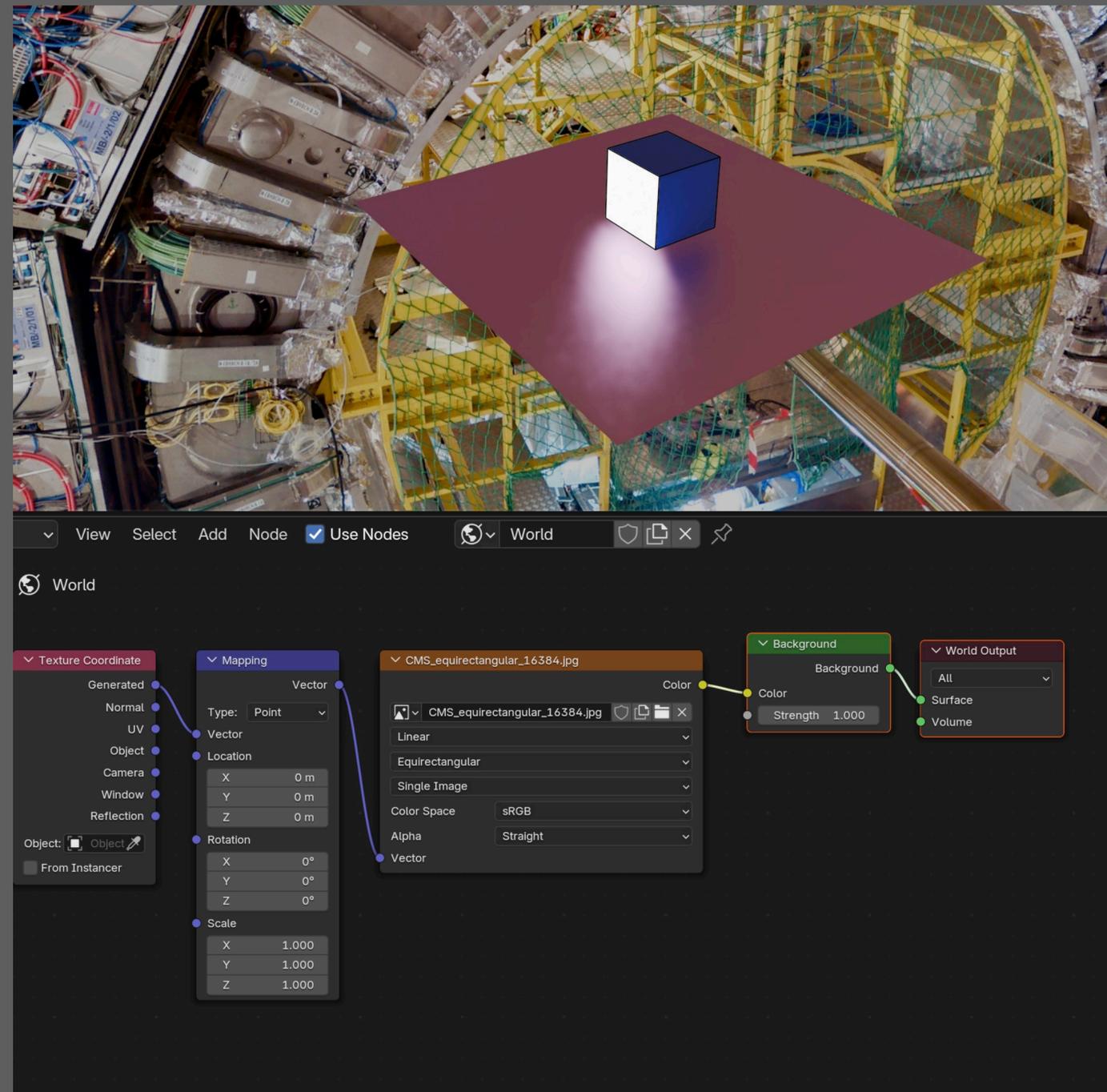
Press „Command +T“

Open HDRI

# Use Environment Texture

**Task:**

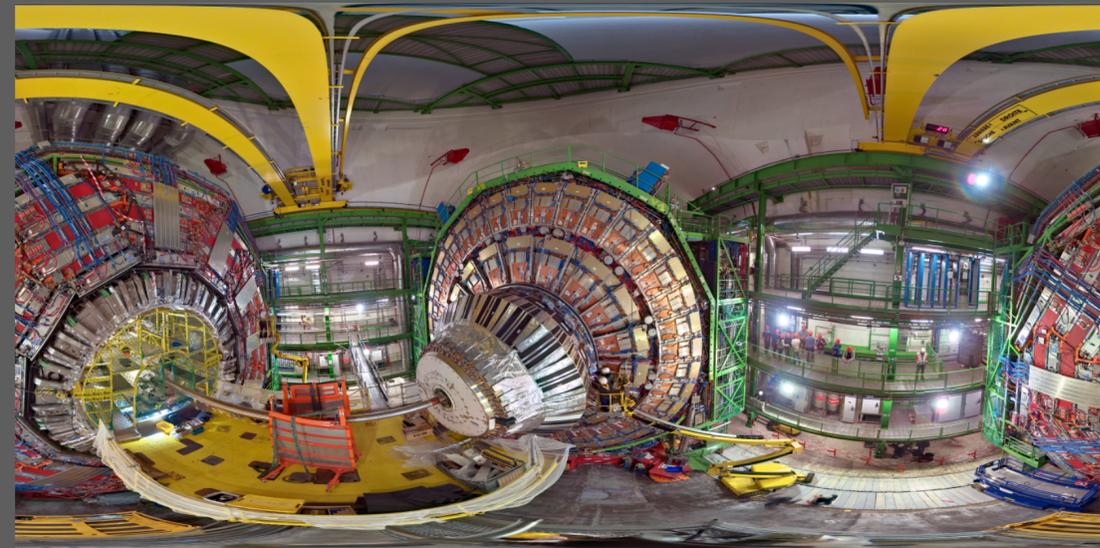
Create this Scene



# HDRI - Resources



<https://cds.cern.ch/record/2252595>



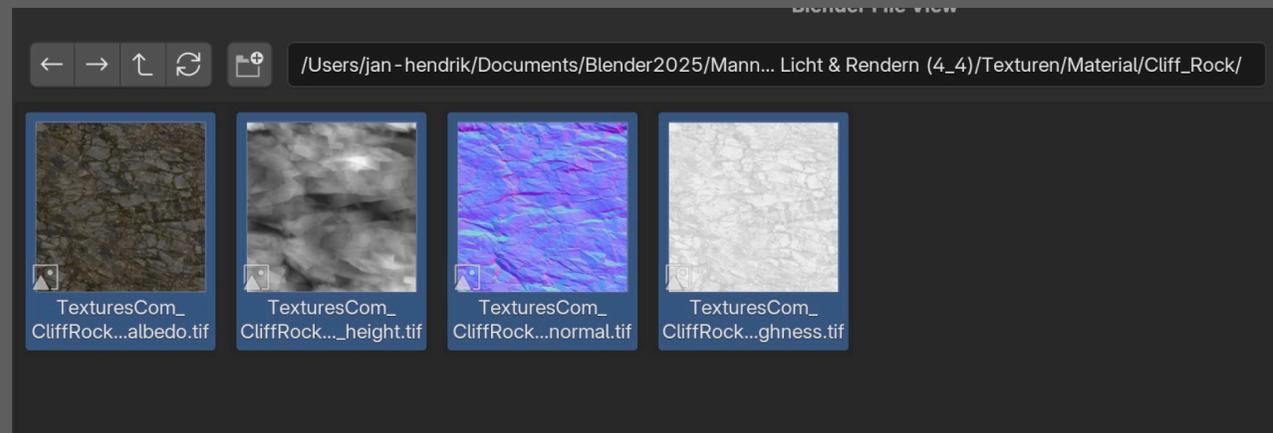
[https://polyhaven.com/a/qwantani\\_moonrise\\_puresky](https://polyhaven.com/a/qwantani_moonrise_puresky)

# Setting Up Materials

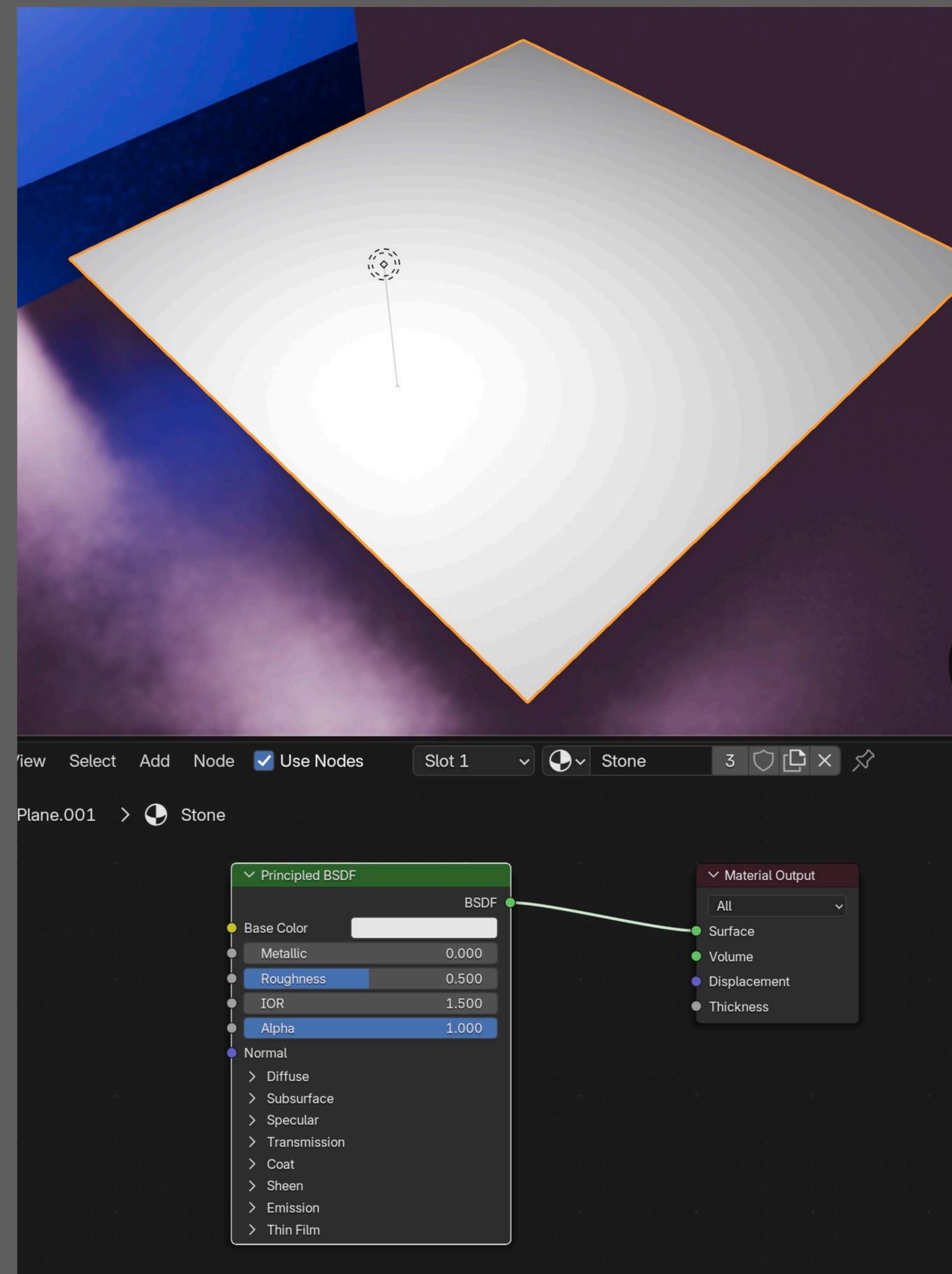
## Task

Select Principled BSDF

Press „Command+Shift+T“



Open Cliff Rock Texture

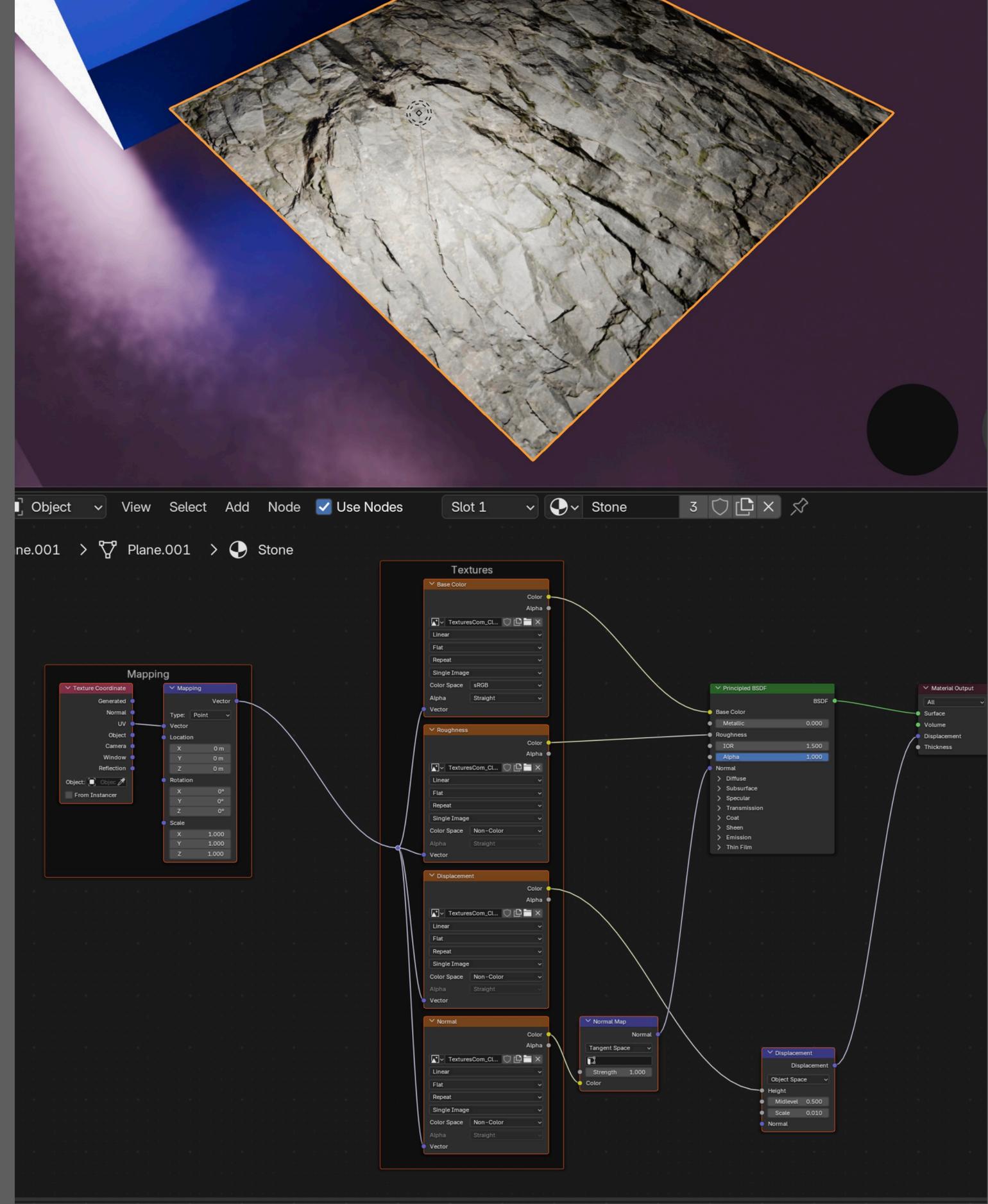


# Setting Up Materials

## Task

Next:

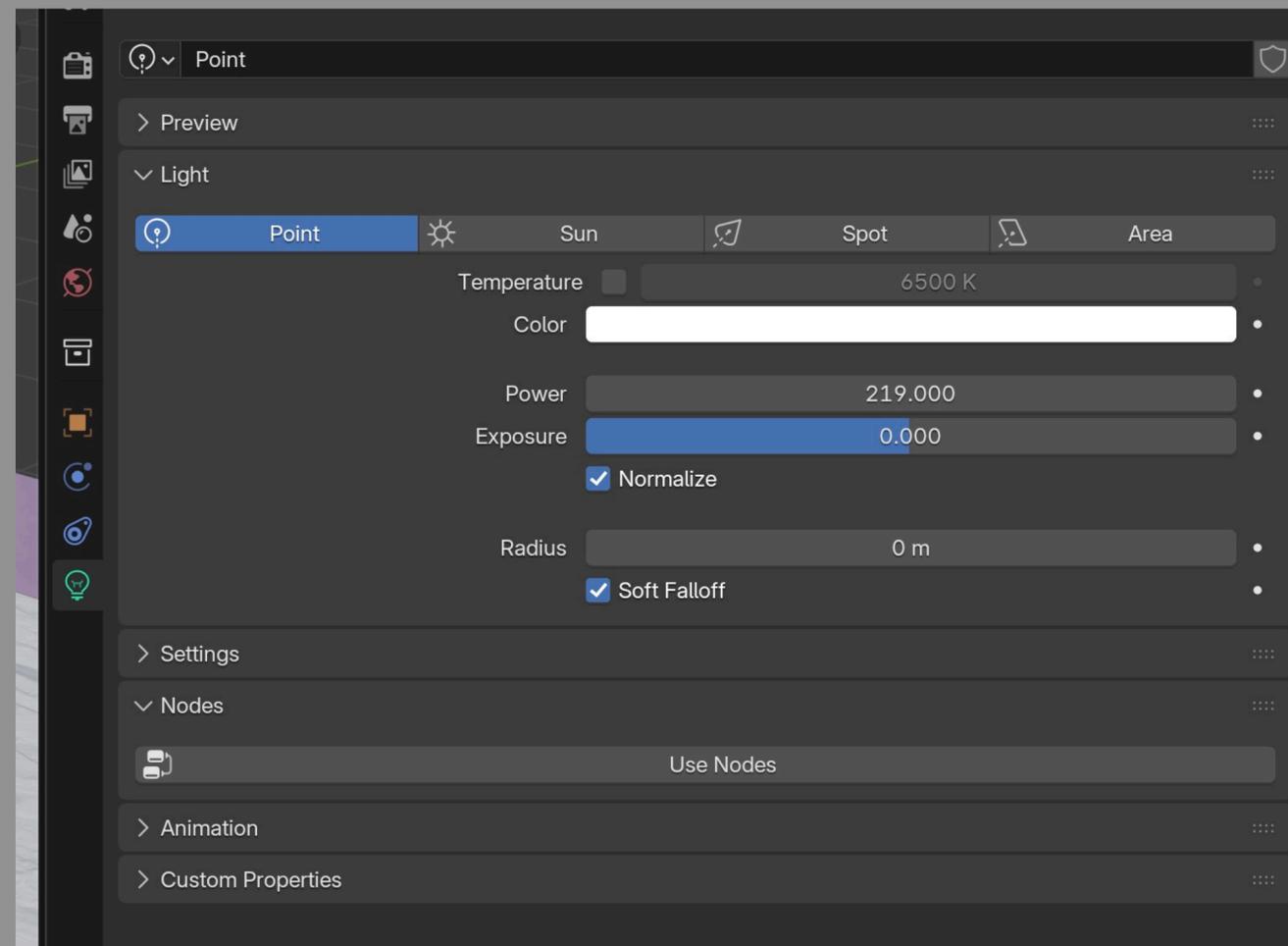
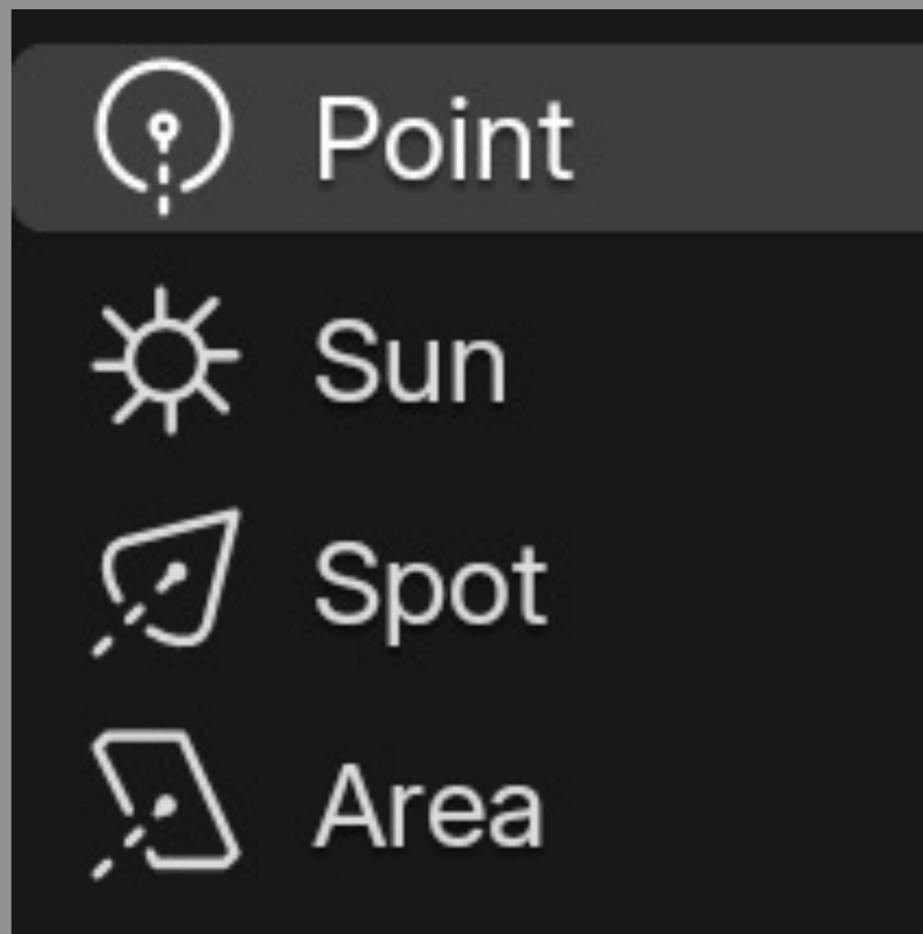
- Add a „Point Light“ to the scene, move it around
- Mute the Nodes one by one (M) and see what happens
- Move sliders in the „Mapping“ panel.



