

W14 Element D 6.0 Analysis and Selection

Team Members Full Name: Matthew Jeide, Owen O'Rafferty

Project Name/Topic : Open STEM Project

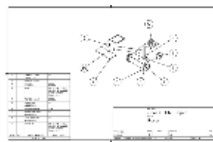
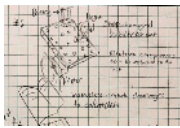

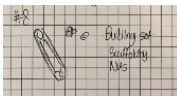
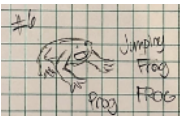
Date: 12/2/2025

Problem Statement: How can we design an affordable, gender-neutral STEM construction kit that promotes authentic inquiry-based learning and guardian-child co-play for children ages 6-13?

Analysis and Selection

- At least 2 paragraphs describing the brainstorming process and the selection process used to determine the final choice.
- How did you narrow all the choices down to the final one? How did you get input from your consumers/experts?
- Defend why the solution selected will work.
- Defend what benchmarks/specifications the chosen solution will meet.
- Provide evidence that your solution choice was substantiated by an expert/stakeholder. (email proof/communication proof)

Insert an image of your top 5 ranked ideas:

Rated Designs	Ranked # 1	Ranked #2	Ranked#3	Ranked #4	Ranked#5
Sketches					
How was the final choice selected/ customer/ expert input?	Builds 2 rovers, interchangeable parts	Open construction kit	High modularity but expensive	Not innovative	Limited features

At least 2 paragraphs describing the brainstorming process and the selection process used to determine the final choice.

Our brainstorming process began with identifying the core problems in existing STEM toys marketed towards girls: narrow technical content, stereotyped themes, confusing instructions, and poor value propositions. We generated multiple design concepts ranging from simple mechanical toys to complex modular systems. Each concept was evaluated against nine critical criteria including affordability, modularity, durability, co-play support, gender neutrality, educational value, complexity appropriateness, reusability, and aesthetics. We used a scoring matrix (1-5 scale) to objectively compare our four M.O.J.O. concepts against three existing market problems.

The selection process was heavily influenced by our expert consultations and consumer research. Dr. Grace Paradis emphasized the need for neutral/mixed colors and dual marketing strategies, while Dr. Nancy Dayne stressed that "parents play the largest role in how kids use

STEM toys," elevating co-play from a secondary feature to our second design requirement. The Modular Rover concept emerged as the clear winner with 37/45 points because it uniquely balanced all critical factors: high modularity (5/5), strong gender neutrality (5/5), good affordability (4/5), and structured co-play support (4/5). Unlike the Sillbird Robot which also scored high on modularity but failed on affordability and co-play, our design addressed multiple barriers simultaneously rather than optimizing single features.

- How did you narrow all the choices down to the final one? How did you get input from your consumers/experts?

We narrowed our choices through three key mechanisms:

1. Quantitative Scoring Matrix (applied the 9-criteria system of 1-5 scale to all seven concepts)
2. Expert Consultation Integration (expert's recommendations shaped the decision making process)
3. Consumer Feedback Validation (used consumer survey data to inform our decision)

- Defend why the solution selected will work.

The Modular Rover solution systematically addresses market gaps with validated design features by experts and consumers. It provides authentic STEM content, including engineering concepts like gear ratios and line-following algorithms, meeting the educational rigor requirement. The co-play framework, with two rovers from one kit, responds to Dr. Dayne's research showing parental guidance increases child engagement. Guardians can facilitate learning through racing and problem-solving without engineering expertise. The mechanics-first aesthetic with dual packaging addresses the gender marketing barrier, reaching families seeking "girls' STEM toys" while still maintaining universal appeal. The prototype budget is under \$70, with a clear manufacturing pathway to under \$25 production cost at scale, meeting the affordability threshold held by our consumers. Every major design decision is based on documented stakeholder needs, not designer assumptions.

- Defend what benchmarks/specifications the chosen solution will meet.

Our solution meets five critical specifications that translate customer requirements into testable criteria.

