

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 sup-



THE KEY PRINCIPLES THAT GUIDE THE DESIGN OF OUR CHALLENGES.

port interest development in the broad areas of design, technology, and engineering.

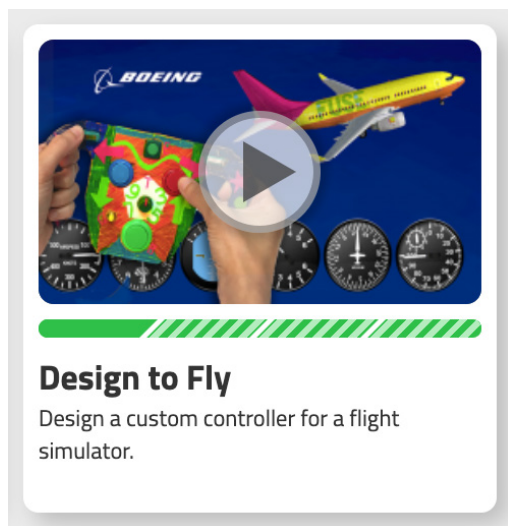
As indicated above, our Challenge Design process utilizes several design principles. Our "Design to Fly" challenge demonstrates how FUSE employs these principles while working with an industry partner to develop a new challenge.

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	How to Train Your Robot	Sparki 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	Just Bead It	Science	Chemistry & Oncofertility	Technology	Chemistry	Medical Sciences	
2013	Electric Apparel	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	Stencyl	Stencyl	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	Onshape	AutoCAD/3DStudio Max	Design	Arts	3DModeling/Design/Fabrication/Engineering	Christopher Duquet Fine Jewelry
2014	Print My Ride	Onshape	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	Onshape	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	WeVideo	Adobe Premiere/Final Cut Pro/ AVID	Design	Arts	Film & Video Production	
2022	Balancing Act	Tinkercad	AutoCAD/3DStudio Max	Design	Arts	Human/Machine Interface Design	The Mazda Foundation