# More Light Sources

## Task

Use these light sources in your scene  
Change properties in this side panel



# More on Nodes

Yellow: Color input

Grey: Numerical Value

Blue: Vector

Principled BSDF

Base Color

Metallic 1.000

Roughness 0.458

IOR 1.500

Alpha 1.000

Normal

- > Diffuse
- > Subsurface
- > Specular
- > Transmission
- > Coat
- > Sheen
- > Emission
- > Thin Film

BSDF

Green: Shader

# Textures



Material node configuration for a Voronoi texture:

- Value:** 165.800
- Multiply:** Value: 0.010
- Voronoi Texture:**
  - Distance:
  - Color:
  - Position:
  - W:
  - 4D:
  - F1:
  - Euclidean:
  - Normalize:
  - Vector:
  - W:
  - Scale: 5.000
  - Detail: 0.000
  - Roughn...: 0.190
  - Lacuna...: 10.000
  - Random...: 1.000
- Principled BSDF:**
  - Base Color:
  - Metallic: 0.000
  - Roughness: 0.500
  - IOR: 1.500
  - Alpha: 1.000
  - Normal:
  - Diffuse:
  - Subsurface:
  - Specular:
  - Transmission:
  - Coat:
  - Sheen:
  - Emission:
  - Thin Film:
- Material Output:** All (dropdown), Surface (selected), Volume, Displacement, Thickness

# Viewport color settings



Render Engine: **EEVEE**

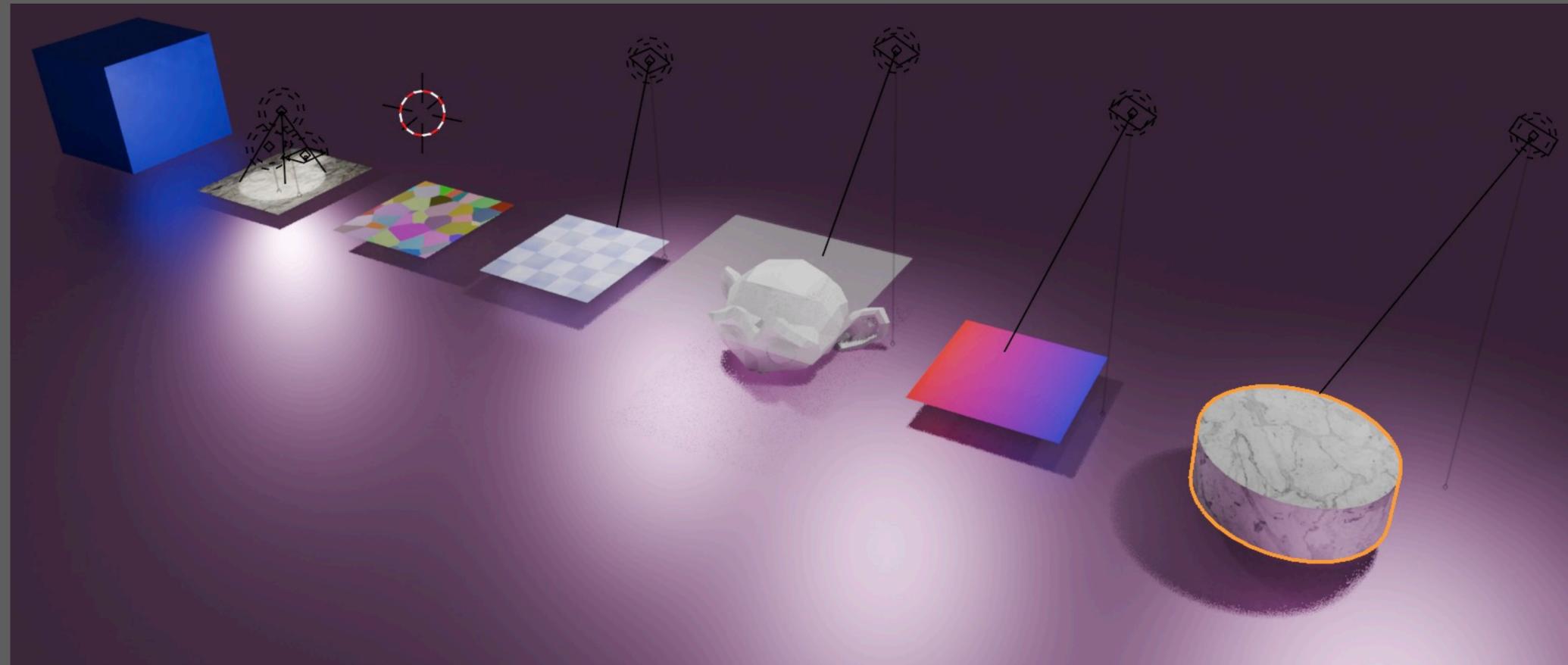
- > Sampling
- > Clamping
- >  Raytracing
- > Volumes
- > Curves
- >  Simplify
- > Depth of Field
- >  Motion Blur
- > Film
- > Performance
- > Grease Pencil
- >  Freestyle
- Color Management
  - Display Device: sRGB
  - View Transform: **AgX**
  - Look: None
  - Exposure: 0.000
  - Gamma: 1.000
  - Sequencer: sRGB
- > Display
- >  Curves
- >  White Balance

Render Engine: **EEVEE**

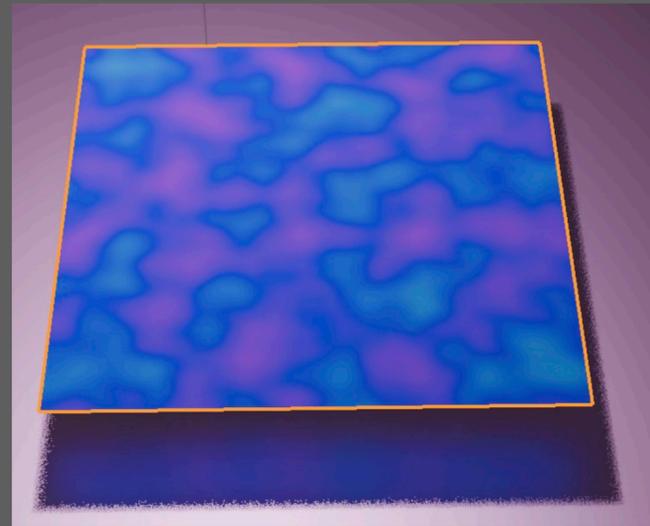
- > Sampling
- > Clamping
- >  Raytracing
- > Volumes
- > Curves
- >  Simplify
- > Depth of Field
- >  Motion Blur
- > Film
- > Performance
- > Grease Pencil
- >  Freestyle
- Color Management
  - Display Device: sRGB
  - View Transform: **Standard**
  - Look: None
  - Exposure: 0.000
  - Gamma: 1.000
  - Sequencer: sRGB
- > Display
- >  Curves
- >  White Balance

# Progress Tracking

- useful to get a version history
- Motivating to see progress



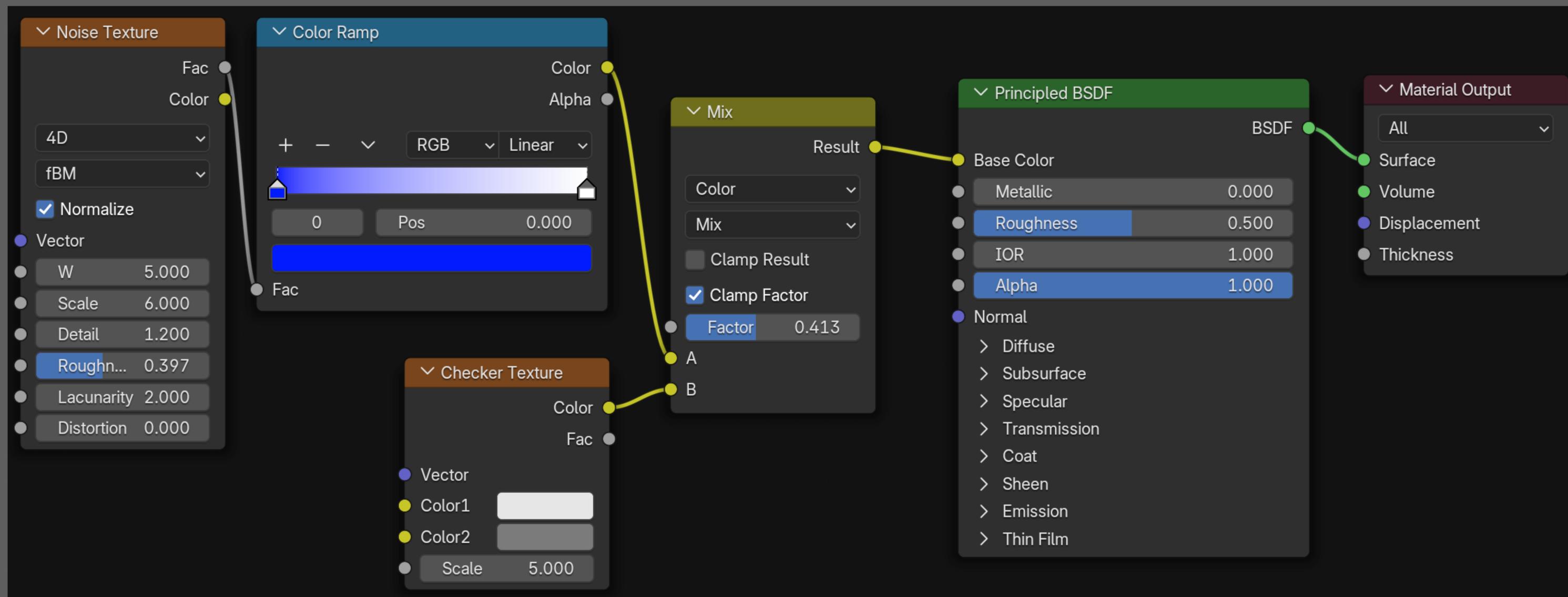
# Textures



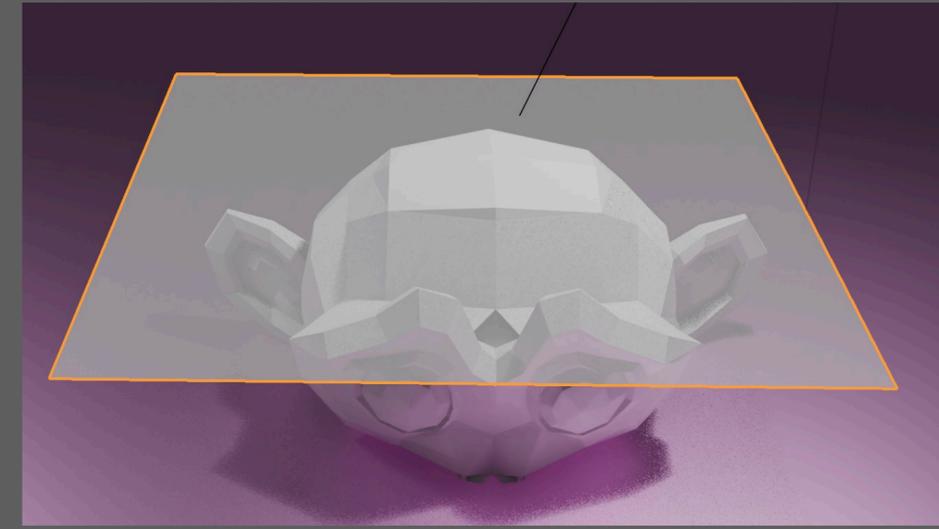
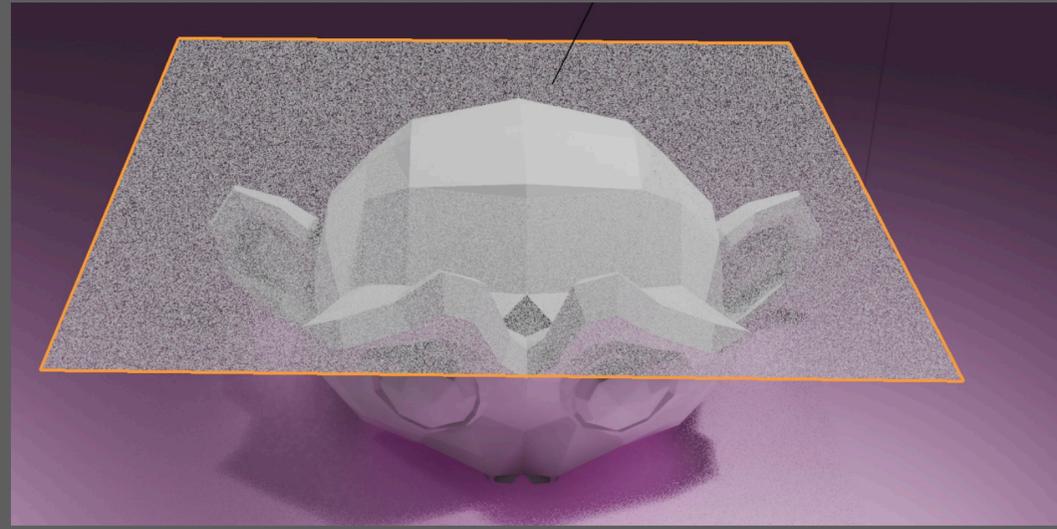
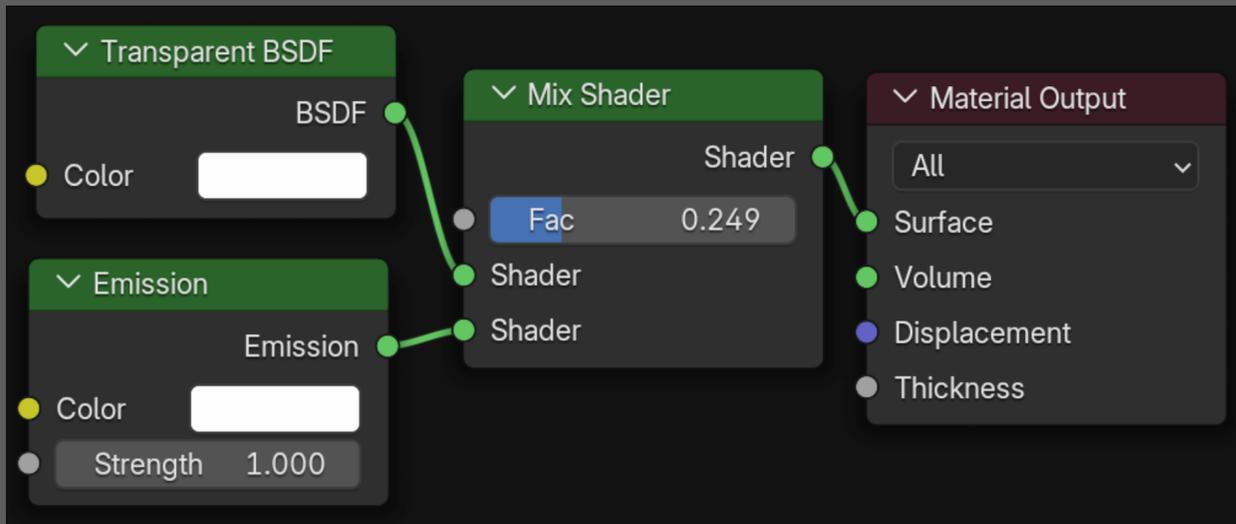
Material Editor Node Configuration:

- Noise Texture**
  - Fac: 0.000
  - Color: 0.000
  - 4D:
  - fBM:
  - Normalize
  - Vector:
  - W: 1.000
  - Scale: 6.000
  - Detail: 1.200
  - Roughne...: 0.500
  - Lacunarity: 2.000
  - Distortion: 0.000
- Color Ramp**
  - Color: 0.000
  - Alpha: 0.000
  - Mode: HSV
  - Clock...:
  - 0: 0.000
  - Pos: 0.000
  - Fac: 0.000
- Principled BSDF**
  - Base Color: 0.000
  - Metallic: 0.000
  - Roughness: 0.500
  - IOR: 1.000
  - Alpha: 1.000
  - Normal
    - Diffuse
    - Subsurface
    - Specular
    - Transmission
    - Coat
    - Sheen
    - Emission
    - Thin Film
- Material Output**
  - All:
  - Surface:
  - Volume:
  - Displacement:
  - Thickness:

# Mix Color



# Mix Shaders

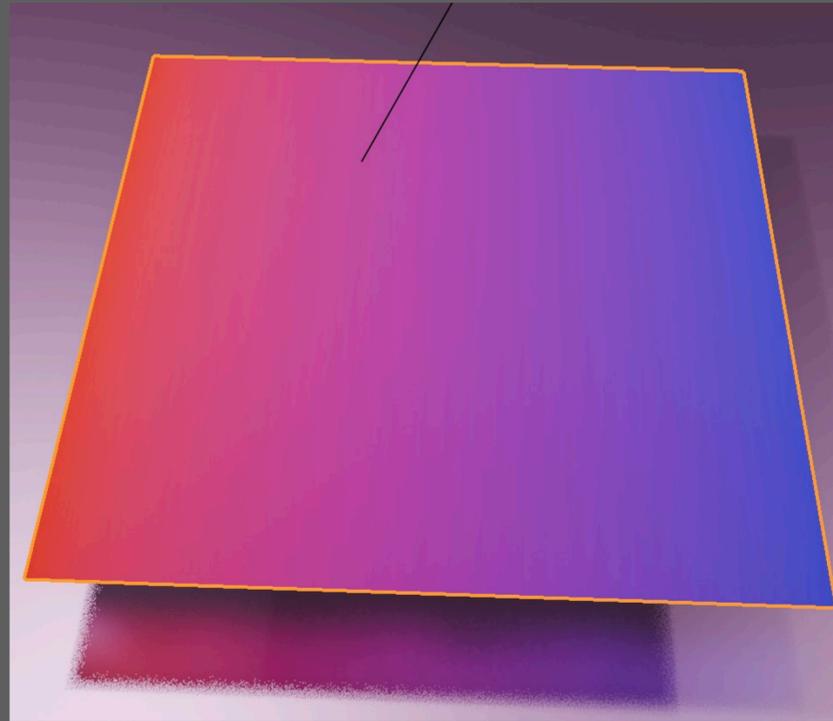


The screenshot shows the Blender 2.80 Shader Editor interface for a 'Mix Shader' node. The node is selected, and the 'Settings' tab is active. The 'Pass Index' is set to 0. The 'Surface' section is expanded, showing the following settings:

- Backface Culling:  Camera,  Shadow,  Light Probe Volume
- Displacement: Bump Only (dropdown)
- Max Distance: 0 m
- Transparent Shadows:
- Render Method: Dithered (dropdown)
- Raytraced Transmission:

The close-up shows the 'Render Method' dropdown menu, which is currently set to 'Blended'. The dropdown is highlighted with a yellow box.

