Research-based Design of Challenges

FUSE's innovative model is based on decades of research in education.

The program was initially conceived to create an alternative infrastructure for learning. This approach provides both more structure and support than open-ended makerspaces (where learners are simply let loose to explore available tools) but also more choice than standard STEM curriculum (where all students do the same project or use the same tools). In FUSE, the teacher is just one of many resources upon which students can draw. In fact, FUSE is designed to encourage students to seek help from peers or digital resources before seeking help from adults.

FUSE's approach is consequential for the interest pathways it provides students and the learning that occurs on those pathways. FUSE classrooms differ from traditional classrooms most fundamentally in the fact that students choose among the Challenges, and the principle of choice extends to who they work with, how long they work on Challenges, and whether they continue with a particular Challenge or try something new. This core commitment to choice is rooted in the goal of seeking to help students find, cultivate, and deepen their own STEAM-based interests.

FUSE Challenges are designed to be appealing to any student, including students with little prior expressed interest in STEM. We design our Challenges to reach across the gender and interest spectrum. Our goal is to meet students wherever they are in their learning pathway and to support interest development in the broad areas of design, technology, and engineering.

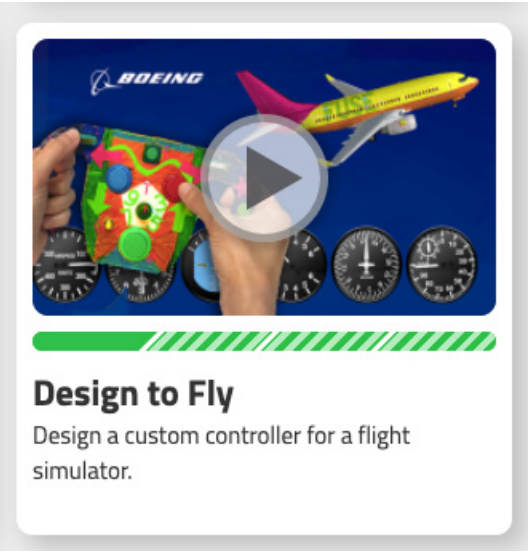
THE KEY PRINCIPLES THAT GUIDE THE DESIGN OF OUR CHALLENGES.

As indicated above, our Challenge Design process utilizes several design principles. Our "Design to Fly" Challenge demonstrates how FUSE employs these principles while working with an industry partner to develop a new Challenge.

Inside our Challenge Design: Design to Fly

In 2018, FUSE and Boeing partnered to design a new Challenge related to flight. We began by examining web-based flight simulators, which bring together video gaming and the dynamics of flight. It is fun to fly a plane in a simulator, but there is limited creativity in the activity itself. We noticed that flying a simulator using a keyboard is challenging, especially as one develops skills to manage more flight controls. In response to this observation, we developed a controller design Challenge, using cardboard, a Makey Makey, pushbuttons, toggles, and other inputs. The design and construction of the controller gets more complex as users progress through the levels of the Challenge. The Challenge reflects the design process used by engineers at all levels of the

Challenge Development & STEM Pathways



DESIGN TO FLY IN THE CHALLENGE GALLERY

flight design process: prototyping with simple materials, testing, and iterating to improve the design.

After engaging in Design to Fly, a student might explore different pathways within FUSE and beyond. A student might find similar design opportunities in other FUSE Challenges like Dream Home, Jewelry Designer, or Game Designer. They might pursue emerging interests in aeronautics, engineering, electronics, user interface design or industrial design.

The tables below include all our FUSE Challenges with their general content area and interest pathways.

While the Challenges are broadly categorized here, as an integrated STEAM program there is overlap between technology, engineering, and design. The student view of FUSE Challenges is intentionally left uncategorized; it is important for students to have open choice as they survey the FUSE Challenge gallery and select a Challenge to try.

Challenges undergo regular maintenance to align with technological innovation and to improve student engagement (e.g., reaching more girls with robotics and coding Challenges). Most Challenges are Chromebook compatible and take advantage of browser based software.

All Challenges listed below are included in our comprehensive Innovate package.

