University of British Columbia / Emerging Media Lab

IMLE (Immersive Materials Learning Environment)

Summer 2026

PURPOSE

The Immersive Materials Learning Environment is a browser-based, interactive learning tool for APSC 278/279 and MECH 221, core second year materials science and engineering courses that serve nearly 700 students from different engineering disciplines annually.

By providing experiential access to concepts that are otherwise difficult or impossible to observe or practice, the IMLE promotes deep learning and higher-order cognitive engagement, enabling students to move beyond memorization toward application of concepts to real-world engineering problems.

CONTEXT

Before development, several barriers to student learning were identified, revealing a common risk pathway that guided IMLE’s design and intended role.

IDENTIFIED CONDITIONS AND RISKS

Fig 1. Diagram identifying key contextual conditions present in APSC 278 and APSC 279.

Fig 2. Diagram identifying the risk pathway that IMLE aims to intervene with and prevent.

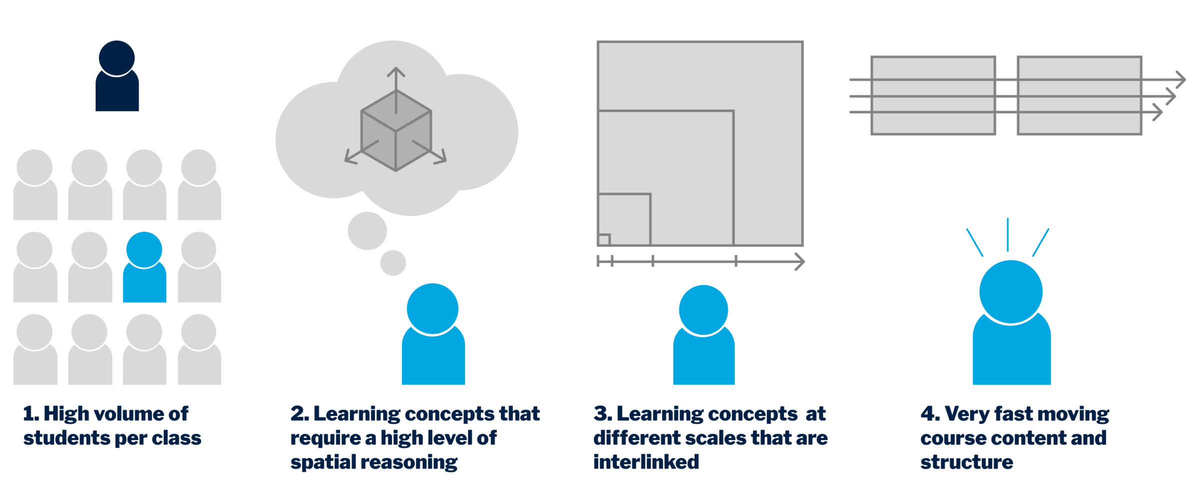


Fig 1. Identified Conditions