# Gradient



Texture Coordinate

- Generated
- Normal
- UV
- Object
- Camera
- Window
- Reflection

Object:  Object

From Instancer

Separate XYZ

- X
- Y
- Z

Vector

Color Ramp

Color

Alpha

+ - ▾ RGB ▾ Linear ▾

0 Pos 0.000

Fac

Principled BSDF

BSDF

- Base Color
- Metallic 0.000
- Roughness 0.500
- IOR 1.000
- Alpha 1.000
- Normal
  - > Diffuse
  - > Subsurface
  - > Specular
  - > Transmission
  - > Coat
  - > Sheen
  - > Emission
  - > Thin Film

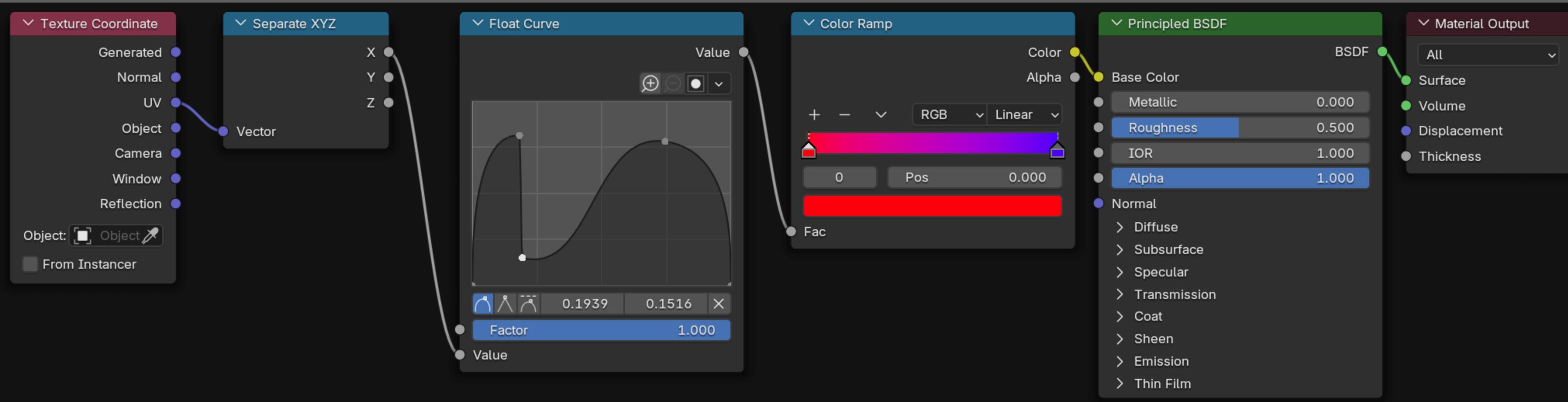
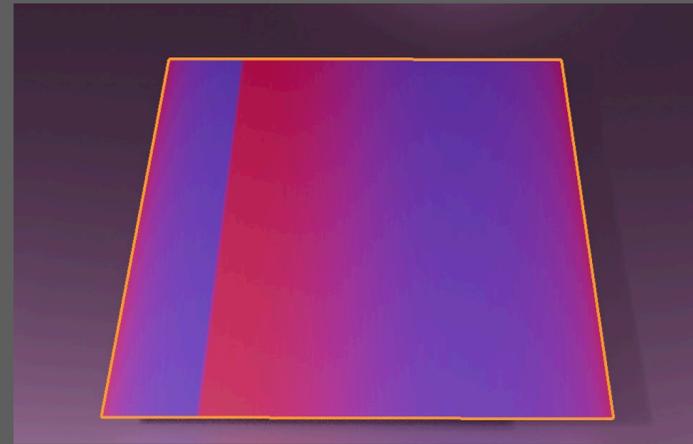
Material Output

All ▾

- Surface
- Volume
- Displacement
- Thickness

# Float Curve

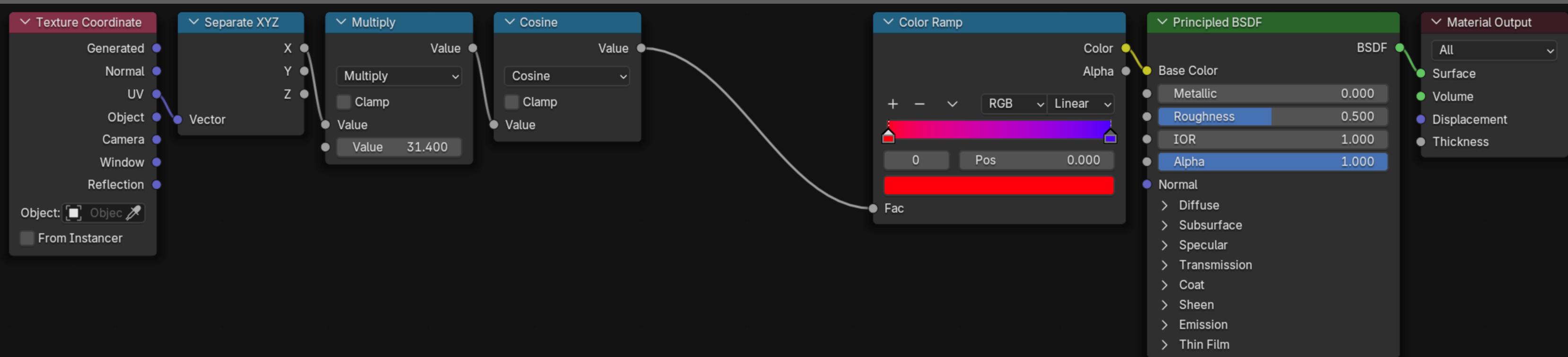
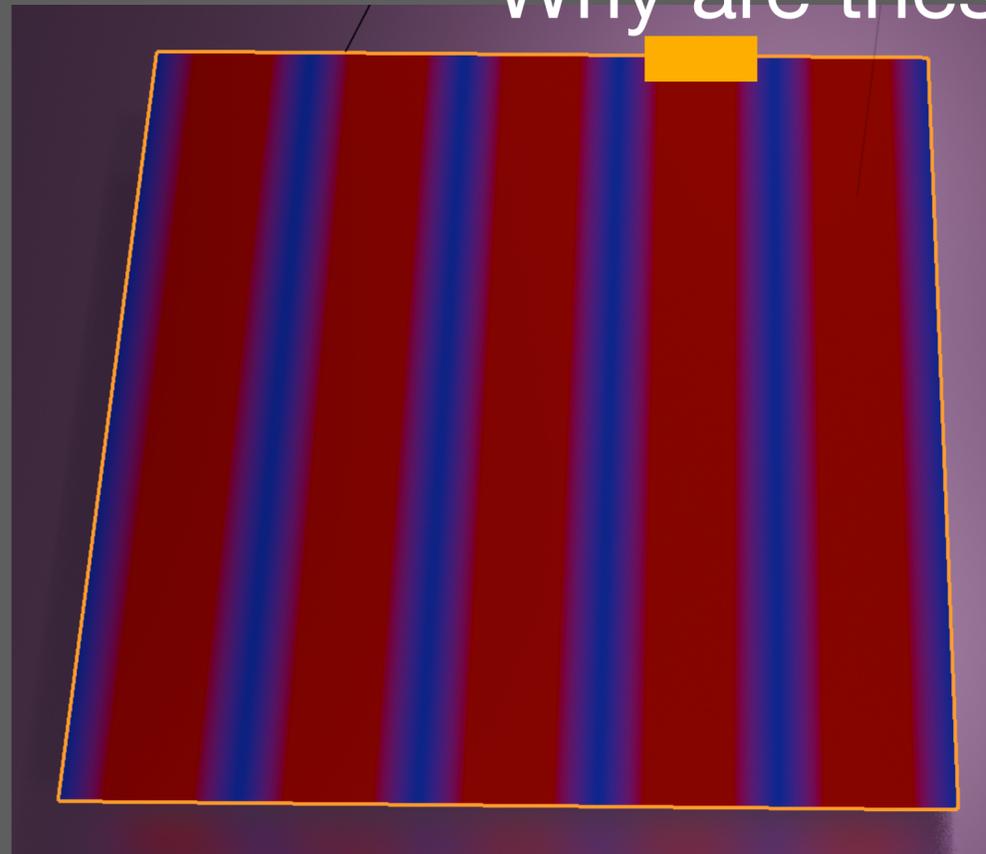
- Remaps the input values



# 1D-Wave

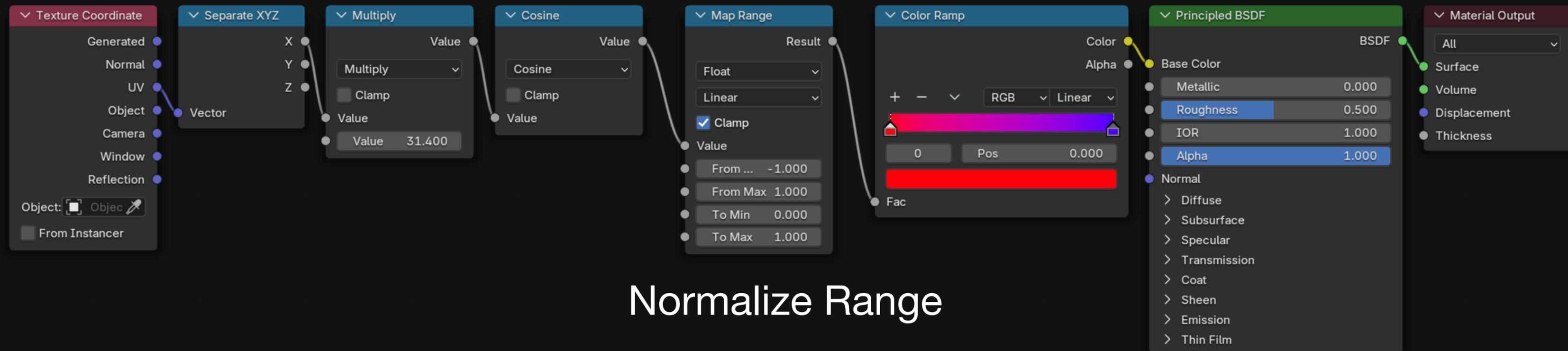
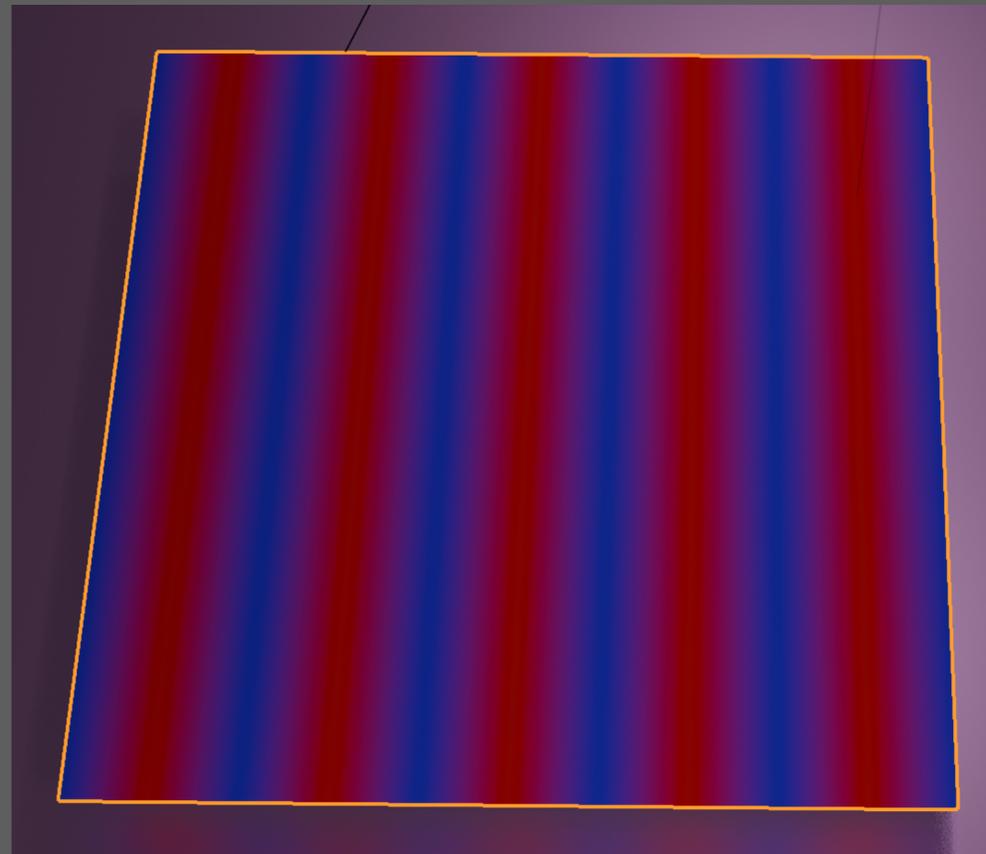
$$f(x, y) = \cos(kx)$$

Why are these stripes so long?



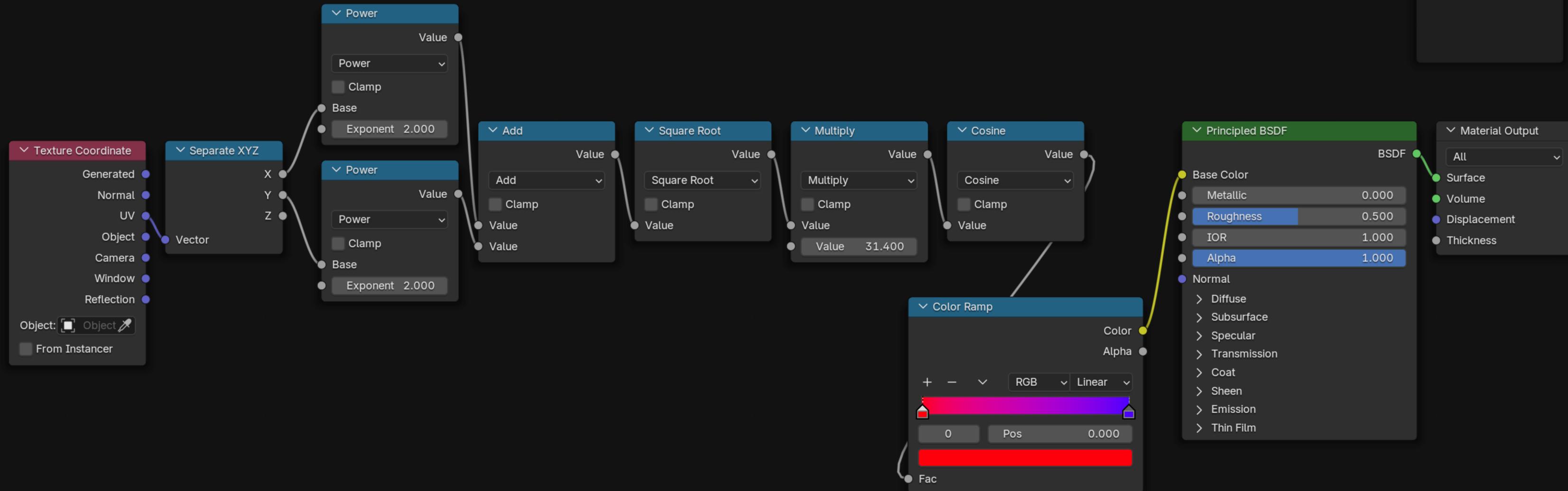
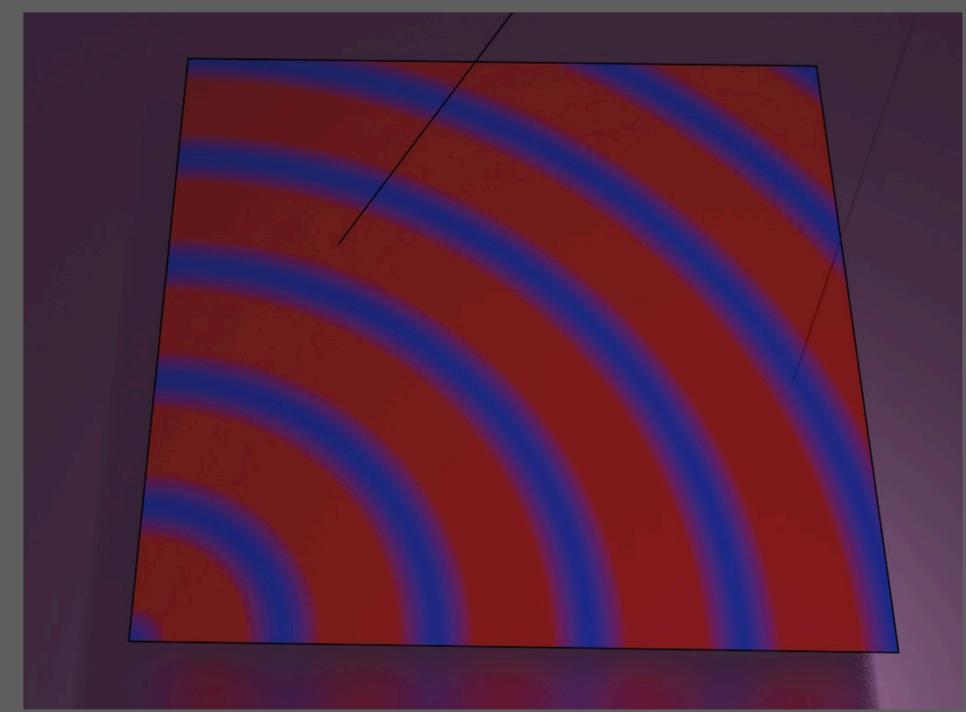
# 1D-Wave

