FOSSEE Summer Fellowship 2025 Report

on

Graphics and Animation in Blender

Submitted by:

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Under the guidance of

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Acknowledgment

I would like to express my sincerest gratitude to **Prof. Kannan Moudgalya** whose vision of FOSSEE has enabled me to unleash my creative side. I extend special gratitude to my project mentor, **Mr. Khushalsingh Rajput**, SPSE (Graphics and Animation), whose constructive suggestions, empowering guidance and encouragement, helped me to build a successful project.
I thank them for ceaseless support throughout the fellowship, adding to that their valuable feedback, intuitive approaches, and perspective towards working. I also appreciate the guidance given by my fellow-mates for their support and guidance in the journey of this fellowship.
I perceive this opportunity as a big milestone in my career development. I will strive to use gained skills and knowledge in the best possible way and I will continue to work on their improvement, to attain desired career objectives. I also hope to continue cooperation with all of you in the future.

Contents

Objective

The core mission of this fellowship is the creation of a comprehensive library of 3D educational animation videos. These videos are designed to be clear, simple, and concise, serving as an invaluable resource for students. By making use of visual storytelling and 3D representations, the fellowship aims to break down complex subjects and present information in an easily digestible and engaging format, thereby significantly enhancing comprehension and retention.

The focus of this endeavor lies in the process of video creation. This involves dabbling in advanced 3D modeling techniques and sophisticated animation workflows, primarily utilizing the open source software, Blender. Every video is crafted with accuracy in its representations and fluidity in its animations. This objective highlights the technical expertise and artistic vision required to transform educational concepts into compelling visual experiences.

About Software

Blender is the free and open-source 3D creation suite. It supports the entirety of the **3D pipeline—modeling, rigging, animation, simulation, rendering, compositing and motion tracking, even video editing and game creation**. Blender is well suited to individuals and small studios who benefit from its unified pipeline and responsive development process.

Blender is cross-platform and runs equally well on Linux, Windows, and Macintosh computers. Its interface uses **OpenGL** to provide a consistent experience. 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.

Blender has no price tag: it is your own 3D software. For this project we will be using Blender 4.4 version and Cycles renderer for the rendering process.

Project Workflow

Selecting Topics

- "Electric Motor 3D Model & Animation" project focuses on the working mechanism of an electric motor through 3D visualization.

- "Electromagnetic Induction Animation" covers Faraday’s and Lenz’s Law using coil, magnet, and battery-based interactions.

- "DNA Structure Animation" explores the hierarchical organization of DNA from chromosomes to base pairs
- “Animate 2025”- creation of scene 4 and 5 of the intro video of animate 2025 organised by IIT Bombay

Idea and Reference Finding

- References include educational YouTube videos, textbook diagrams, and existing 3D visualizations.

- Electromagnetic induction animation was guided by the principles of Faraday’s Law and Lenz’s Law and their real-world applications.

- DNA animation was based on visual hierarchy from chromosome to nucleotide level, relying on biological representations.

Scripting and Storyboarding

- Electric Motor includes a detailed storyboard with scene descriptions, timings, animation notes, and camera effects for all parts of the animation cycle.

- Electromagnetic Induction includes a scene-by-scene storyboard from initial coil state to induction via magnet movement.

- DNA Structure project lists a 7-scene progressive breakdown from a full chromosome to labeled base pairs.

Modelling and Texturing

- Electric Motor assets: rotor shaft (cylinder), stator windings (torus), housing, fins, and coils. Textures: metallic (aluminum), copper, worn metal, rubber, matte grey.

- Electromagnetic Induction models: copper coil, bar magnet, battery, plain scene plane. Materials: copper wire, plastic casing.

- DNA: not explicitly listed but involves chromosomes, chromatids, nucleosomes, DNA helices, and labeled base components.
- Intro video: 3D side developed in Blender using previous project assets; 2D side sketched and vector-layered in Synfig Studio using matching structure.

Rigging and Animations

- Electric Motor: rotating rotor, assembling parts, animating the working and isolating each part.

- Electromagnetic Induction: magnet and battery motion, magnetic field line animation, current indicators with directional change.

- DNA: animations include zooming, rotating chromosome, magnifying into helices, strand unzipping

Rendering

- All projects rendered in Blender using **Cycles** rendering engine and **Eevee.**
- Scene setup emphasized clean visuals and lighting
- Output formats included `.avi` video and `.blend` source files

Audio and Video Editing

- Intro video: Composited dual outputs side-by-side in video editor; narration aligned with actions, minor background music layered for clarity.
- Rest of the projects had simple fading in and fading out, cut and copy were performed on the video clips.