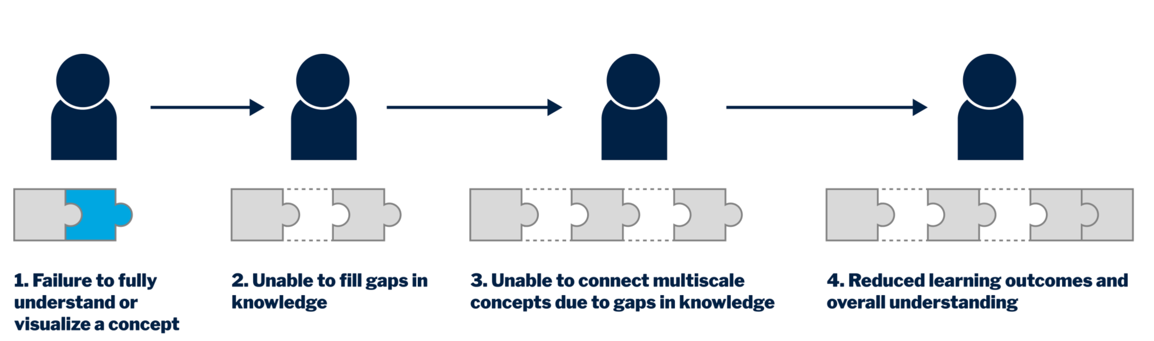
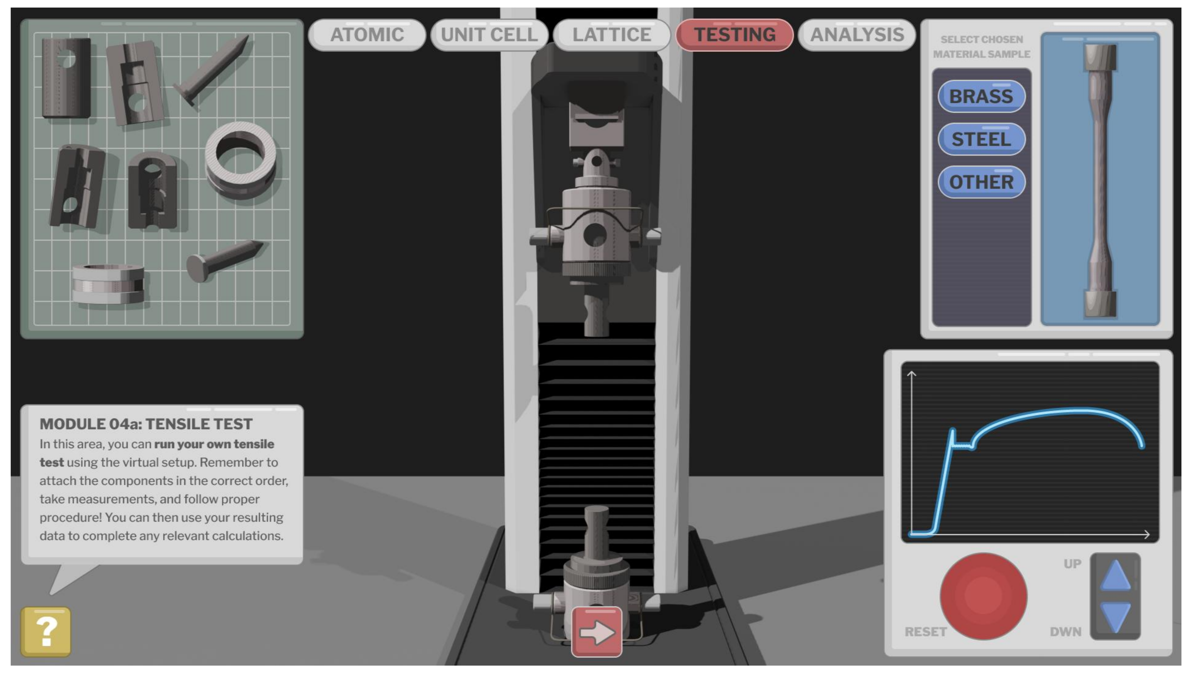


Fig 2. Identified Risks

PROJECT DETAILS

The current IMLE project includes 5 interactive modules aligned with selected course topics:

- Atomic Bonding Module: Students select elements from an interactive periodic table to explore which elements they are likely to bond with and the resulting bond type.
- Unit Cell Module: Students interact with unit cells to visualize atomic arrangements in different crystal structures and determine key characteristics such as coordination number and atomic packing factor.
- Lattice Defects Module: Students explore different lattice defects, visualize their structures, and examine how they move and distort the surrounding lattice.
- Tensile Testing Module: Students independently perform virtual tensile tests on a wide range of materials without the equipment, safety, or specimen limitations of a physical laboratory.
- Graph Analysis Module: Students explore an interactive graph to understand how different material’s physical properties, and atomic structure change and evolve during a tensile test.