FUSE Engineering Challenges

Year	Challenge	Technology Used	Professional Analog	Category	Topic	Professional Pathway	Industry Partner
2011	**Spaghetti Structures**	Design Thinking	*Civil Engineering*	Engineering	Physics	*Engineering/Design*	
2013	**Wind Commander**	Windmill/Weights	*Renewables*	Engineering	Wind Power	*Wind Power/Environmental Engineering*	Siemens
2013	**Solar Roller**	Solar Powered Car	*Renewables*	Engineering	Solar Energy	*Solar Power/Automobile Design*	Siemens
2014	**Get in the Game**	Makey Makey/ Design Thinking	*Interactive Game Design*	Engineering	User Experience	*Programming/Physical Computing*	
2015	**Coaster Boss**	Design Thinking		Engineering	Physics	*Engineering/Design*	
2012	**Laser Defender**	Lasers/Media/Design Thinking	*Smart Technologies*	Engineering	Physics	*Quantum Computing*	
2018	**Smart Castle**	Sensors/Electronics	*Smart Technologies*	Engineering	Electronics	*Automation/Information Technology*	Siemens
2018	**Design To Fly**	Flight Simulator/ Prototyping	*P3D and X-Plane*	Engineering	Physics	*Aeronautics/Engineering/Design*	Boeing
2020	**Look No Hands**	Design Thinking		Engineering	Physics	*Engineering/Design*	
2020	**Slow Your Roll**	Design Thinking		Engineering	Physics	*Engineering/Design*	

FUSE Technology Challenges

Year	Challenge	Technology Used	Professional Analog	Category	Topic	Professional Pathway	Industry Partner
2012	**Robot Rodeo**	Dash Robot	*Robotic Engineering*	Technology	Robotics Coding	*Programming/Robotics*	
2012	**LED Color Lights**	LEDs/Components		Technology	Electronics	*Electrical Engineering*	
2013	**Music Amplifier**	Amplifier/ Components	*Sound Engineering*	Technology	Electronics	*Electrical Engineering*	
2012	**Gel Chemistry**	Science	*Chemistry*	Technology	Chemistry	*Medical Sciences*	
2013	**Electrify It**	LEDs/conductive materials	*E-textiles*	Technology	Electronics	*Nanotech/E-textiles/Engineering*	
2013	**Party Lights**	LEDs/components	*Lighting Design*	Technology	Coding	*Programming/Physical Computing*	
2015	**Game Designer**	Gamefroot	*Unity*	Technology	Coding	*Platform Game Design*	
2018	**VR Escape Room**	Glitch/Web GL/ WebVR	*HTML5 Coding*	Technology	Coding	*Web Coding & Development*	CompTIA
2019	**Friend Finder**	Micro:bits	*Micro-controllers*	Technology	Coding	*Programming/Physical Computing*	CompTIA
2019	**Mini Jumbotron**	Arduino	*LED Displays*	Technology	Coding	*Electrical Engineering*	CompTIA

FUSE Design Challenges

Year	Challenge	Technology Used	Professional Analog	Category	Topic	Professional Pathway	Industry Partner
2011	**Dream Home 1 & 2**	SketchUp	*Sketchup/AutoCAD*	Design	Architecture	*Architecture/Construction Management*	Chicago Architecture Foundation
2012	**Beats Builder**	Digital Audio Workstation	*ProTools*	Design	Music	*Musician/Audio Engineer*	
2013	**Jewelry Designer**	Tinkercad	*AutoCAD/3DStudio Max*	Design	Arts	*3DModeling/Design/Fabrication/Engineering*	Christopher Duquet Fine Jewelry
2014	**Print My Ride**	Tinkercad	*AutoCAD/3DStudio Max*	Design	3D Printing	*3D/Modeling/Design/Fabrication/ Engineering*	
2016	**Keychain Customizer**	Tinkercad	*AutoCAD/3DStudio Max*	Design	3D Printing	*3D/Modeling/Design/Fabrication/ Engineering*	
2016	**Eye Candy**	Tinkercad	*AutoCAD/3DStudio Max*	Design	3D Printing	*3D/Modeling/Design/Fabrication/ Engineering*	
2016	**MiniMe Animation**	Blender	*Blender/Autodesk Maya*	Design	3D Animation	*3D Animation*	
2017	**Selfie Sticker**	Silhouette Cameo	*CNC Machining*	Design	Arts	*Fabrication/Engineering/Design*	
2018	**Cookie Customizer**	Tinkercad	*AutoCAD/3DStudio Max*	Design	3D Printing	*3D/Modeling/Design/Fabrication/ Engineering*	
2019	**Sculpty Pet**	Sculpt GL/Web GL	*Z-Brush*	Design	Arts	*3D Modeling/Animation/Design*	
2020	**Video Magic Tricks**	Clipchamp/Kapwing	*Adobe Premiere/Final Cut Pro/ AVID*	Design	Arts	*Film & Video Production*	
2022	**Balancing Act**	Tinkercad	*AutoCAD/3DStudio Max*	Desgn	Arts	*Human/Machine Interface Design*	The Mazda Foundation