$$f(x, y) = \cos(kx)$$



# 2D-Wave

$$f(x, y) = \cos(k \cdot \sqrt{x^2 + y^2})$$

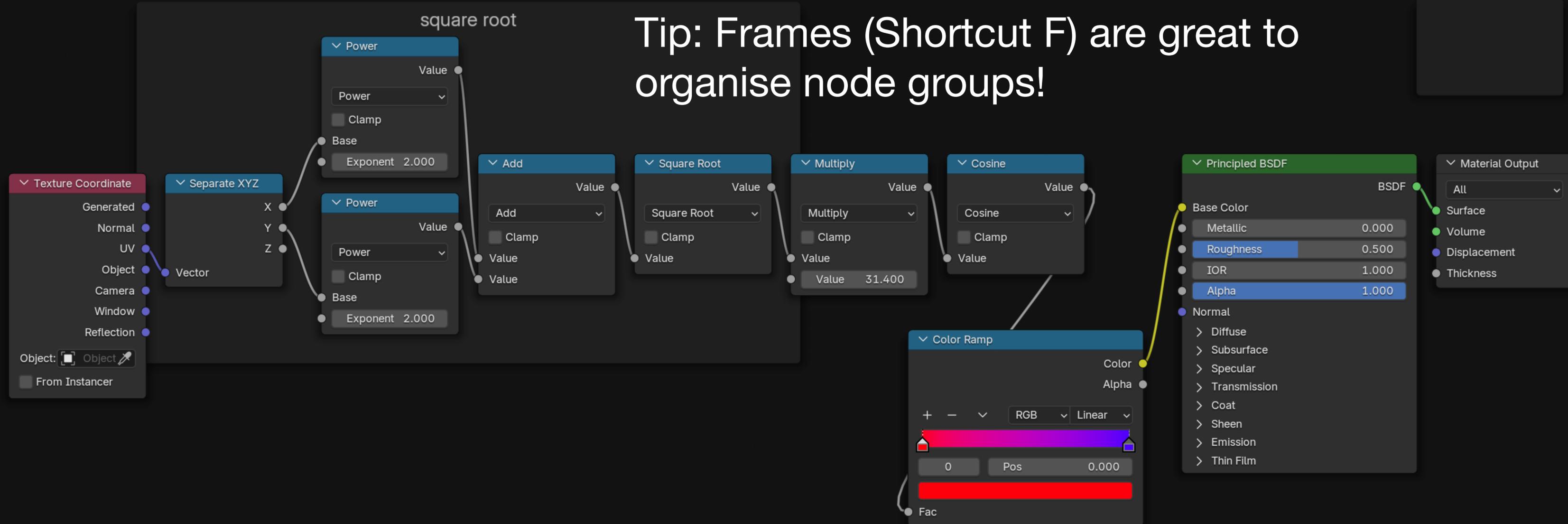


# 2D-Wave

$$f(x, y) = \cos(k \cdot \sqrt{x^2 + y^2})$$



Tip: Frames (Shortcut F) are great to organise node groups!

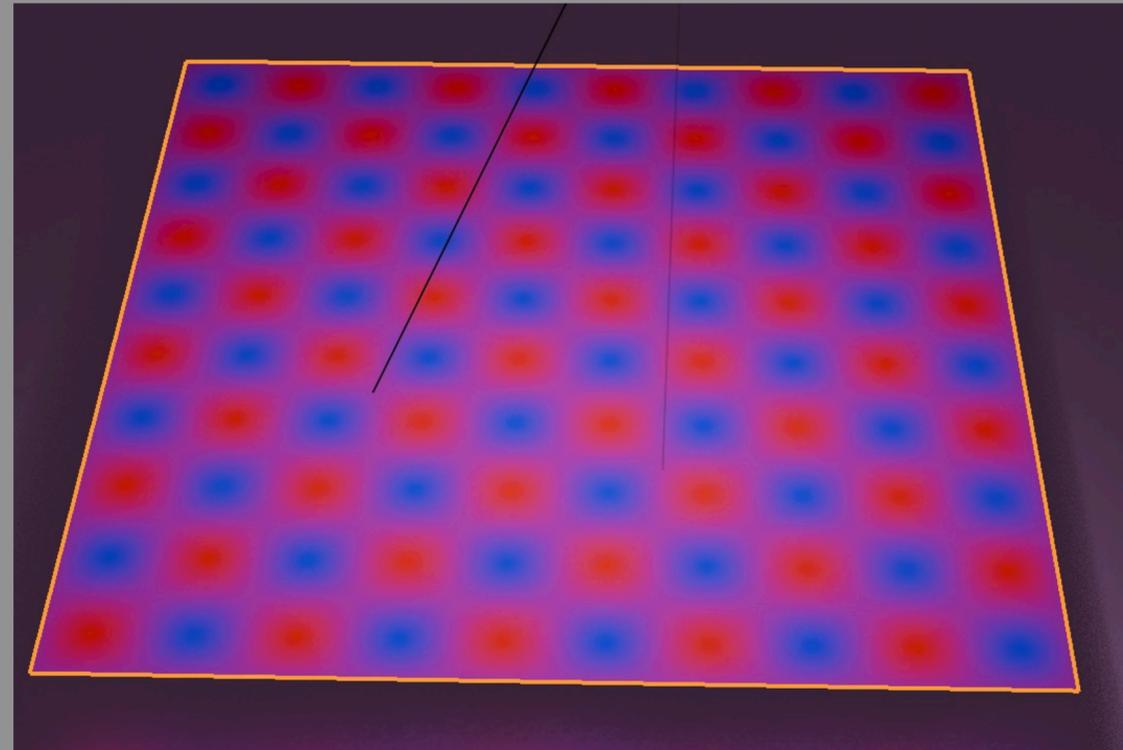


# 2D-Wave

## Task

Create a 2D sine pattern

$$f(x, y) = \sin(kx) \sin(ky)$$



The image shows a Blender material editor interface with the following components:

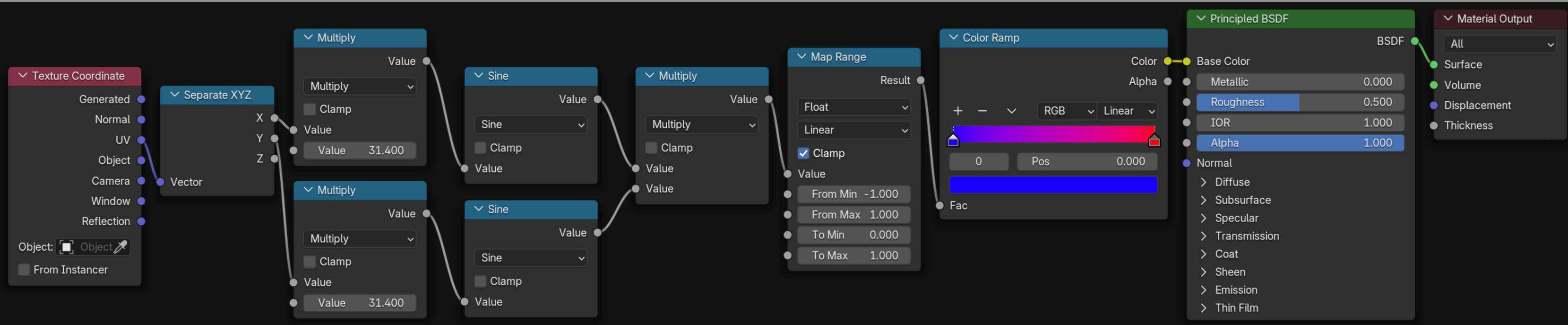
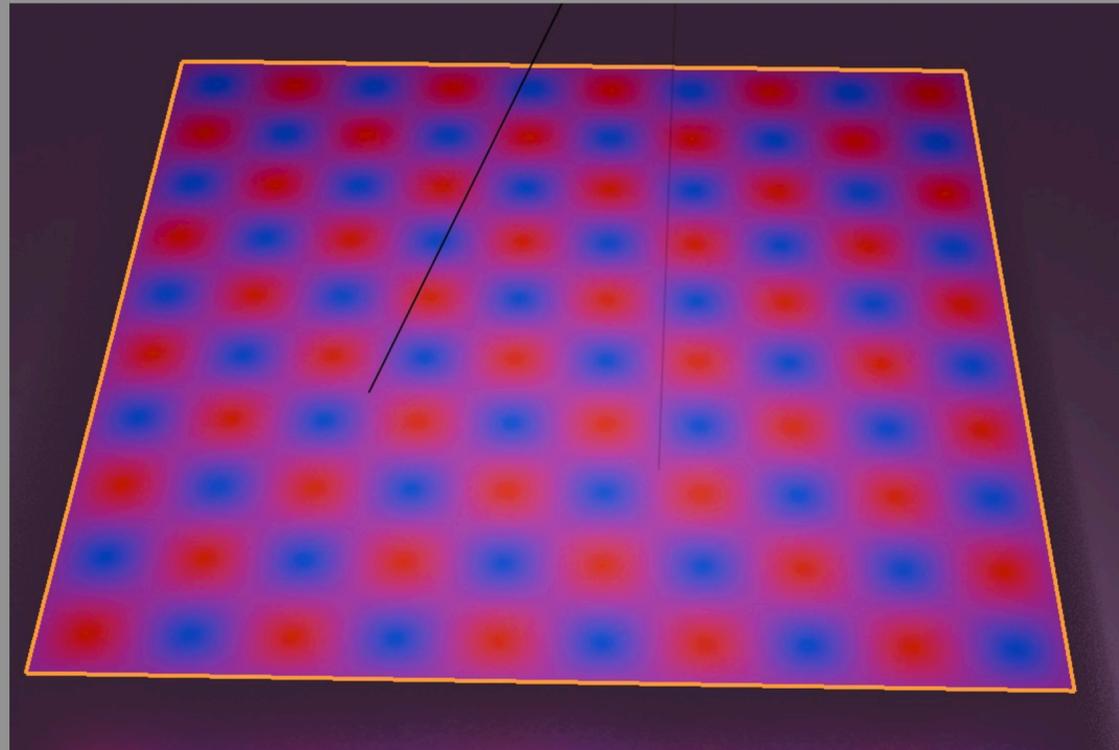
- Texture Coordinate**: A node with 'Generated' selected and 'Separate XYZ' expanded to show X, Y, and Z outputs.
- Map Range**: A node with 'Float' and 'Linear' selected, 'Clamp' checked, and 'Value' set to 0.000.
- Color Ramp**: A node with 'RGB' and 'Linear' selected, 'Fac' set to 0.000, and a color gradient from blue to red.
- Principled BSDF**: A node with 'Base Color' connected to the Color Ramp's 'Color' output, 'Metallic' at 0.000, 'Roughness' at 0.500, 'IOR' at 1.000, and 'Alpha' at 1.000.
- Material Output**: A node with 'All' selected.

A central blue box with three large white question marks '???' is positioned over the workflow, indicating a missing or unknown step in the process.

# 2D-Wave

## Solution

$$f(x, y) = \sin(kx) \sin(ky)$$

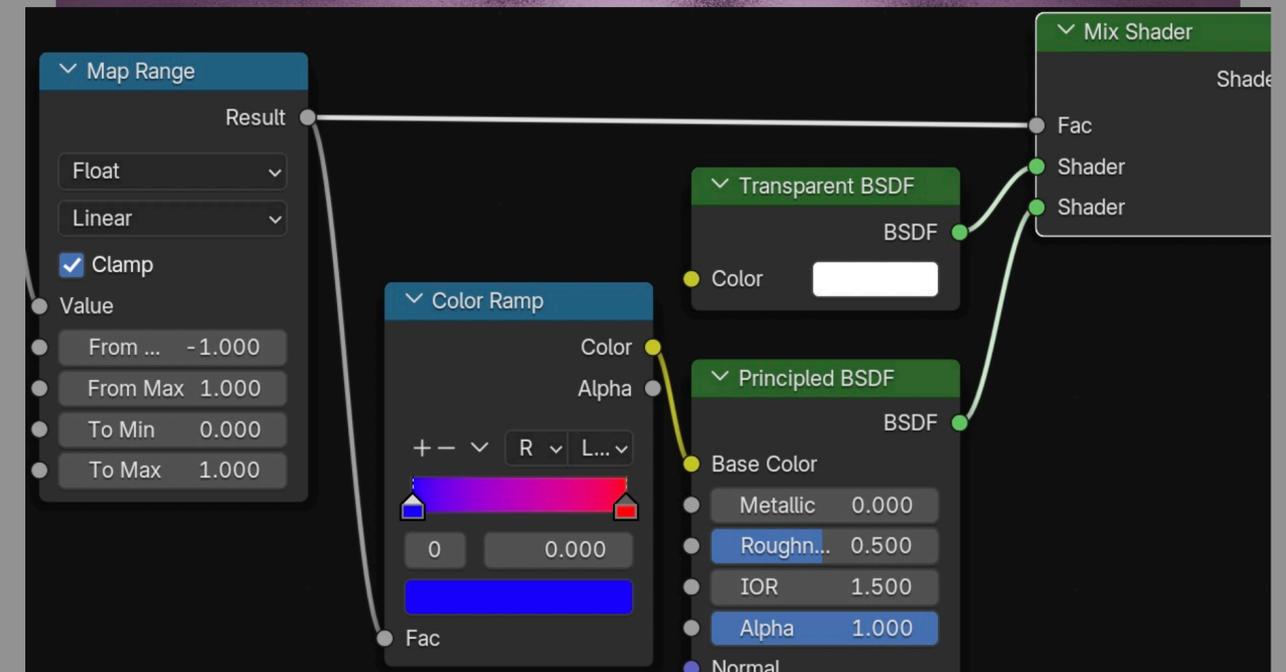
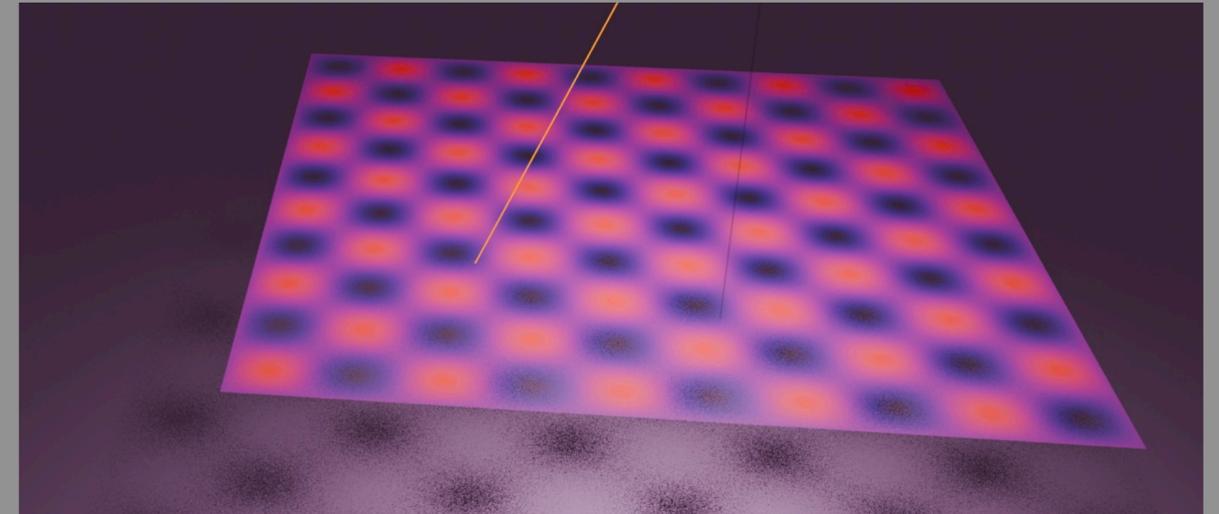


# 2D-Wave

$$f(x, y) = \sin(kx) \sin(ky)$$

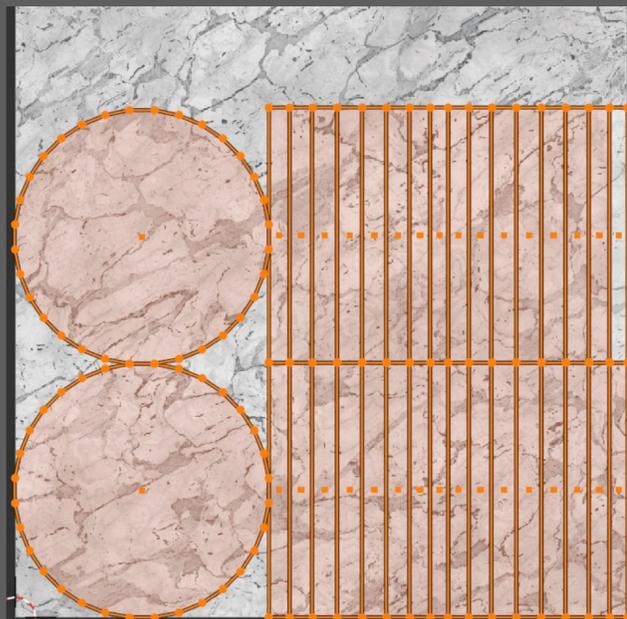
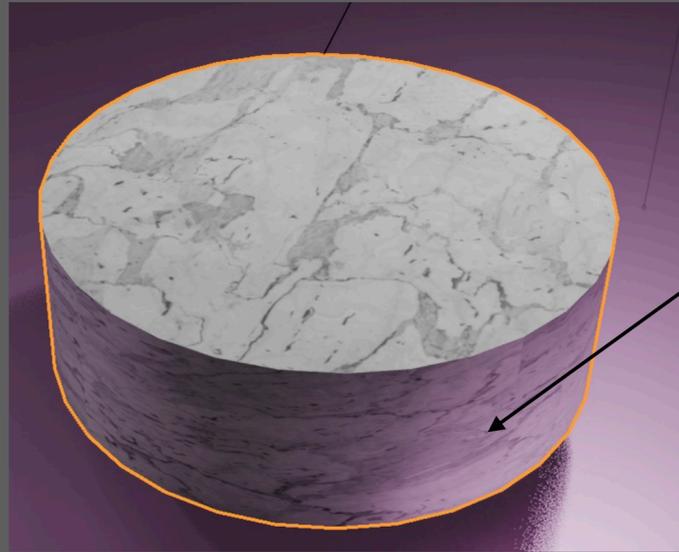
## Task:

