

PLTW Engineering



Design Brief

Client	N. Guzman
Target Consumer	Children ages 6-12, with emphasis on girls and underrepresented groups in STEM. Parents and guardians are the primary purchasers. Secondary market: educators seeking classroom-ready, co-play-enabled kits.
Designer(s)	M.O.J.O. Team (MLKHS EDD 2025)
Problem Statement	Commercially available "girls' STEM toys" often provide shallow technical depth, reinforce stereotypes through gendered packaging, and underdeliver on authentic inquiry. Market research reveals that 61.1% of consumers believe toys are not marketed equally toward boys and girls. Existing products range from \$23-\$150 with inconsistent value: some feature confusing instructions (Butterfly EduFields), others have limited durability and reusability (Mega Cyborg Hand), and many rely on consumables or themed aesthetics rather than sustainable engineering challenges. These factors lead to uneven value propositions and reduced long-term engagement, particularly affecting girls' persistence in STEM.
Design Statement	The team will design, build, and test a modular rover construction kit that addresses key market gaps through: <ol style="list-style-type: none">1) interchangeable mechanical components enabling authentic inquiry and experimentation;2) dual-packaging strategy (gender-neutral + girl-targeted versions with identical content);3) structured guardian co-play framework with facilitation guides;4) NGSS-aligned progressive challenge pathways;5) mechanics-forward, identity-affirming design free from stereotyped themes. The kit will enable building two complete rovers from one package to support collaborative experimentation, racing, and comparative testing.
Criteria	<p>1. Authentic Inquiry Through Modular Design</p> <p>Enables prediction, hypothesis testing, data collection, and evidence-based conclusions through interchangeable mechanical components (motors, sensors, chassis designs). Multiple "brain modules" provide progressive difficulty levels (line-following, obstacle avoidance, basic driving) allowing learners to engage at their skill level. One kit builds two complete rovers to enable racing, collaborative experimentation, and comparative testing.</p> <p>2. Guardian Co-Play Framework</p> <p>Dual instruction sets (solo + facilitated) with observation prompts and challenge cards enable any guardian to support learning without engineering expertise, directly</p>

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	<p>addressing expert feedback that parental involvement is critical for sustained engagement.</p> <p>3. Universal and Inclusive Design</p> <p>Mechanics-first aesthetics avoiding stereotyped themes with neutral color palette. Dual packaging strategy offers identical educational content in two package designs (gender-neutral and girl-targeted) to address guardian purchase bias (61.1% recognize unequal marketing) while maintaining universal appeal. Instructions are concise, bilingual-friendly with visual step-by-step support.</p> <p>4. Durability and Reusability</p> <p>Robust materials designed for extended play cycles with easily replaceable components and minimal reliance on consumables. All components support repeated assembly and experimentation to deliver long-term value and reduce waste.</p> <p>5. Cost-Effectiveness and Value</p> <p>Strong value proposition with target retail range of \$40-60, positioned between budget sets (\$20) and premium kits (\$120+), directly addressing the 44.2% of consumers who prioritize affordability while maintaining genuine educational depth.</p>
Constraints	<p>1. Timeline and Manufacturing</p> <p>Limited to school-year development cycle (August 2025 - April 2026) including prototyping, testing, redesign, and documentation. Must be manufacturable with available classroom prototyping tools (3D printers, laser cutters, basic electronics assembly) using readily available electronic components to ensure scalability.</p> <p>2. Budget</p> <p>Prototype development must remain within $\leq \\$200$; production cost target of $\leq \\$35$ per unit for viable market pricing at \$40-60 retail range.</p> <p>3. Safety and Age-Appropriateness</p> <p>All materials must be non-toxic and meet safety standards for children ages 6-12. Technical complexity must be accessible to target age group without requiring extensive adult assembly, while still providing genuine engineering challenges.</p> <p>4. Design Requirements</p> <p>Dual packaging design must maintain identical educational content while meeting different marketing approaches. Must incorporate expert feedback from child development specialists (Dr. Grace Paradis, Dr. Nancy Dayne) regarding neutral design, co-play facilitation, and authentic educational value.</p>