Narration

- **Electric Motor**: Implied narration through storyboard structure; scenes were designed with labeled visuals and sequencing intended for explanatory voiceover, such as part assembly, current flow visualization, and final summary screen with overlay text.
- **Electromagnetic Induction**: Included a complete voiceover script narrating the sequence of connecting a battery, generating magnetic fields, and demonstrating induced current using Faraday's and Lenz's Laws.
- **DNA Structure**: Narration implied through structured progression from chromosome to nucleotides, with each scene isolating and highlighting key biological components for guided explanation, intended for educational commentary

Final Output

- Output formats:
    - Electric Motor: animation including multiple scenes with mechanical breakdown and component labels.
    - Electromagnetic Induction: `.avi` animation, `.blend` Blender file.
    - DNA Structure: progressive scene animation concluding with labeled base pairs.
    - Produced a split-screen video demonstrating conceptual parity across 2D and 3D pipelines, exported as a single synchronized educational clip.

- All the outputs were rendered out in 30 fps in .avi codec.
- The DNA video was outputted in a .mov codec (Quicktime)

Issues faced and their Solutions

Issues Faced in Electric Motor Project

1. **Complex Geometry**: Creating precise mechanical parts (rotor, stator, brushes) required accurate referencing and iterative modeling.

2. **Component Alignment**: Ensuring moving parts (e.g., shaft rotation) aligned mechanically.

3. **Magnetic Field Visualization**: Representing invisible phenomena like current and magnetic field required custom shaders and animated overlays.

4. **Timing Consistency**: Assembling sequences and motion had to be tightly timed to narration, requiring multiple animation passes.

5. **Labeling and Clarity**: On-screen labels cluttered visuals; needed adjustments in placement, font size, and timing for legibility.

Issues Faced in Electromagnetic Induction Project

1. **Abstract Concepts**: Visualizing flux changes and induced current in a way that’s intuitive but accurate was challenging.

2. **Magnet Motion Accuracy**: Animating magnet movement smoothly while maintaining physical correctness of field interactions took multiple iterations.

3. **Current Flow Representation**: Visualizing current in a passive coil required symbolic arrows and glow effects, which had to be hand-animated.

4. **Scene Simplification**: Reducing visual noise while keeping all components visible and informative was a continuous balancing task.

Issues Faced in DNA Structure Project

1. **Scale Navigation**: Transitioning from chromosome to molecule scale without confusing the viewer needed carefully planned zoom sequences.

2. **Organic Modeling**: Creating smooth, biologically accurate curves for DNA, nucleosomes, and base pairs was difficult with default mesh tools.

3. **Strand Animation**: Animating the unzipping of the double helix while preserving structural integrity demanded complex bone or path setups.

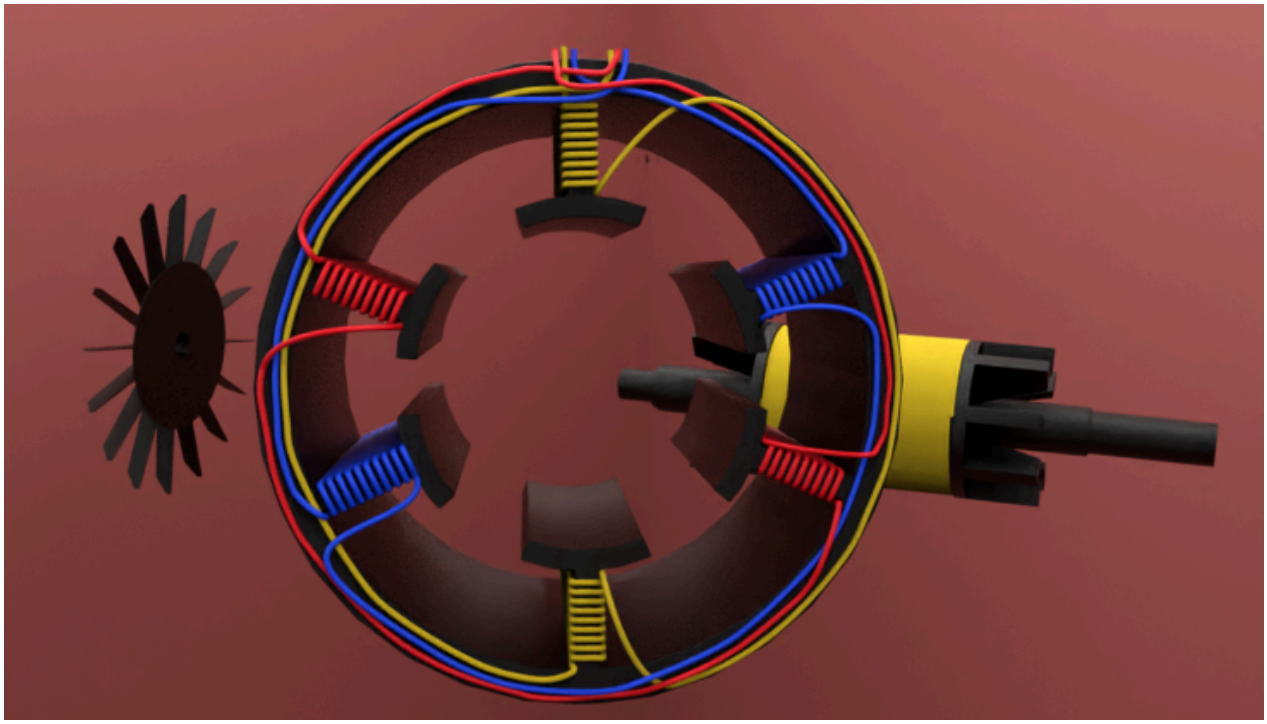
4. **Color Coding**: Assigning and maintaining consistent colors for A, T, G, and C.