- Explore further ideas:
  - Transparent areas
  - Metallic areas
  - Different colors
  - Mix with other textures

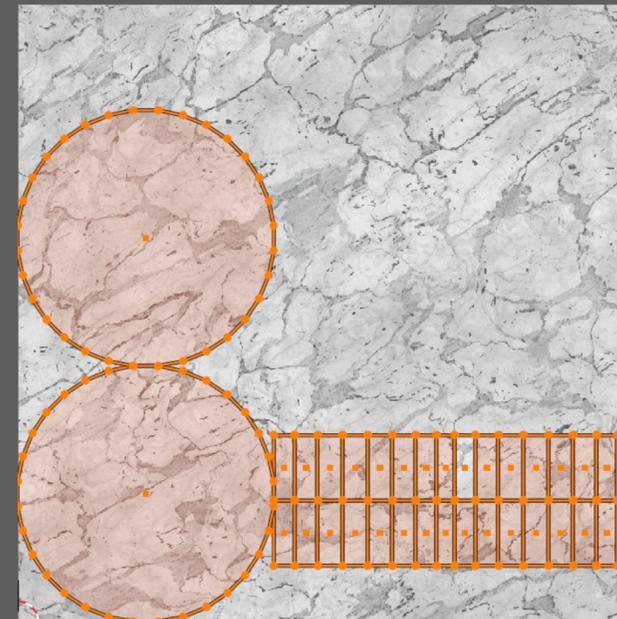
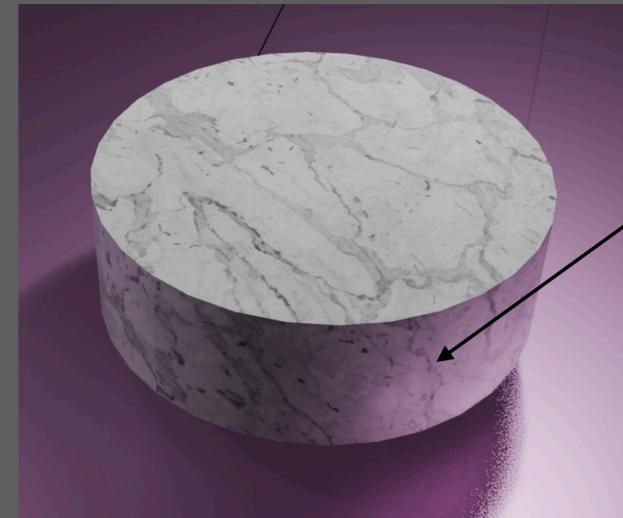


# UV unwrapping

What we have



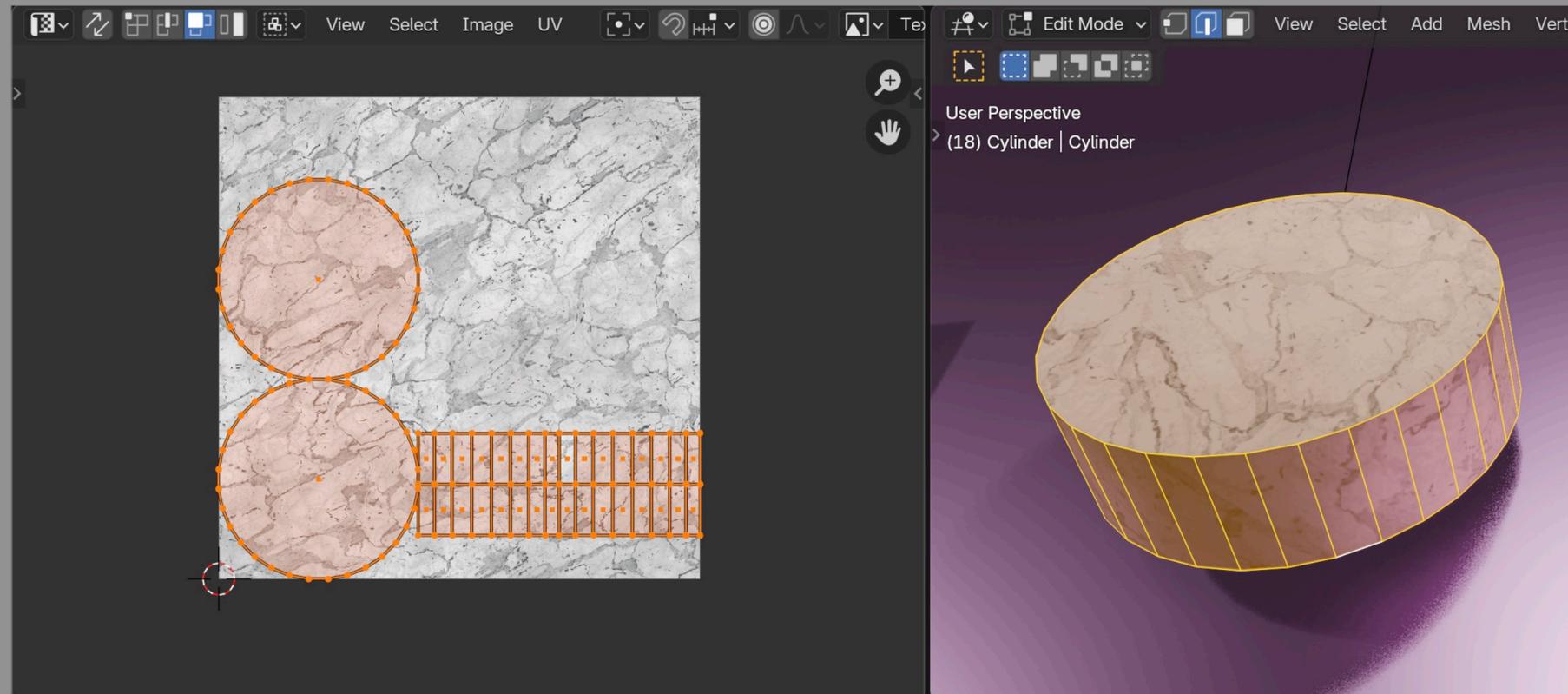
What we want



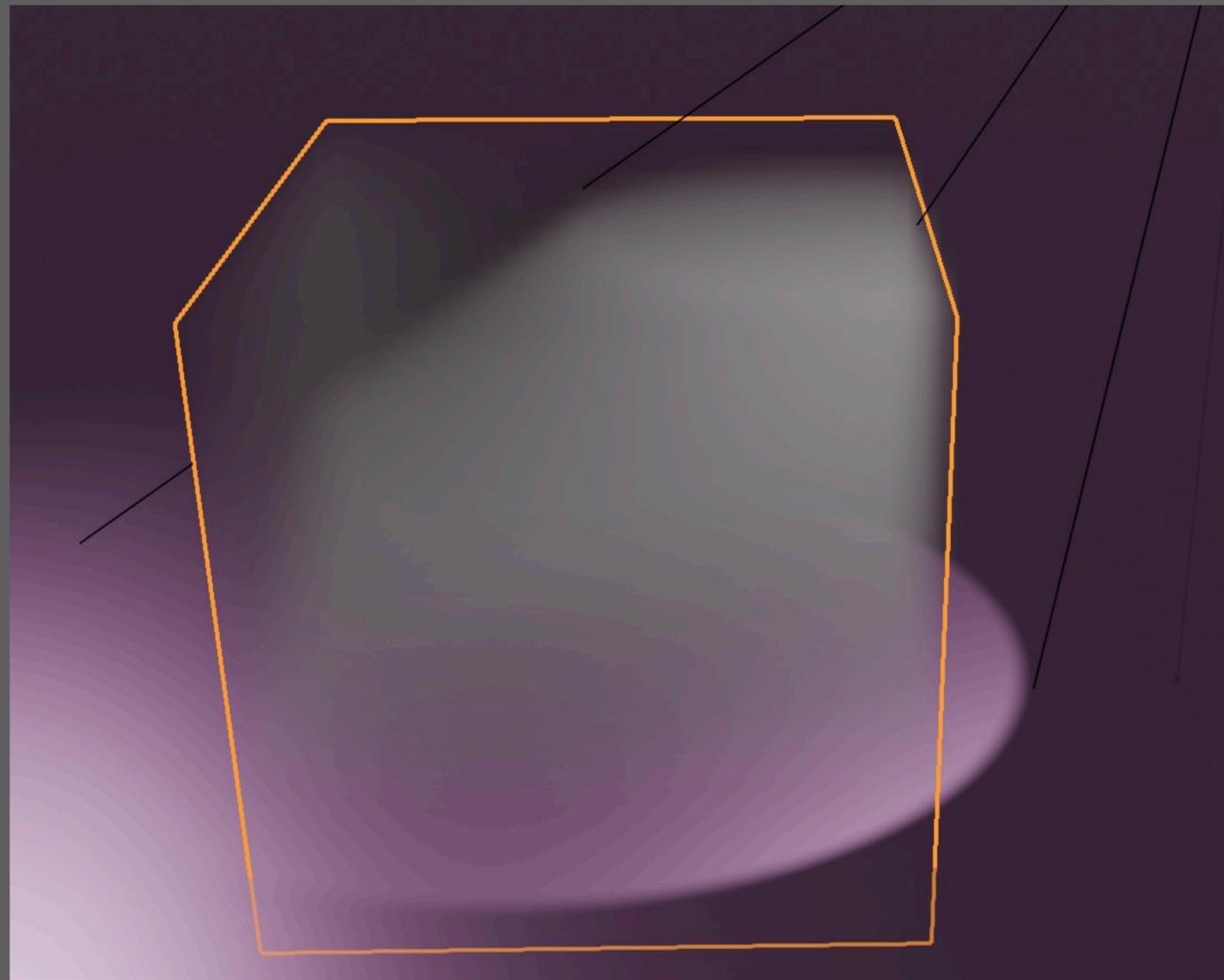
# UV unwrapping

## Task

- Add a cylinder, and scale down in z direction
- Add the „Marble“ material (using the node wrangler)
- In edit mode, select all faces.
- Scale the faces in the UV editor



# Volumetric Shader



Volume Scatter

Volume

Henyeey - Greenstein

Color

Density 0.300

Anisotropy 0.238

Material Output

All

Surface

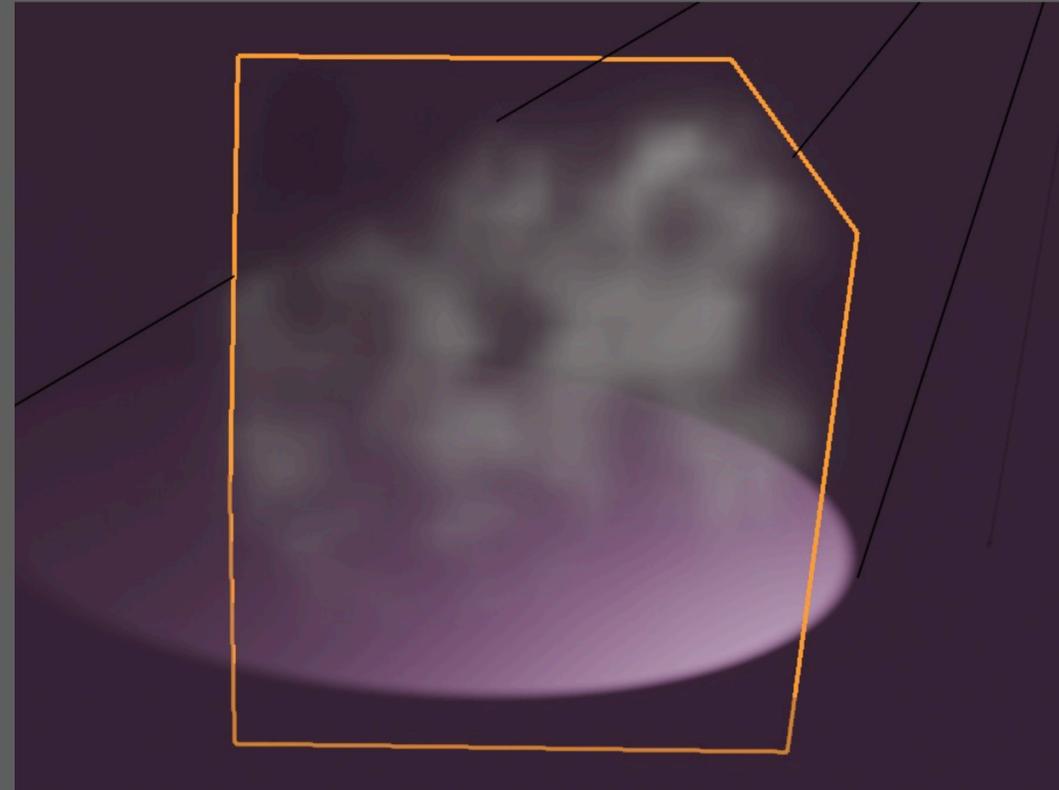
Volume

Displacement

Thickness

# Volumetric Shader

- Fog

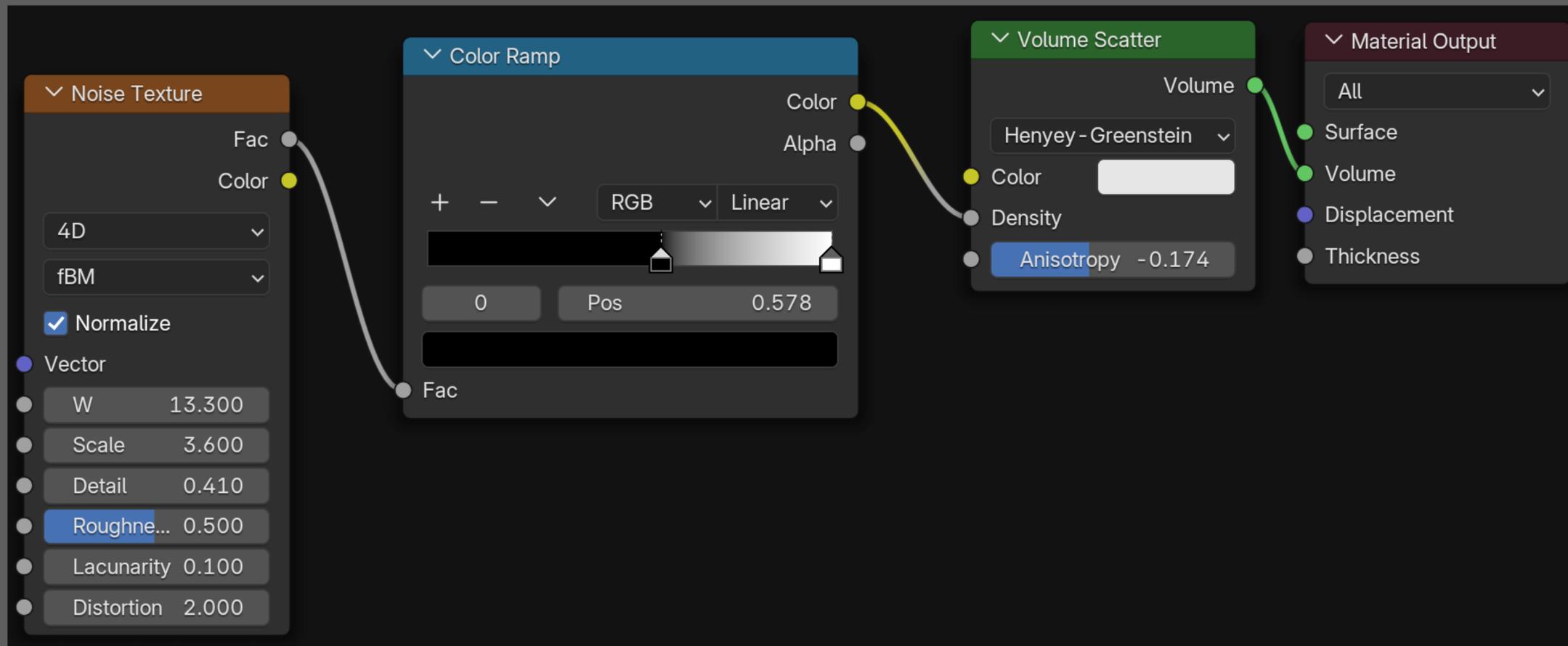
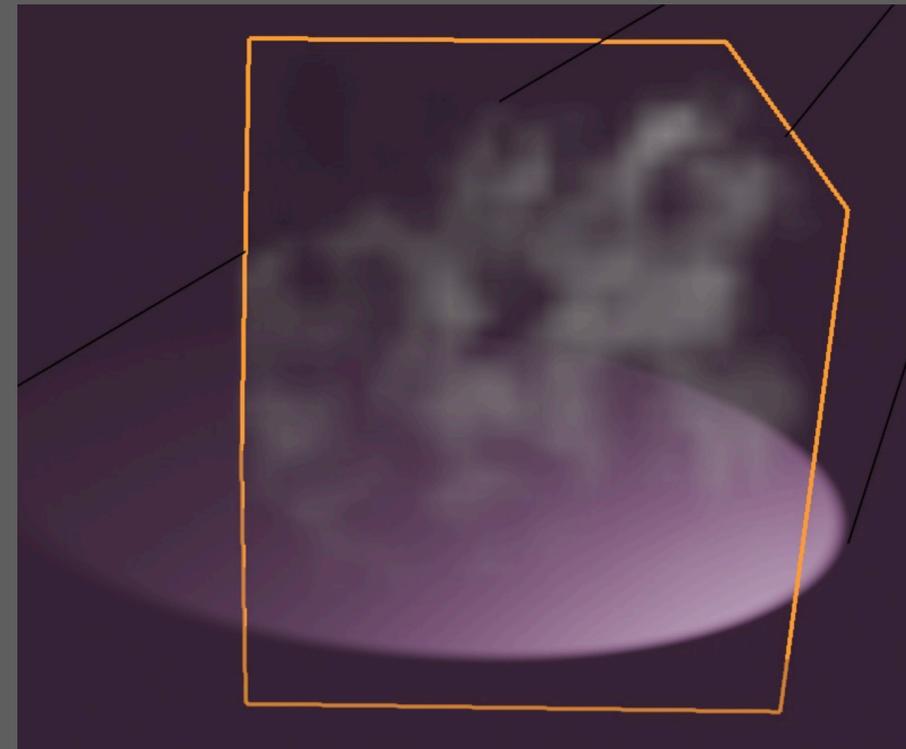


The screenshot displays the following settings in the shader editor:

- Noise Texture:**
  - Fac: [Slider]
  - Color: [Slider]
  - 4D: [Dropdown]
  - fBM: [Dropdown]
  - Normalize
  - Vector: [Radio]
  - W: 13.300
  - Scale: 3.600
  - Detail: 0.410
  - Roughne...: 0.500
  - Lacunarity: 0.100
  - Distortion: 2.000
- Float Curve:**
  - Value: [Slider]
  - Graph: [Grid with curve]
  - Factor: 1.000
- Volume Scatter:**
  - Volume: [Slider]
  - Henyeey - Greenstein: [Dropdown]
  - Color: [Color Picker]
  - Density: [Slider]
  - Anisotropy: -0.174
- Material Output:**
  - All: [Dropdown]
  - Surface: [Radio]
  - Volume: [Radio]
  - Displacement: [Radio]
  - Thickness: [Radio]