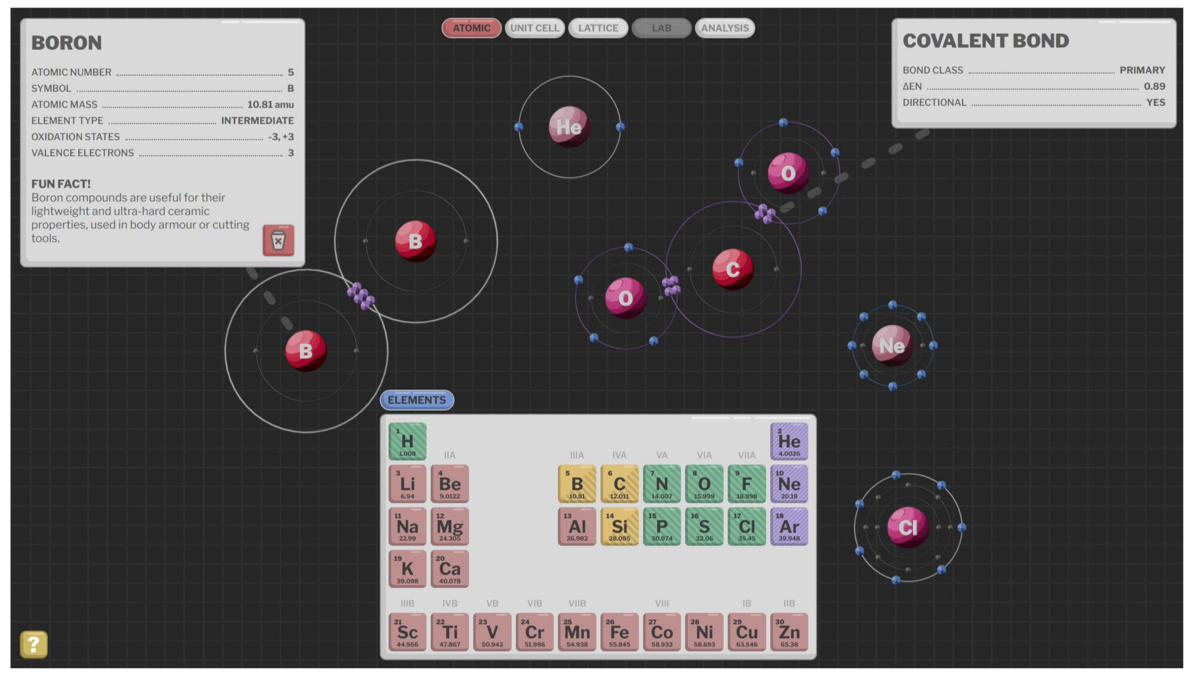
IMLE: Tensile Testing Module

A screenshot of the tensile testing module, showing the virtual tensile testing environment and interactive UI elements.

DESIGN PRINCIPLES

The app was designed with a unified visual style and user interface to be easily understandable and intuitive to use. The references existing scientific tools, media and visualizations to create a seamless experience for students referencing textbook material. Complex scientific concepts were distilled into simplified representations while still retaining enough accuracy and detail to remain effective as educational content.

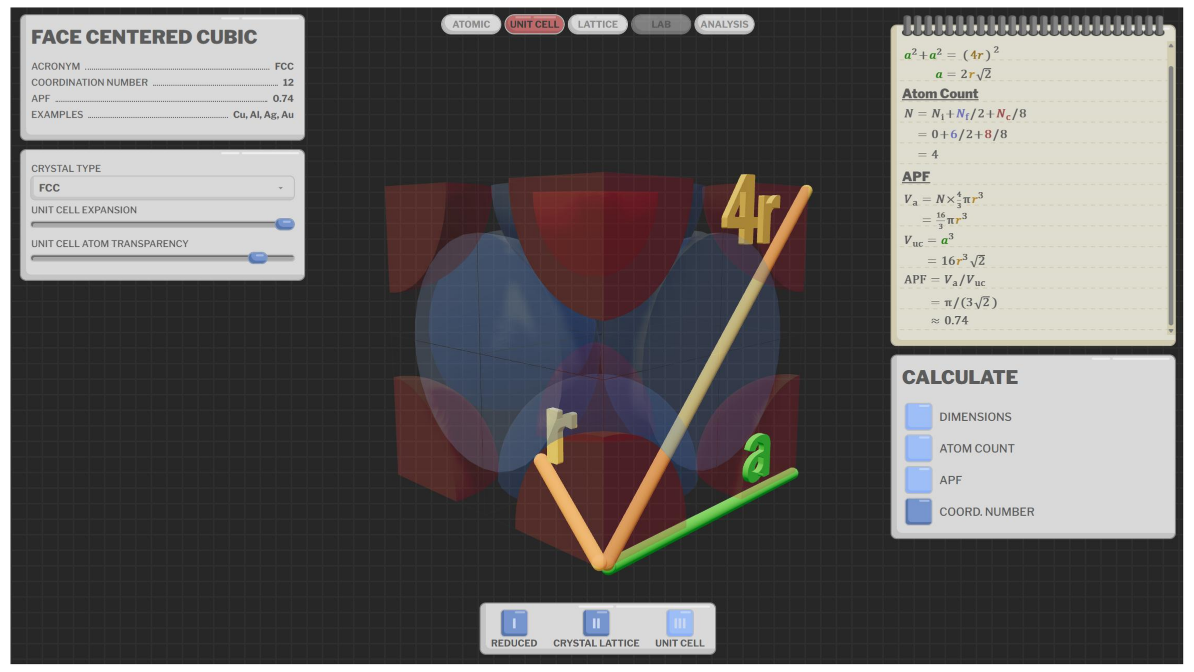
Accessibility was a key concern throughout the design process, with consideration for colorblind users and Universal Design Language (UDL) principles.



IMLE: Atomic Bonding Module & Unit Cell Module

Pictured above: A screenshot of the atomic bonding module, showing atomic bonding, and informational pop-ups.

Pictured below: A screenshot of the unit cell module, and the various tools and information shown while exploring the model.



DEVELOPMENT & SYSTEMS

The app was developed using react, with react-three-fiber used for rendering the 3d scenes.

Key development challenges included:

- The Atomic Bonding Module's bonding system, built to calculate ionic, covalent and metallic bonds from atom configurations.
- The Atomic Bonding Module's procedural metallic bonding animation.
- The Tensile Testing Module's particle physics simulation, showing the movement of defects through a sample.

NEXT STEPS

- Implementation of an additional module focusing on visualizing crystallographic planes.
- Implementation of additional material samples for testing and analysis within module 4.

REFERENCE / BIBLIOGRAPHY

1. William D. Callister, “Materials Science and Engineering”, Wiley, 10th edition.

ACKNOWLEDGEMENTS

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