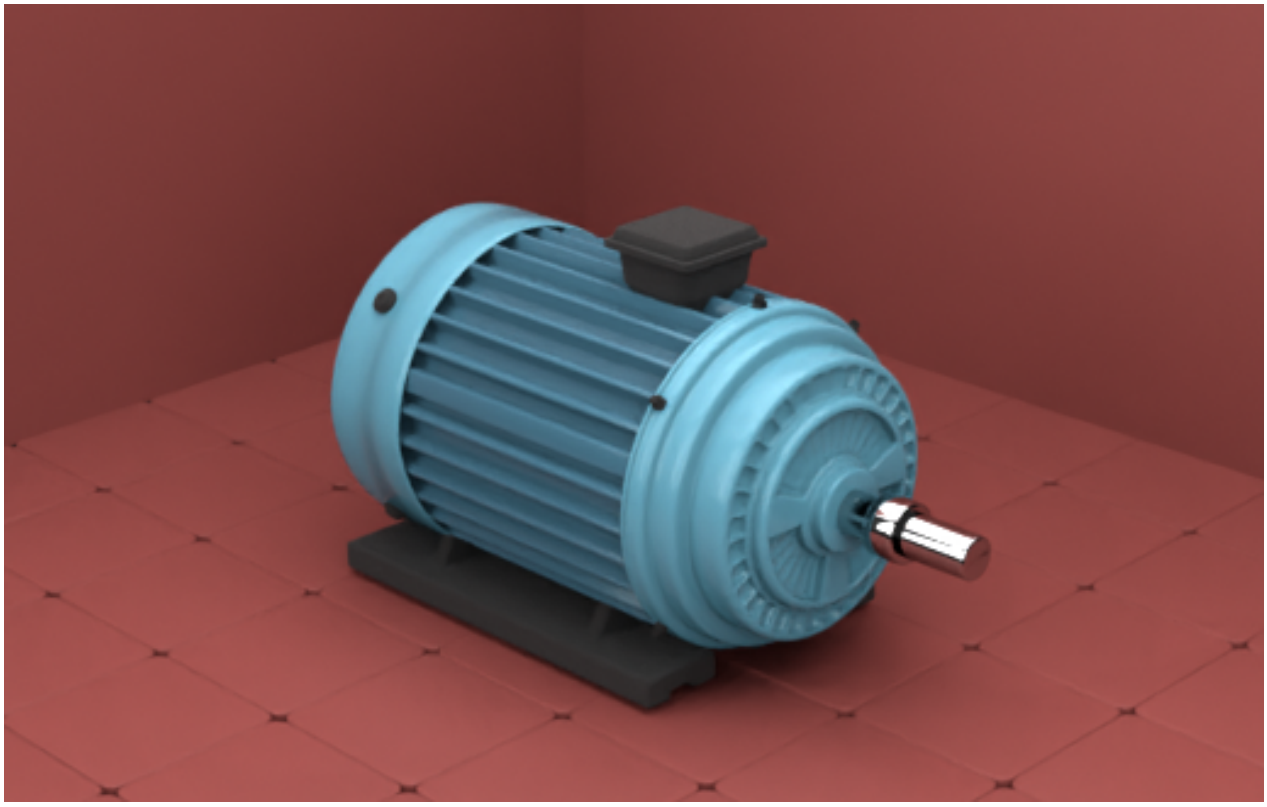
5. **Scene Transitions**: Ensuring seamless continuity across magnification levels (macro to micro) without jump cuts required precise camera paths.