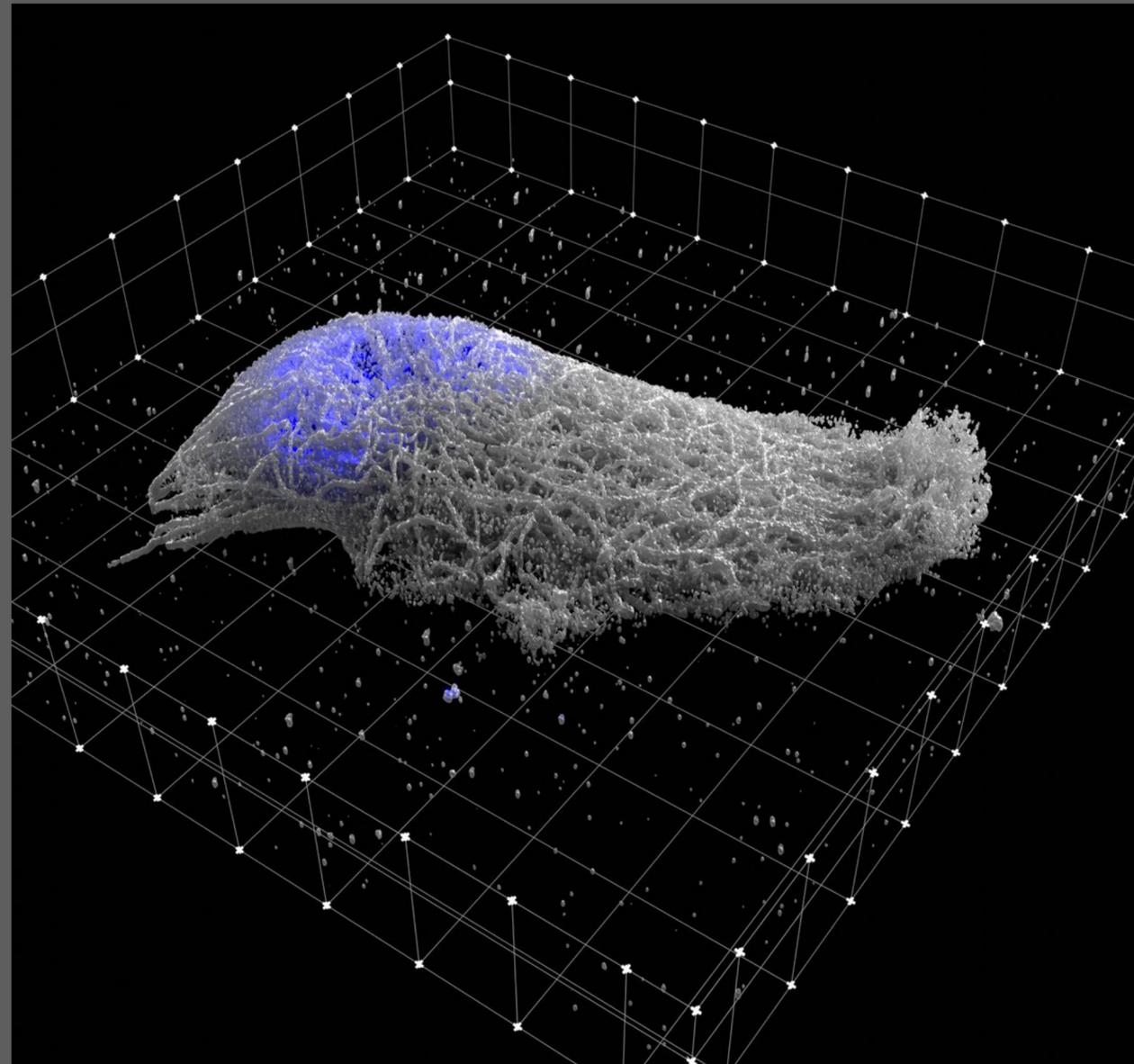
# Volumetric Shader

- Fog
- Also possible to manipulate with Color Ramp



# Volumetric Shader

- Image Stacks via  
„Microscopy Nodes“



# Shader Nodes - Open Shading Language

The image displays the Blender 2.80 interface, showcasing the integration of Open Shading Language (OSL) for custom shading. The top-left pane shows a 3D perspective view of a plane with a colorful, wavy pattern. The top-right pane shows the OSL script code for a 'funny\_shader'.

```
1 shader funny_shader(  
2   float speed = 5.0,  
3   color base_color = color(0.8, 0.2, 0.5),  
4   output color Cout = 0)  
5 {  
6   point pos = P;  
7   float t = time * speed;  
8  
9   float wibble = sin(pos[0] * 10 + t) + cos(pos[1] * 10 + t);  
10  color rave = color(sin(t)*0.5+0.5, cos(t)*0.5+0.5, sin(t + 1.0)*0.5+0.5);  
11  float shimmer = sin(pos[0]*20 + t*3) * 0.1;  
12  
13  Cout = base_color * (0.5 + 0.5 * wibble) + rave * shimmer;  
14 }
```

The bottom-left pane shows the node editor with a 'Script' node named 'shader.osl' connected to a 'Value' node. The bottom-right pane shows the 'Scene' properties, with 'Open Shading Language' checked under the 'Device' section.

# Further Resources

The screenshot shows a web browser window displaying the CGCookie website. The URL in the address bar is <https://cgcookie.com/lessons/materials-and-lighting-5f0c12313169e62e>. The website has a dark theme with a navigation bar at the top containing 'Blender Basics', 'Library', 'Community', 'Gallery', and 'CORE'. The main content area features a large video player with the title 'BLENDER 4.5 BASICS' and 'LESSON 18 MATERIALS AND TEXTURES'. A small 3D character is visible in the video player. To the left of the video player is a sidebar with a course menu. The course is titled 'BLENDER BASICS: An Introduction to Blender 3D 4.5 LTS'. The menu items are: 1. Intro to 3D Space, 2. Editing Objects, 3. The Blender Way (with sub-items: Editors and Windows, Working with Blender Files, Cameras and Rendering, Materials and Textures (marked as 'Playing'), Lighting, 3D Animation with Keyframes, Introduction to Grease Pencil, Introduction to Sculpting, and Where to go from here), and 4. Next Steps. Each sub-item has a 'Free' label. At the bottom of the video player, there is a link to 'Ansehen auf YouTube'.

<https://cgcookie.com/lessons/materials-and-lighting-5f0c12313169e62e>

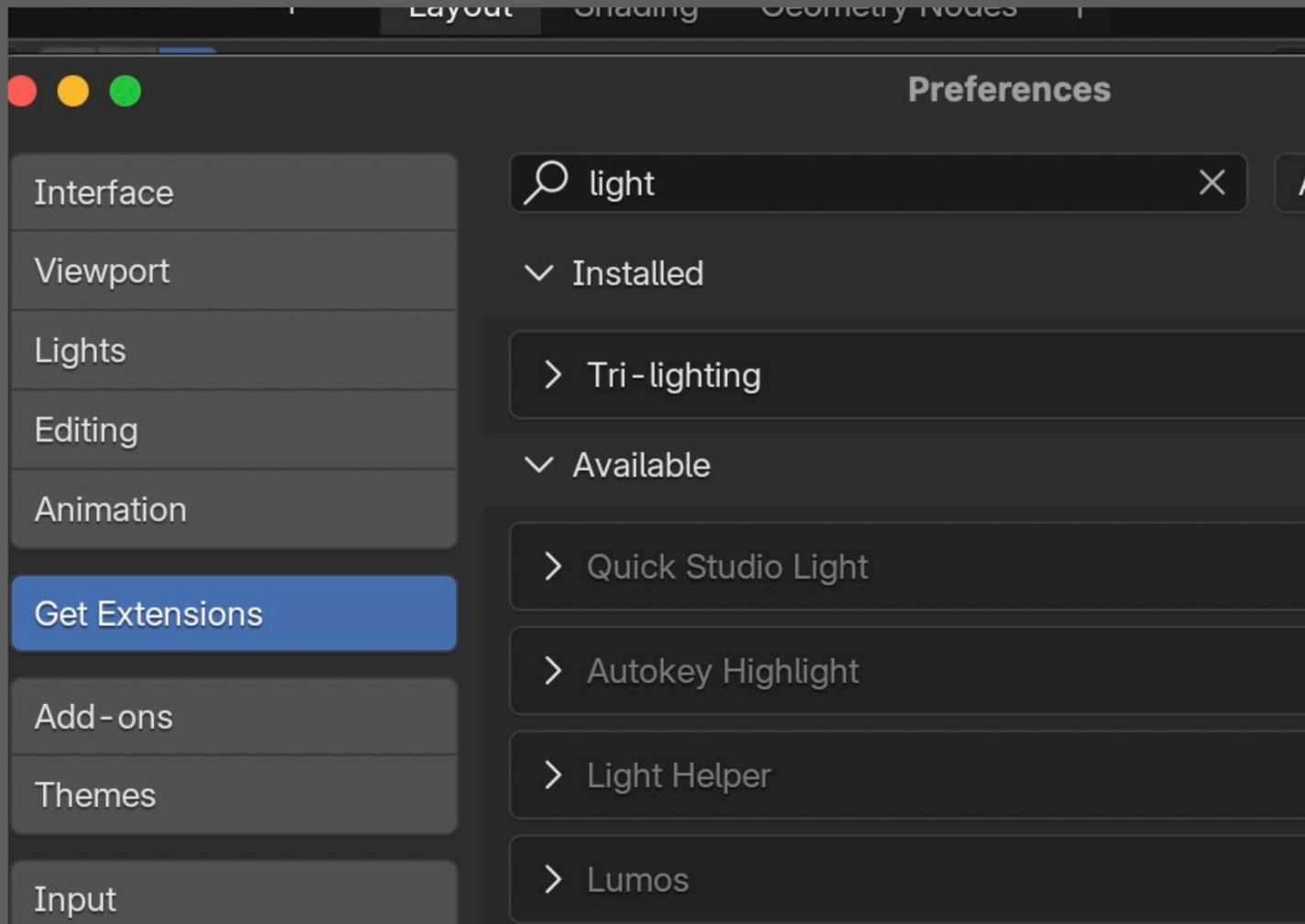
# Last task for today

- Model one simple object you can find in the lab
- Add materials
- Add lights
- Render result

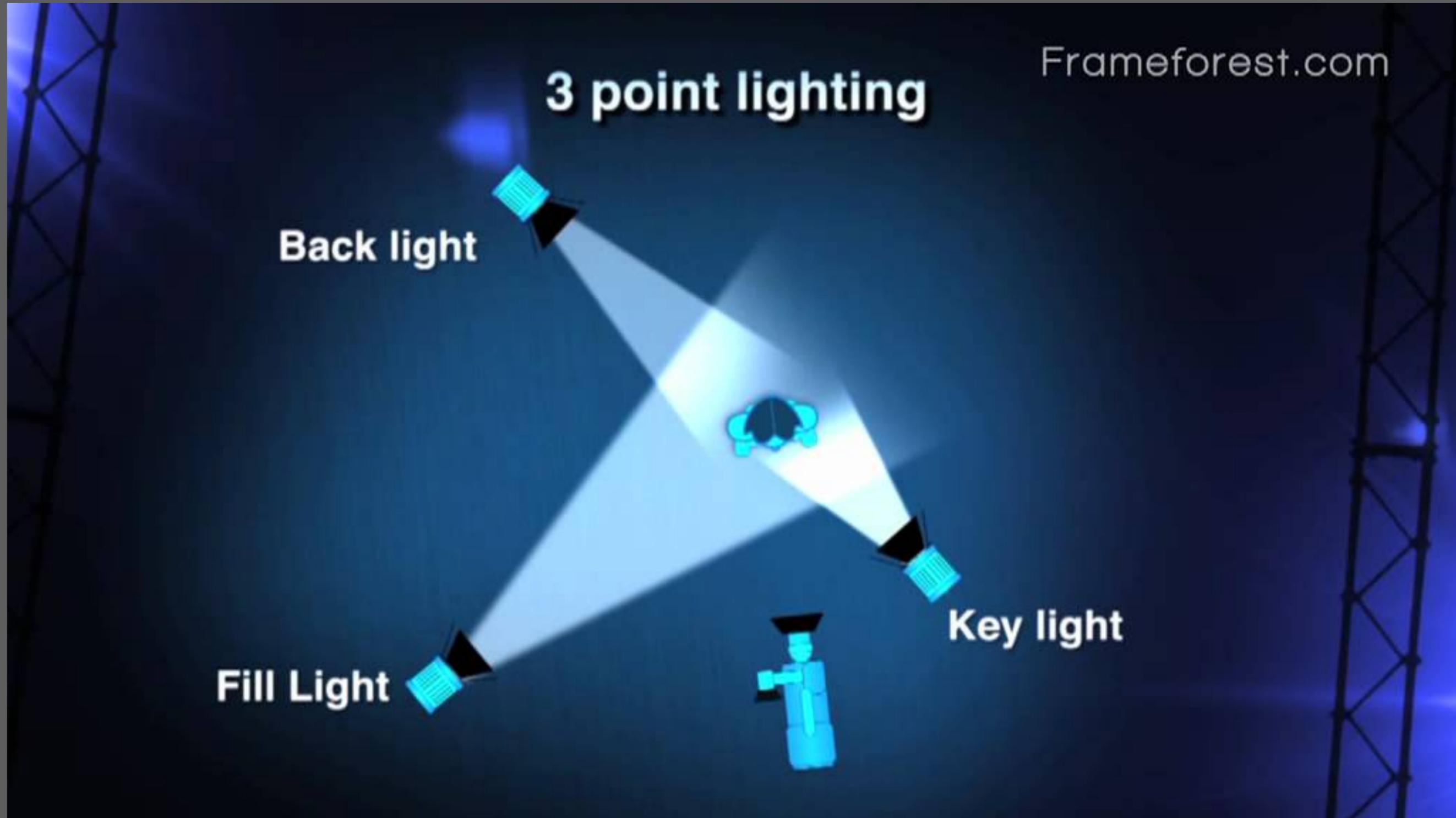


Day 2

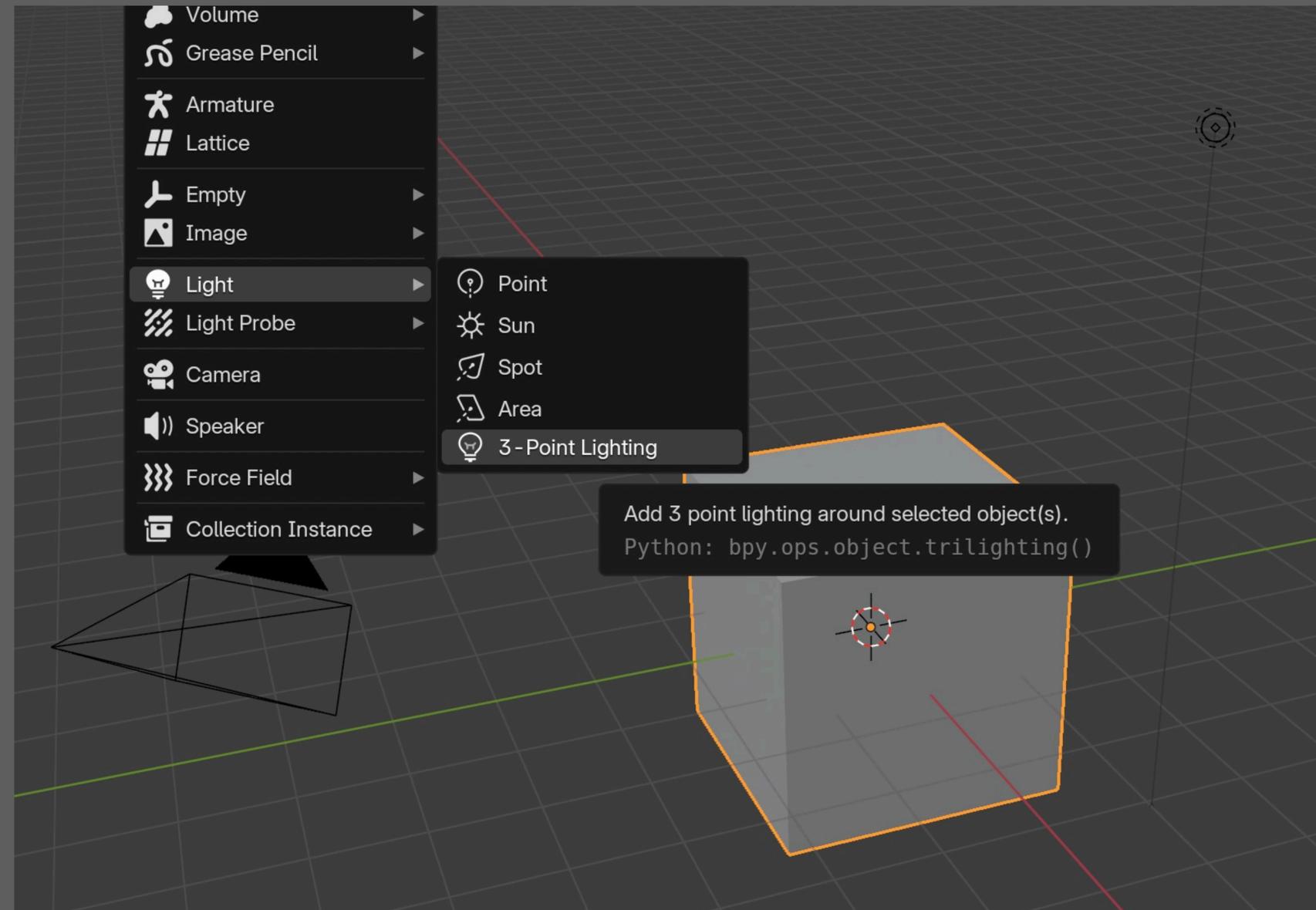
# 3 Point Lighting



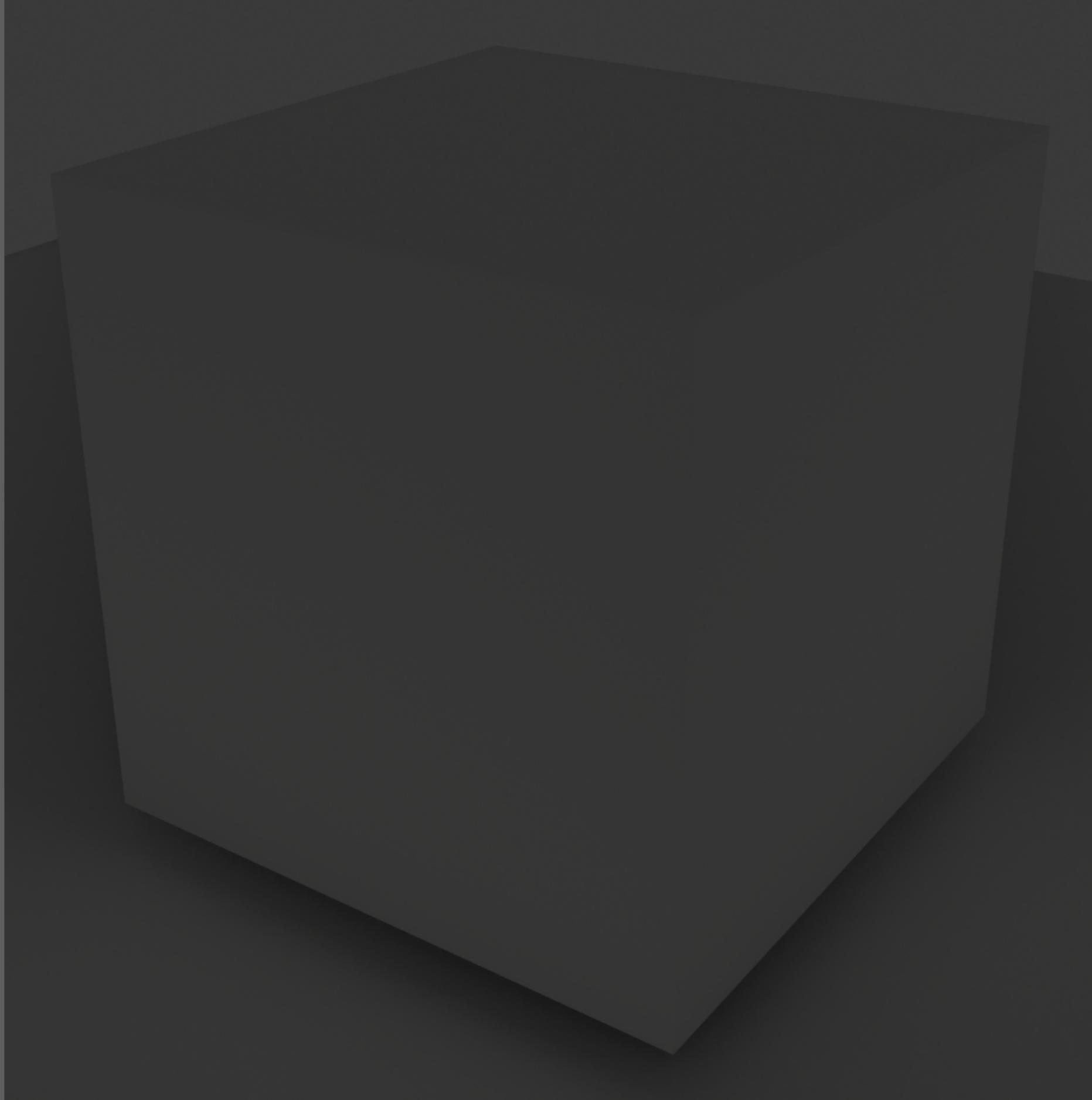
# 3 Point Lighting



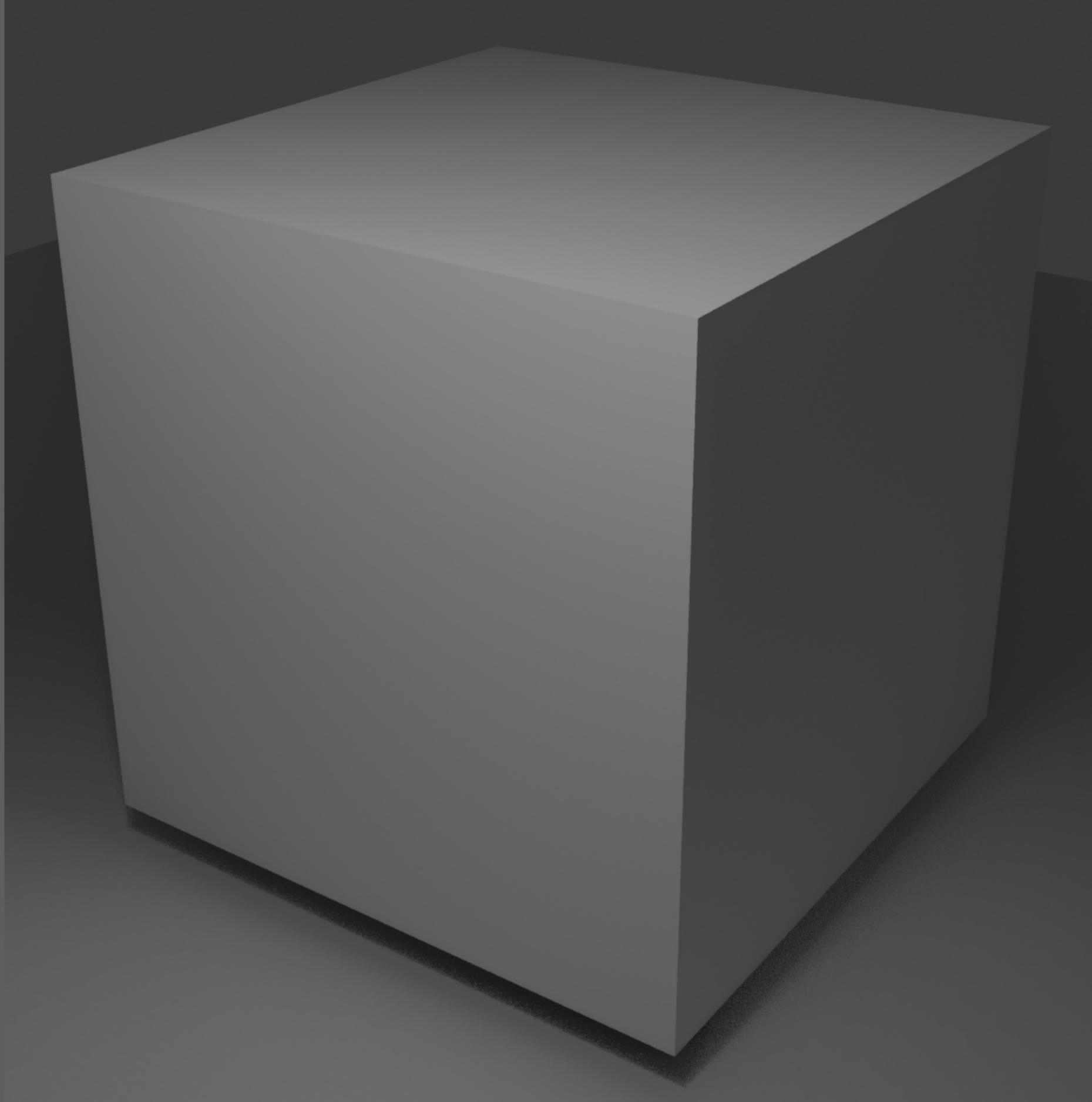
# 3 Point Lighting



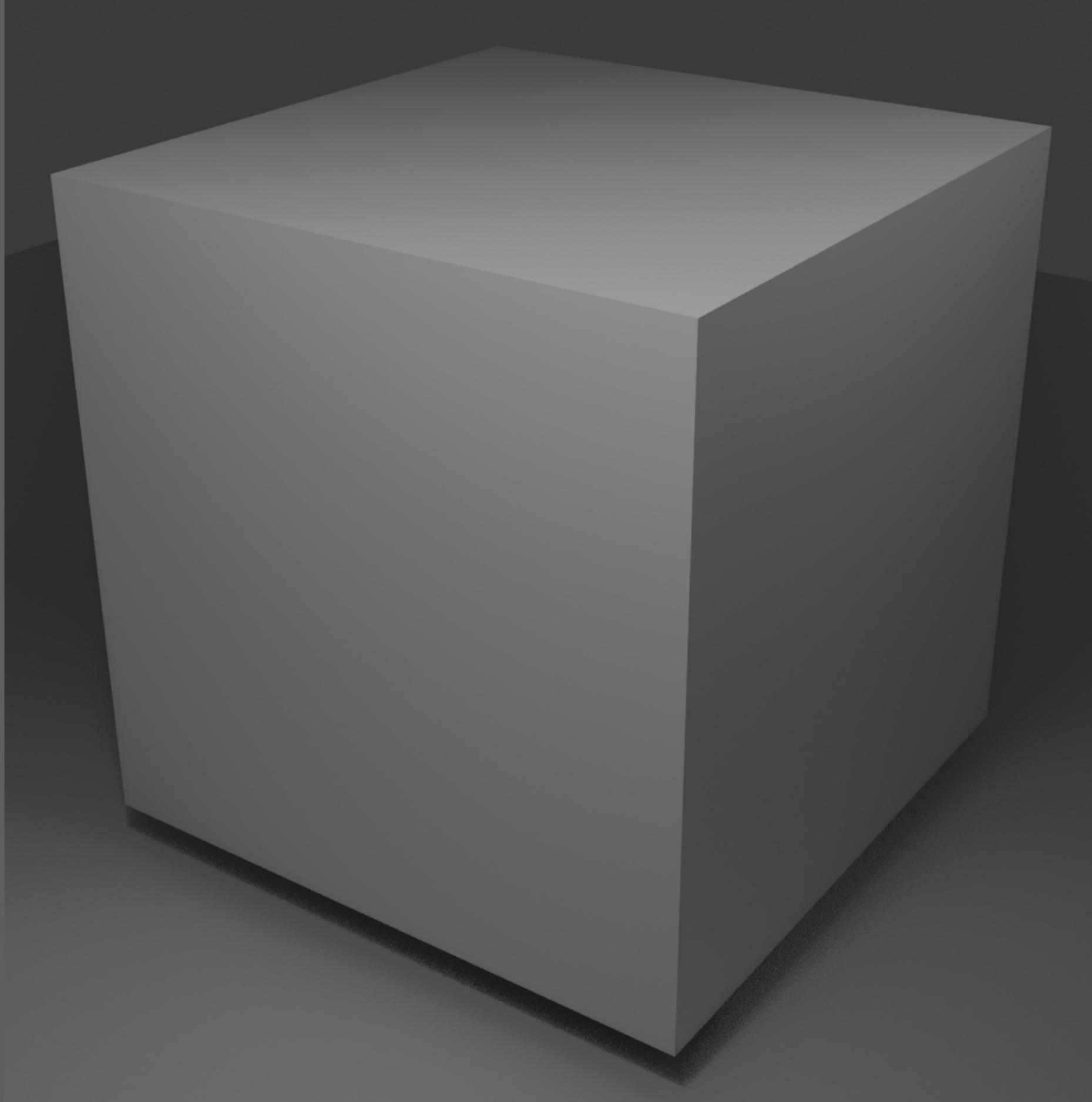
Light



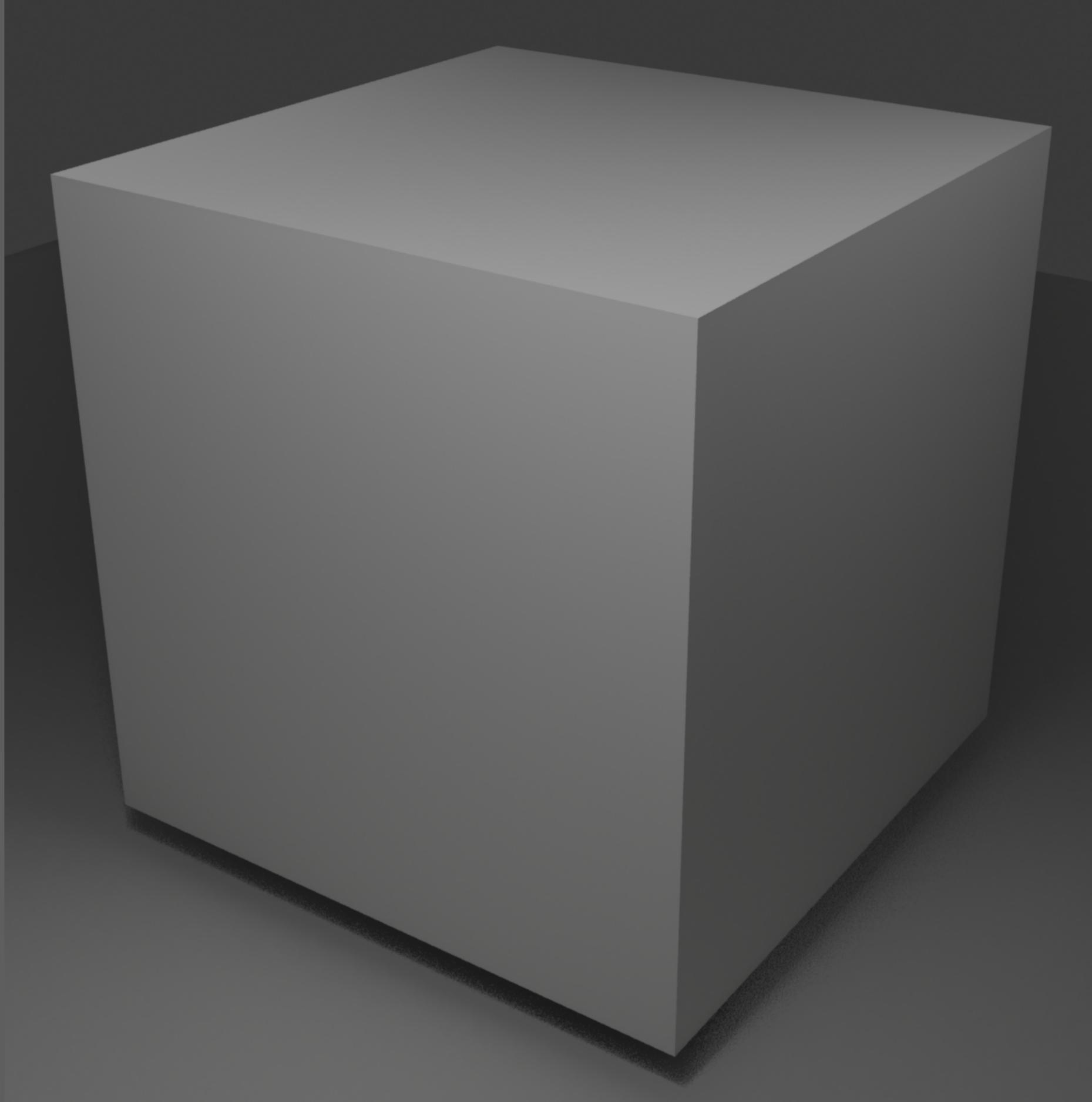
Key



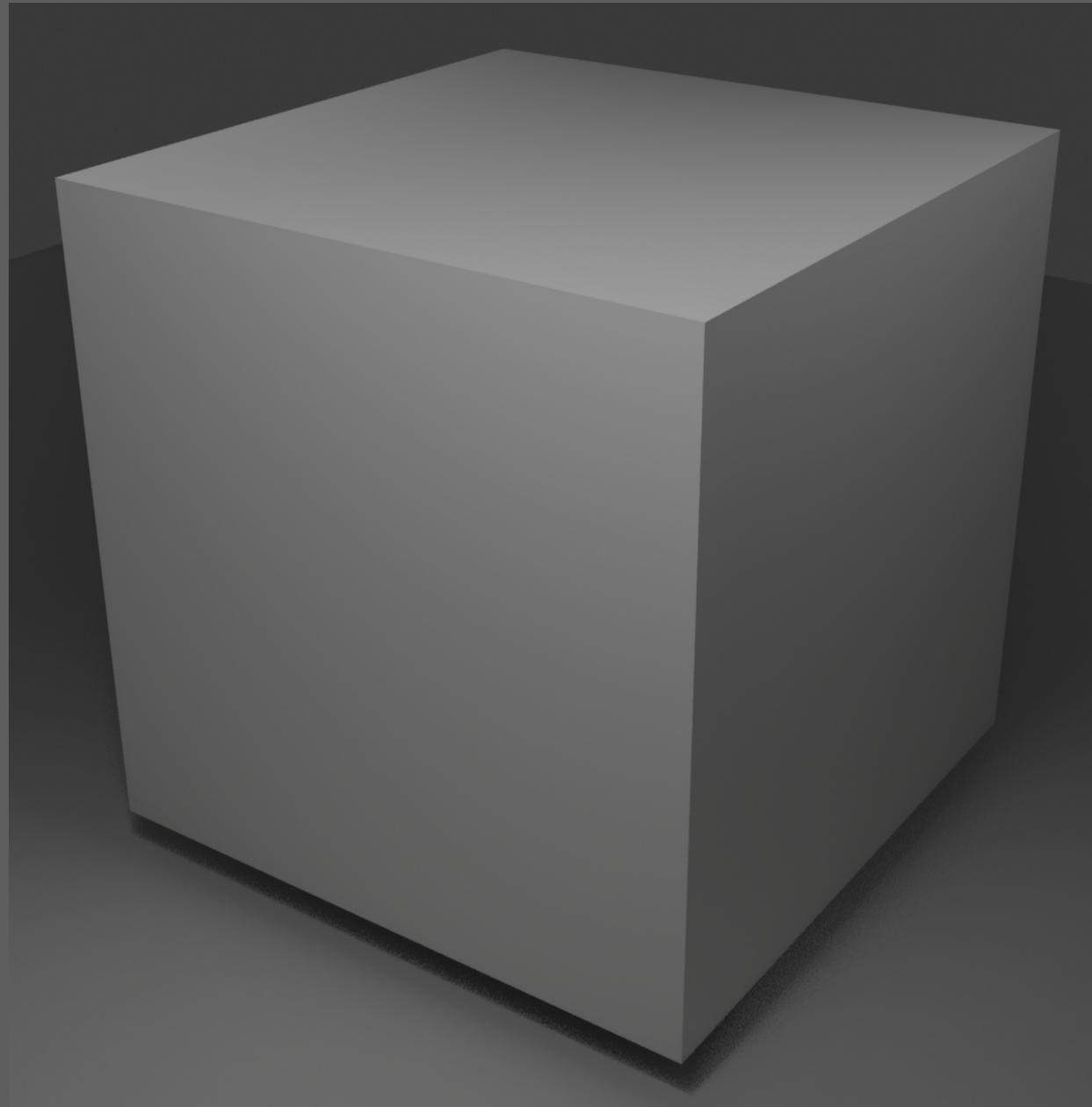
Fill



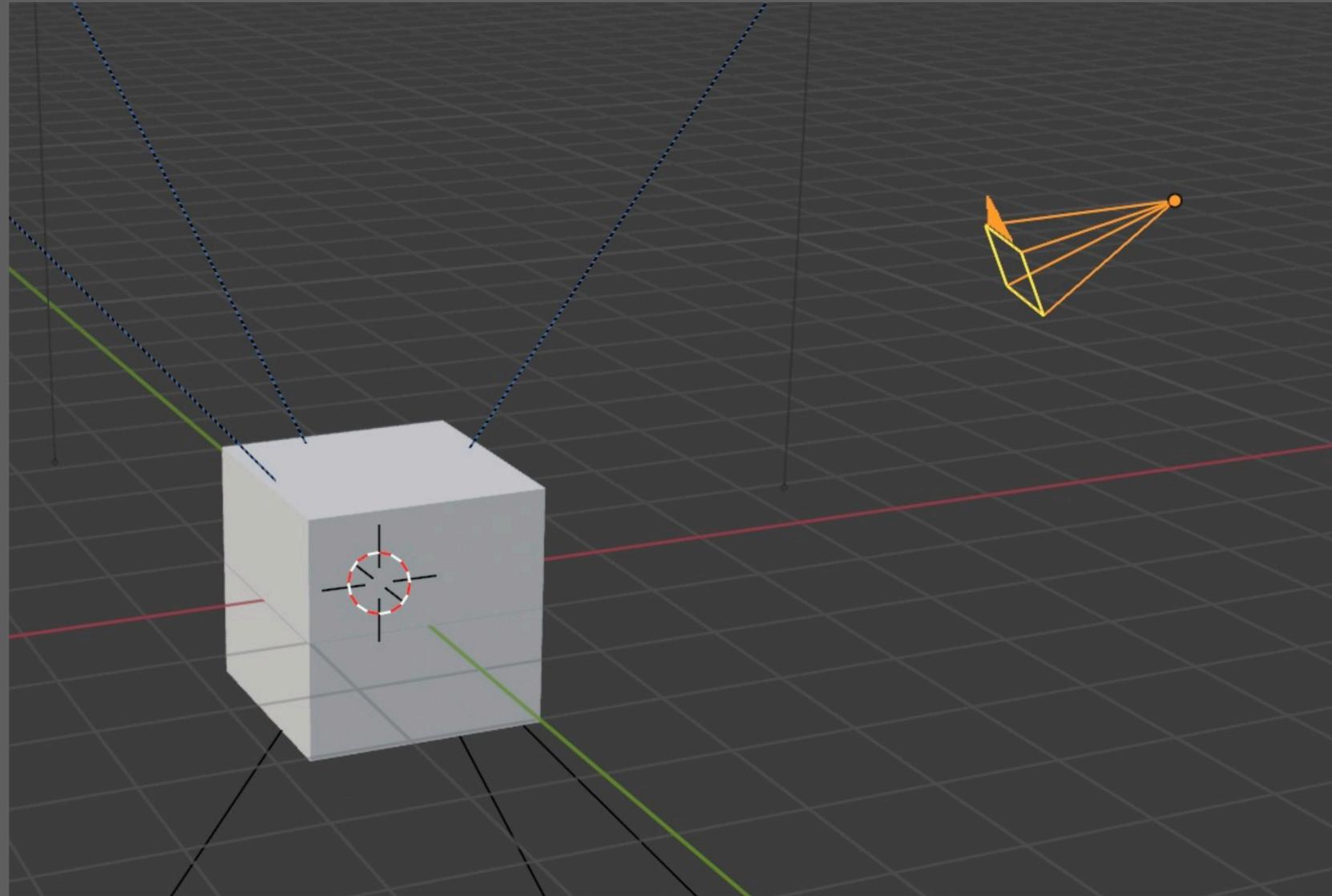
Back



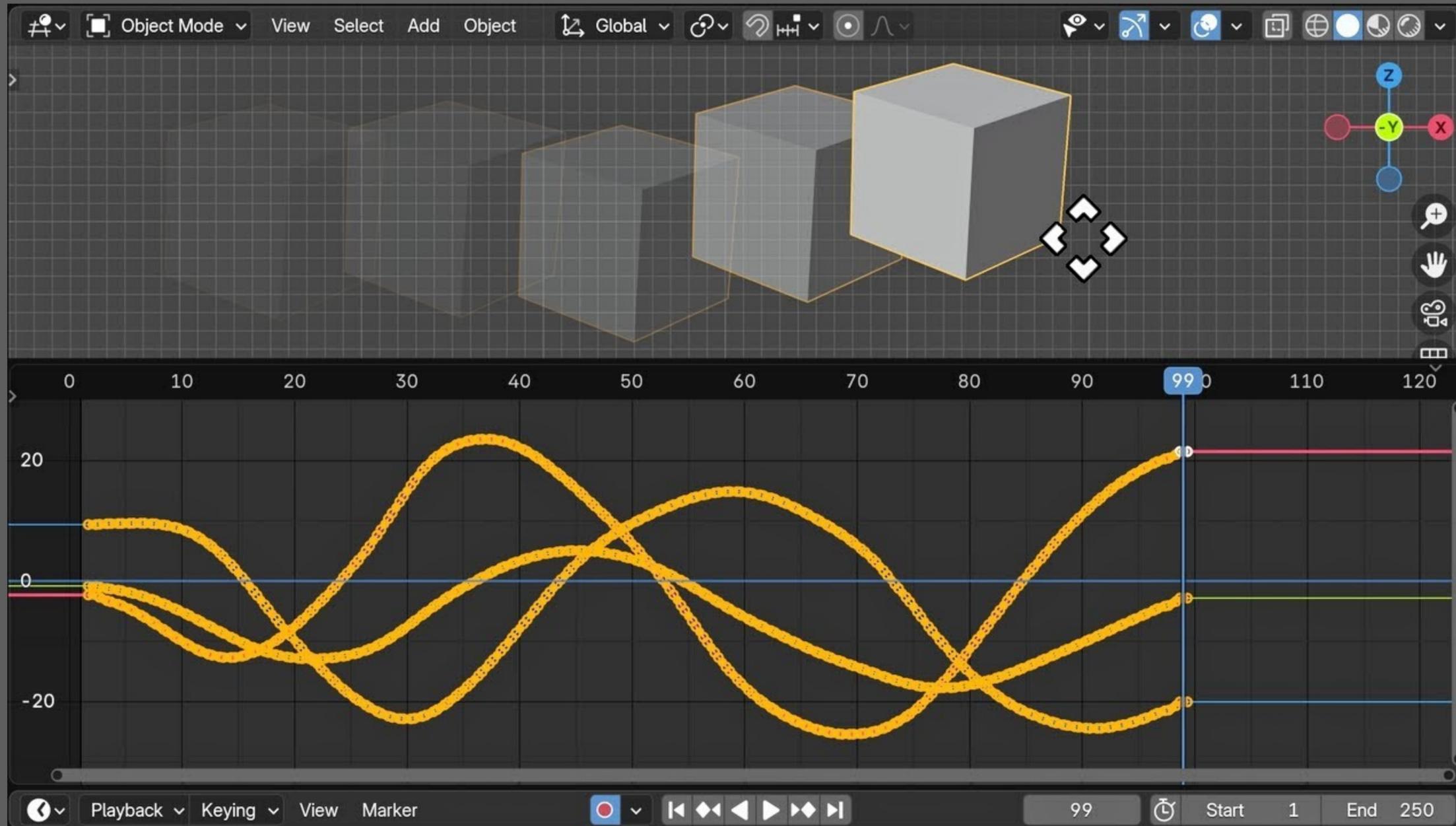
Task: Try 3 Point Lighting on your object



# Camera Movement

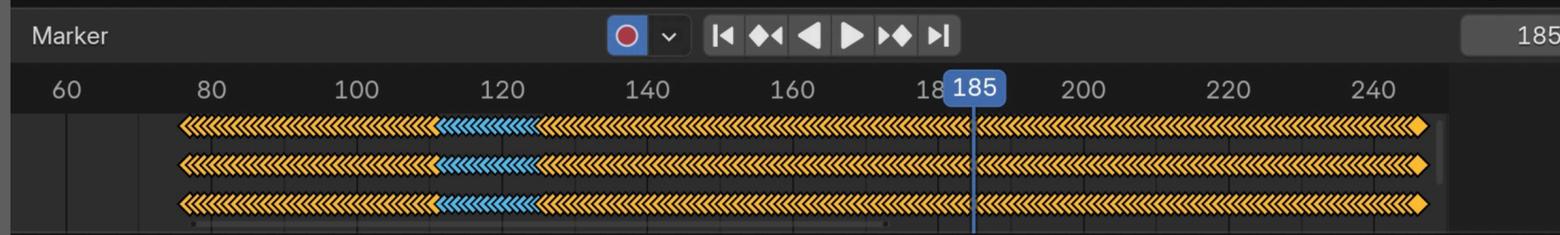