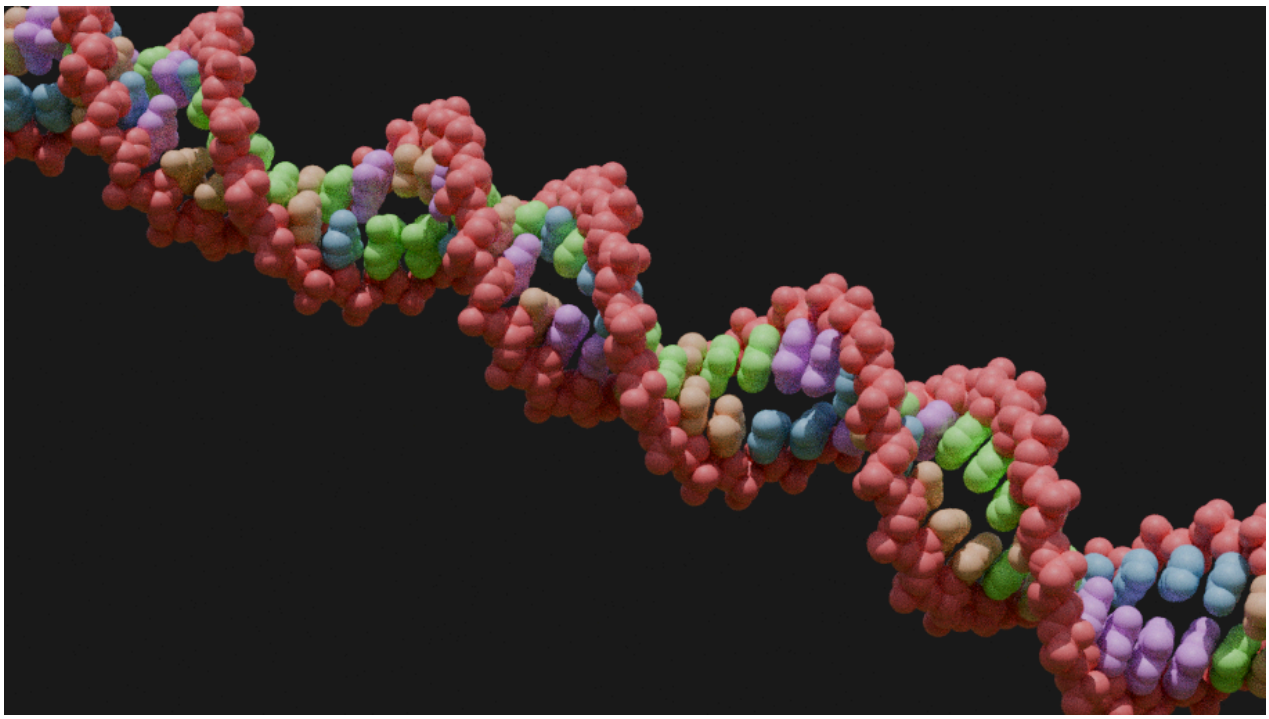
Bibliography and references

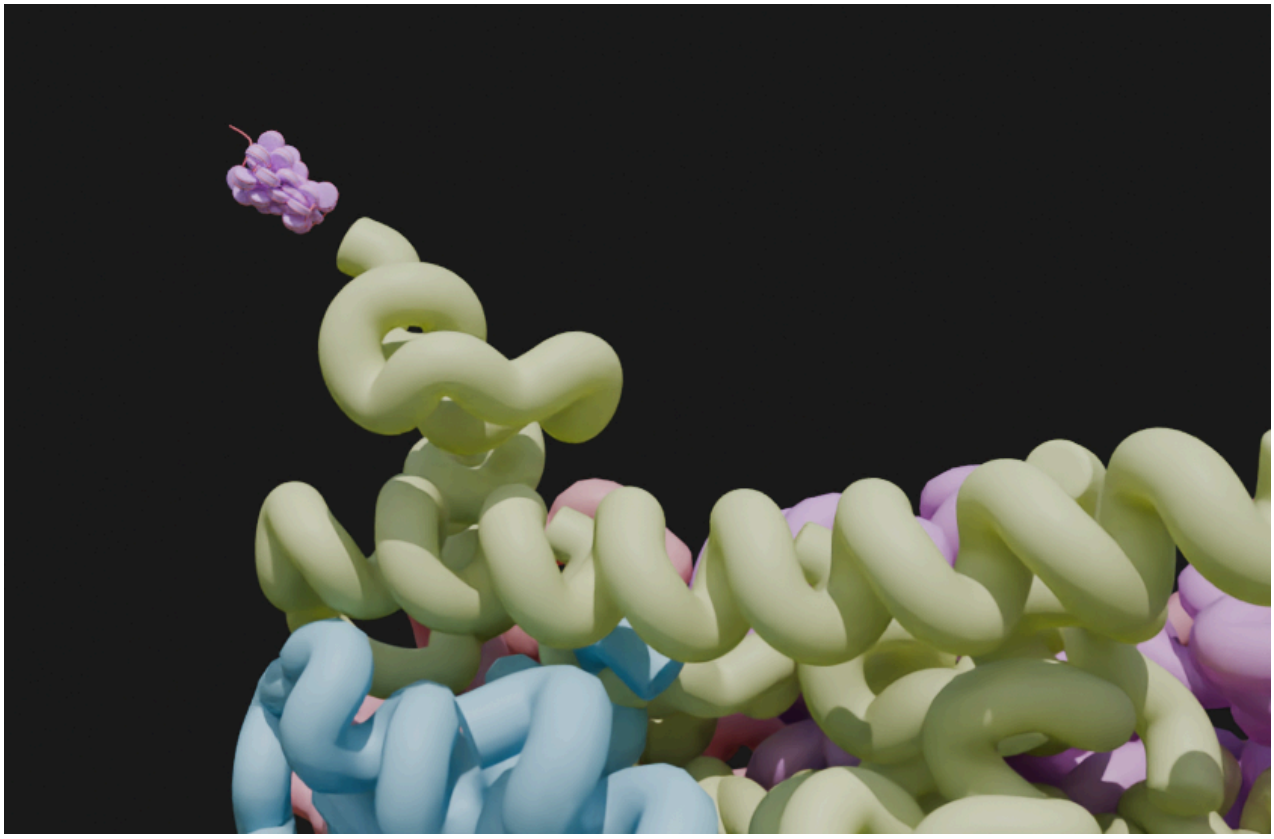
- Base Pair 3-D was referenced for the **DNA project** to understand how the unravelling should occur
- How Electric Motors Work - 3 phase AC induction motors ac motor was very useful in the **electric motor project** as it clearly showed which part goes where.
- Coils and electromagnetic induction | 3d animation #shorts was referenced for the **electromagnetic induction project**
- https://www.narakeet.com/ was used to create the AI generated voiceover.
- blender.org was the software used for the animation.