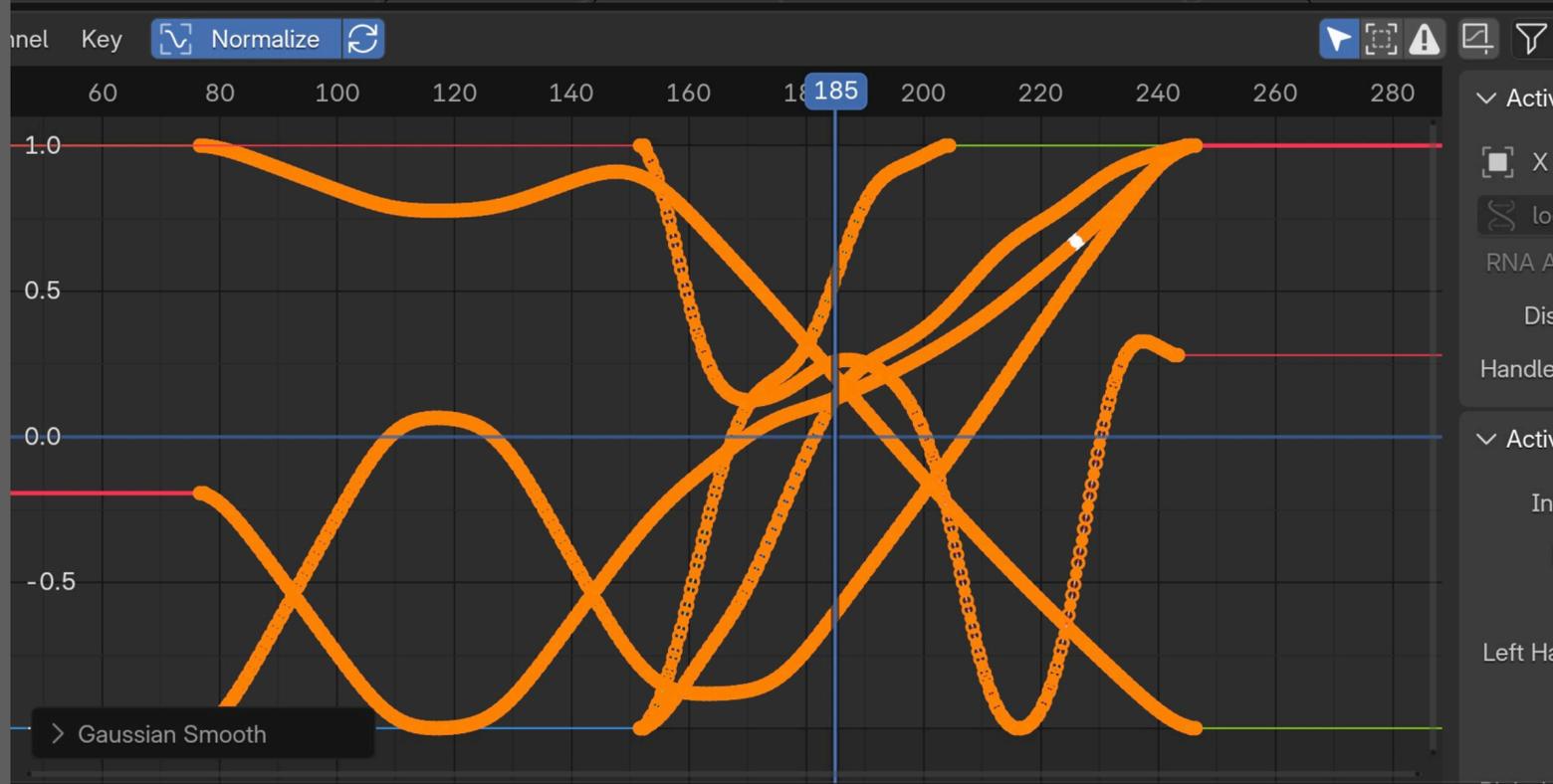
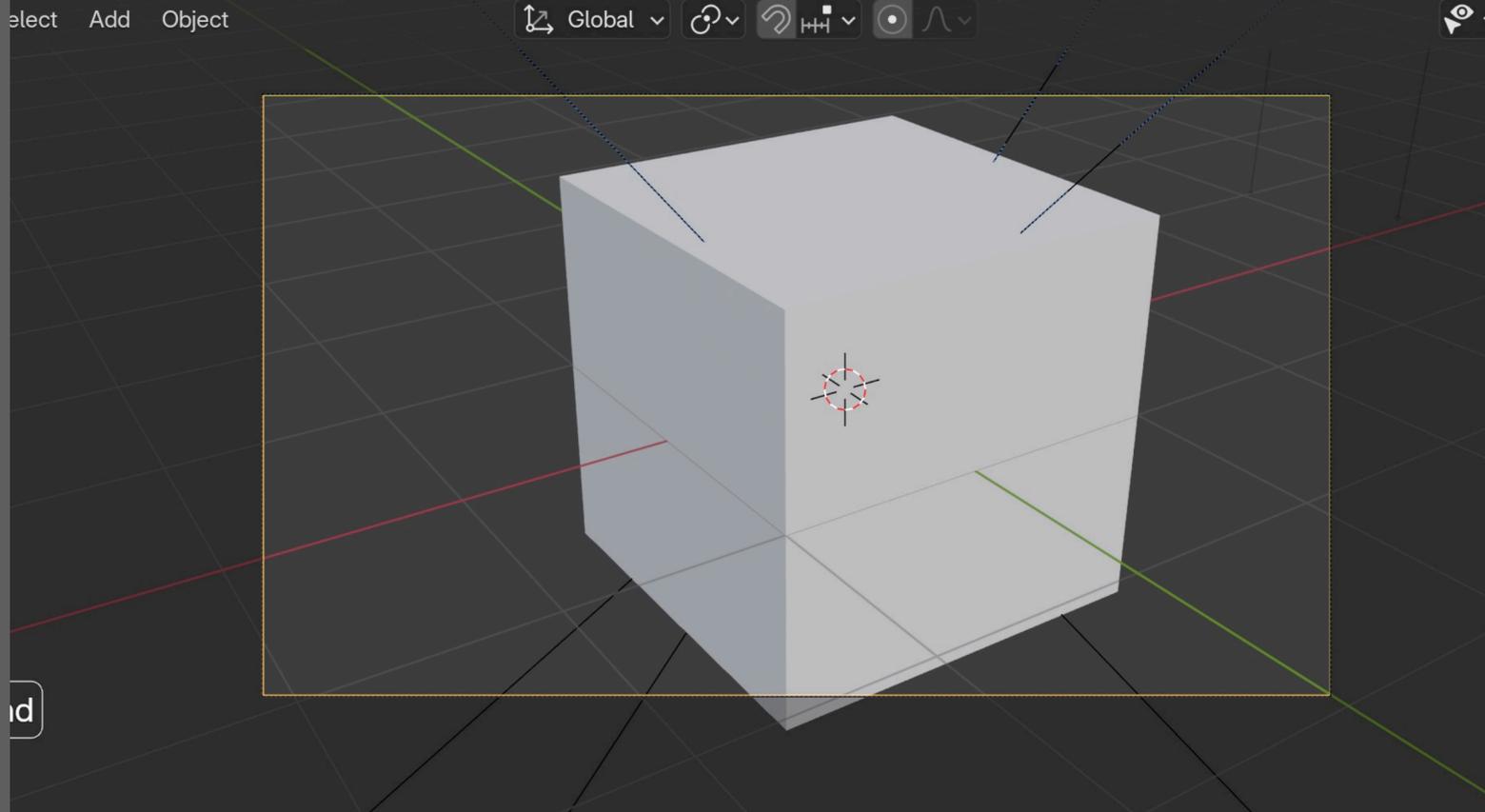


# Camera Movement



<https://www.youtube.com/watch?v=QLLZF9h1bbs>



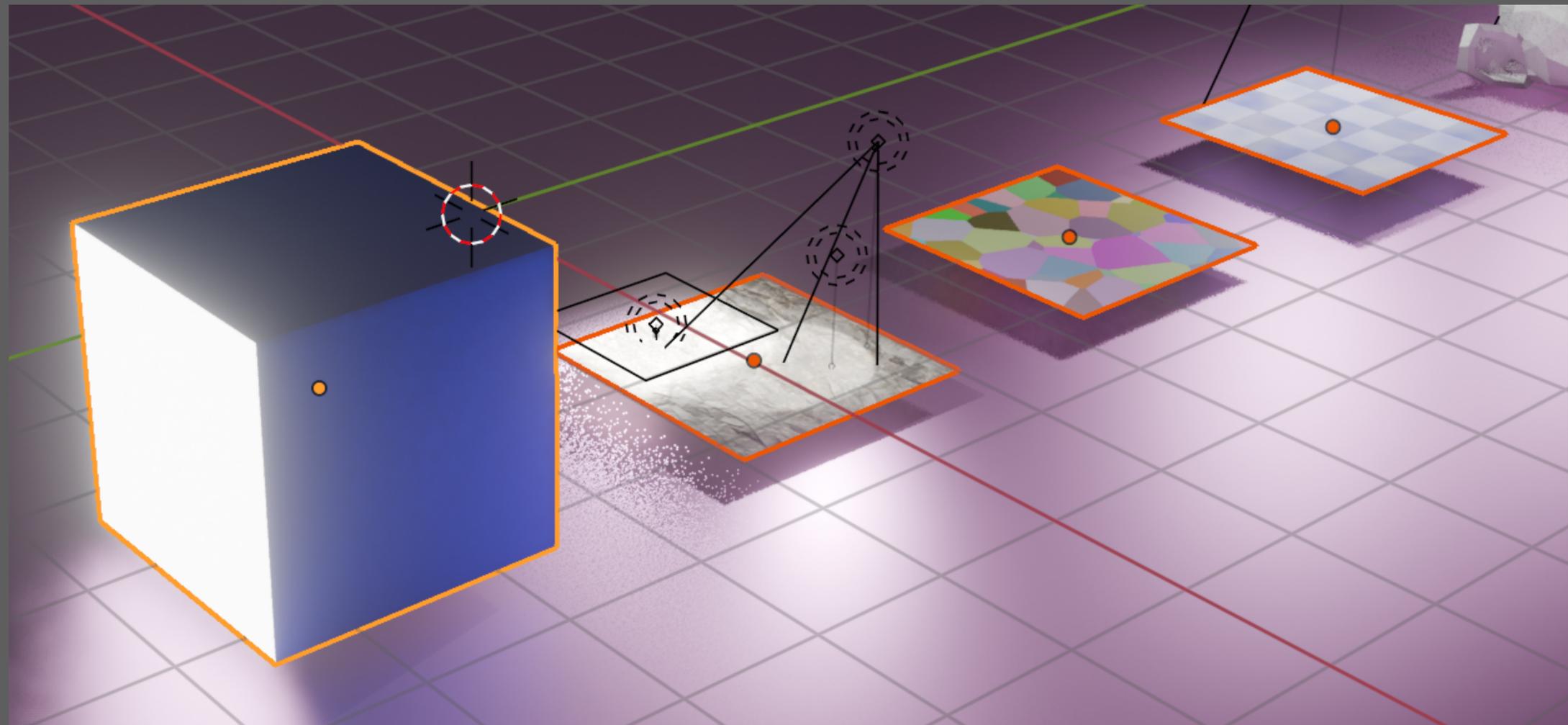


# Compositor

Jan-Hendrik Müller  
Blender 4.5.1

August 2025





Render Layers

- Image
- Alpha
- Scene
- ViewLayer

Glare

- Image
- Glare
- Highlights
- Bloom
- High
- Image
- Highlights
- Adjust
  - Strength 0.200
  - Saturation 1.000
  - Tint
- Glare
  - Size 1.000

Composite

- Image

Viewer

- Image

# Further Resources

<https://www.youtube.com/watch?v=PYTXvo29AsY>