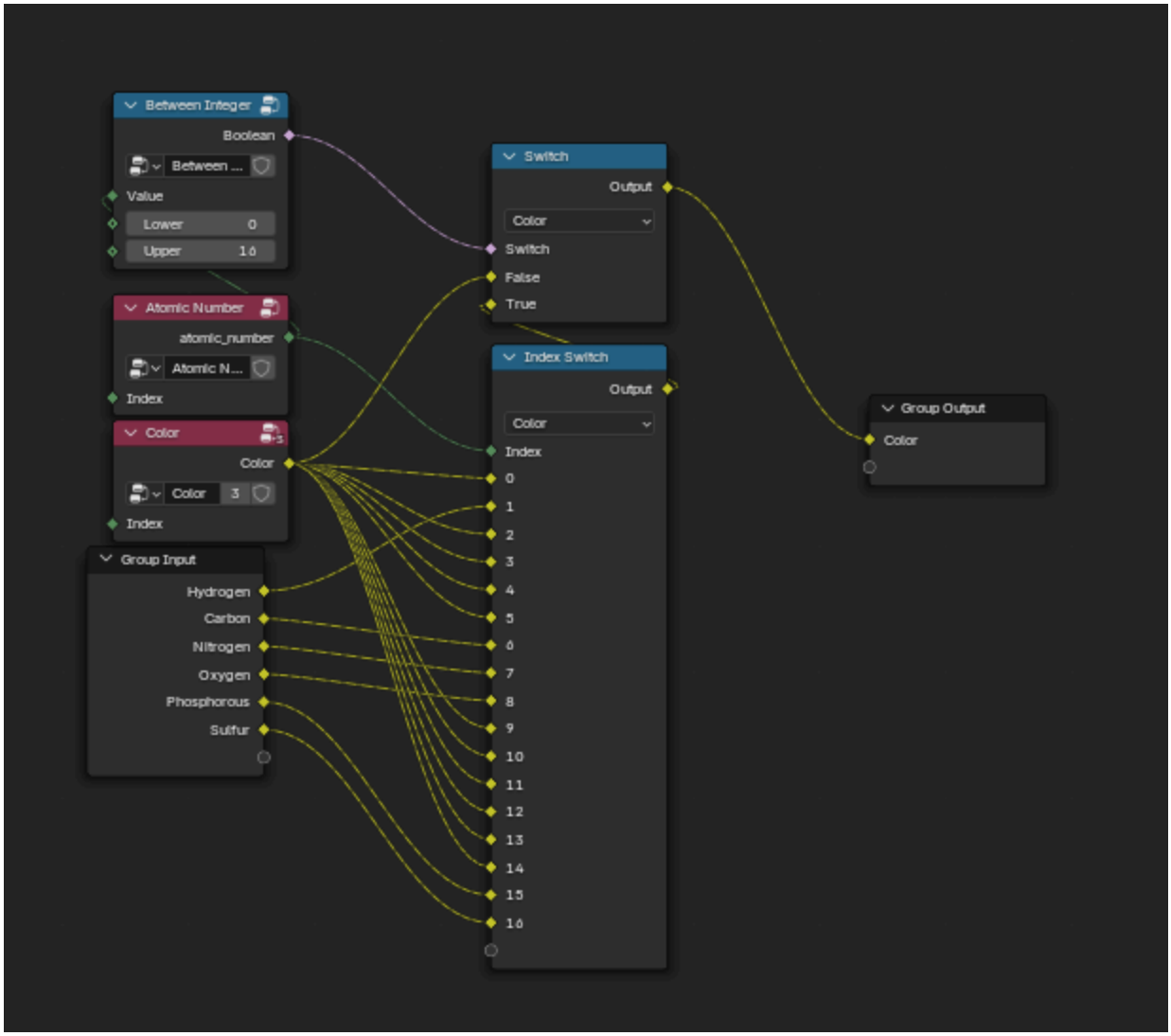
Gallery







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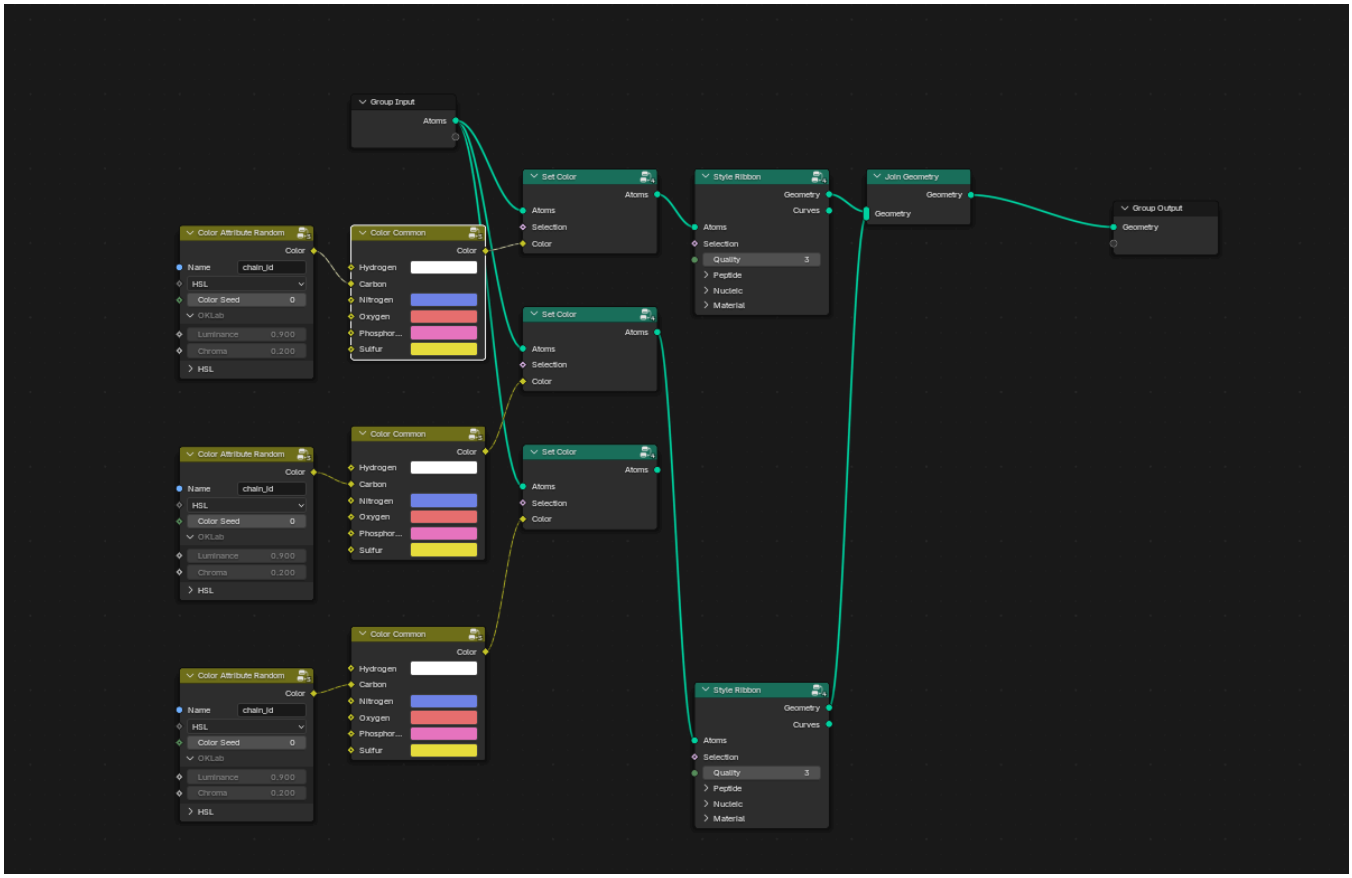
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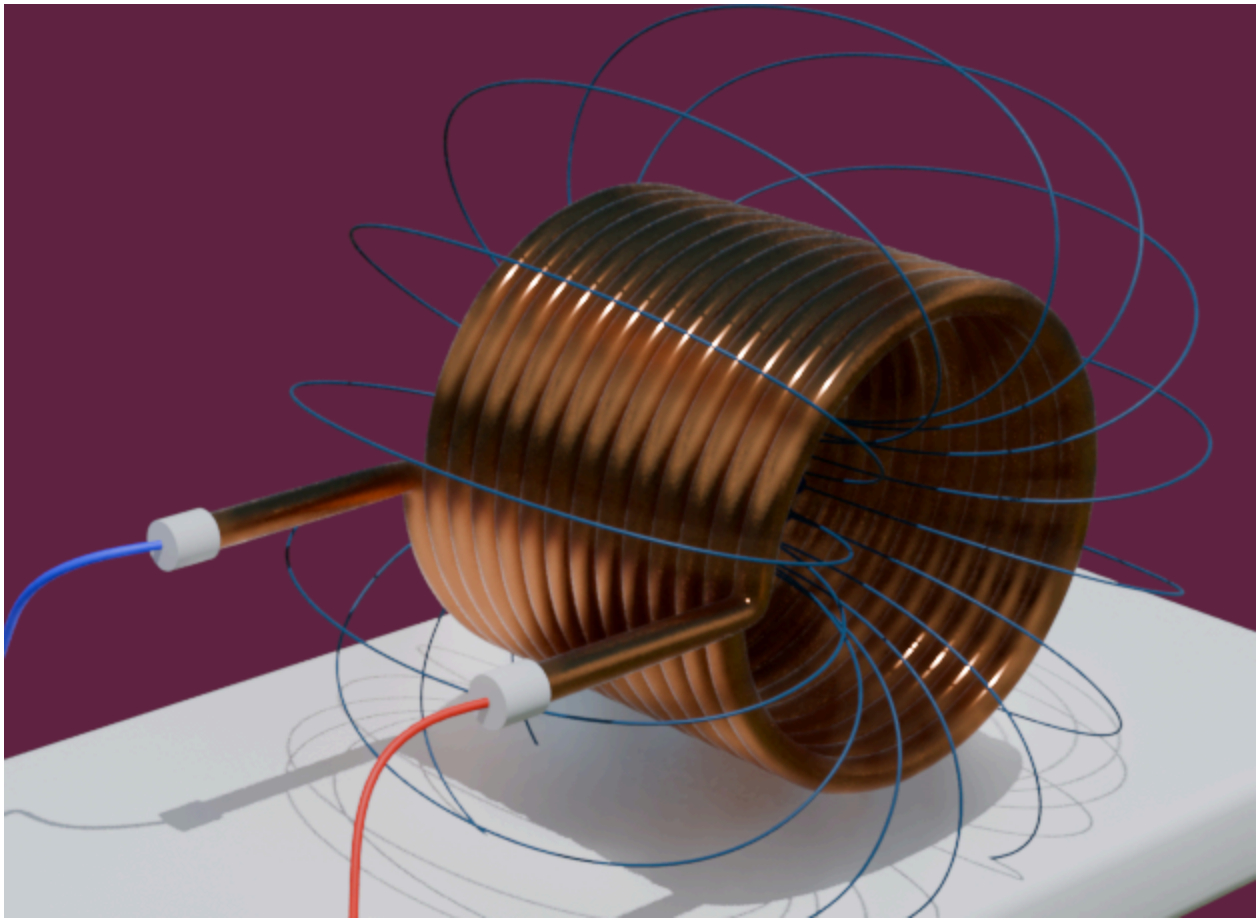

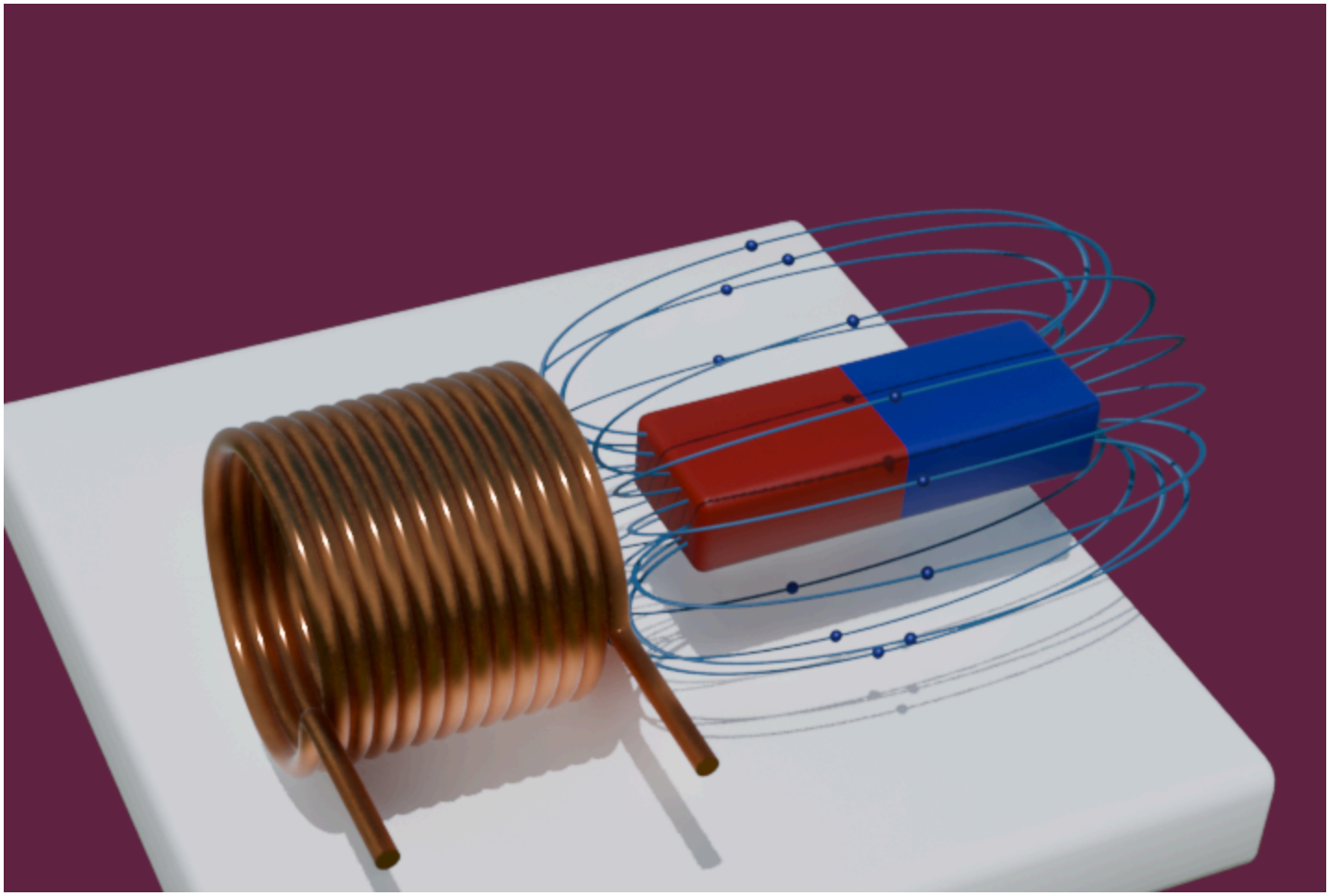

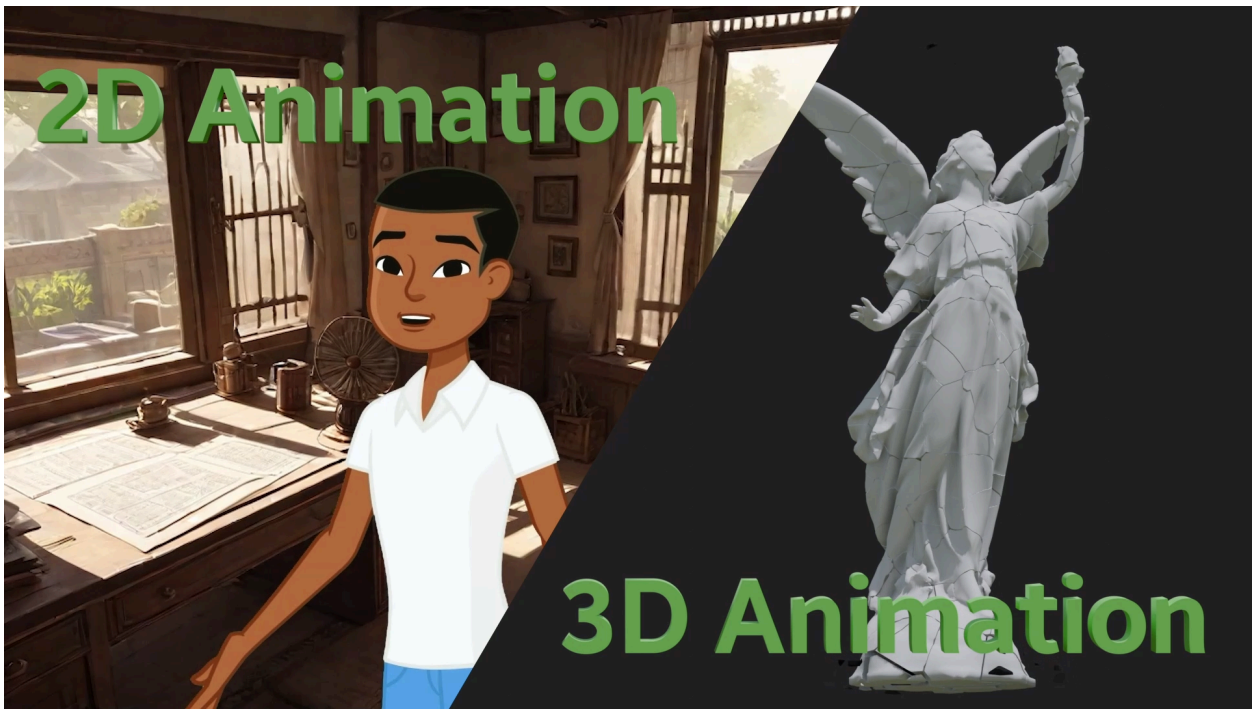
2D Animation
3D Animation