1. The retail price must be under \$60, with a projected production cost under \$25 at manufacturing scale, achieved through a prototype BOM under \$70 and documented pathways to injection molding and custom PCBs.
2. Assembly time must be under 30 minutes using basic hand tools, with all electronic connectors keyed and polarized to prevent wiring errors.
3. The rover must achieve over 45 minutes of runtime per charge using standard 5V USB-C charging, eliminating consumable batteries and supporting reusability.
4. The line-following capability must demonstrate over 85% track completion at speeds between 0.1-0.3 m/s on a standardized test course with turns and curves, providing proof of authentic sensor-based STEM content.
5. The fully assembled rover must survive three drops from 0.8m height onto vinyl flooring without mechanical failure or disconnection, operationalizing the durability requirement.

Each specification includes clear pass/fail criteria for objective testing during prototype development.

- Provide evidence that your solution choice was substantiated by an expert/stakeholder.

(email proof/communication proof)

Interview Request for Our High School EDD Project on STEM Toys and Girls in STEM

Summarize this email

Matthew Jeide

to: nancydayne, nguzman, owen2118225

Sun, Sep 21, 3:35 PM

Dear Dr. Dayne,

We are seniors at Martin Luther King High School in Riverside, and we are currently enrolled in the Engineering Design and Development (EDD) course. As part of our capstone project, we are researching STEM toys in general, specifically focusing on how they can be designed to better engage young girls and encourage long-term interest in science, technology, engineering, and mathematics. We understand that your focus on parent involvement and teacher education in child development may not directly correlate to toys. However, we would greatly appreciate your input, as your expertise in how children learn and succeed in different educational contexts would provide us with invaluable insight. This would help us design toys that are inclusive, engaging, and supportive of diverse learners. The interview would take approximately 20-30 minutes and can be scheduled at your convenience during our school hours (generally between 8:30 AM and 3:30 PM on Mondays through Fridays) or slightly after. Our instructor must be present to oversee the interview. We are happy to connect virtually through Google Meet or by phone. Your guidance would be immensely helpful to our project. Thank you very much for considering our request.

Sincerely,
Matthew Jeide
Owen O'Rafferty
Seniors, Engineering Design and Development (EDD)
Martin Luther King High School, Riverside, CA

Nancy Dayne

to: me, nguzman@riversideunified.org, owen2118225@gmail.com

Mon, Sep 22, 8:57 PM

Matthew,

Hello! Hope you are well. I appreciate your very detailed email and what a great project! This week is a very busy week for me, as I am preparing for a conference that we are hosting on campus. If you have questions you want to send, I can email you the responses, when I have free time to work on it. If that doesn't work, I can maybe connect next week. Have a nice night.

"I may send emails outside of normal office hours. I do not expect you to reply to my emails outside of your normal hours. I do typically reply to emails within 24 hours on the weekdays. Take care!"

Nancy Dayne, Ed.D.
Professor, Child and Family Studies, Department of Family and Consumer Sciences
Director of the Family Resource Center-FCS
Director of Outreach and Recruitment-CHHS
nancy.dayne@csusb.edu

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Interview Request for Our High School EDD Project on STEM Toys and Girls in STEM

Summarize this email

Matthew Jeide

to: gparradis, nguzman, owen2118225

Sun, Sep 21, 3:42 PM

Dear Dr. Parradis,

We are seniors at Martin Luther King High School in Riverside, and we are currently enrolled in the Engineering Design and Development (EDD) course. As part of our capstone project, we are researching STEM toys in general, specifically focusing on how they can be designed to better engage young girls and encourage long-term interest in science, technology, engineering, and mathematics. We understand that your work in language development, parent-child relationships, and the influence of technology on children may not directly focus on toys. However, we would greatly appreciate your input, as your expertise in how children learn and succeed in different educational contexts would provide us with invaluable insight. This would help us design toys that are inclusive, engaging, and supportive of diverse learners. The interview would take approximately 20-30 minutes and can be scheduled at your convenience during our school hours (generally between 8:30 AM and 3:30 PM on Mondays through Fridays) or slightly after. Our instructor must be present to oversee the interview. We are happy to connect virtually through Google Meet or by phone. Your guidance would be immensely helpful to our project. Thank you very much for considering our request.

Sincerely,
Matthew Jeide
Owen O'Rafferty
Seniors, Engineering Design and Development (EDD)
Martin Luther King High School, Riverside, CA

Grace Parradis

to: me, nguzman@riversideunified.org, owen2118225@gmail.com

Mon, Sep 22, 9:29 AM

H,

I have time tomorrow for an interview.

-Dr. Parradis

From: Matthew Jeide <jideemathew@gmail.com>

Sent: Sunday, September 21, 2025 3:42 PM

To: Grace Parradis <gparradis@csustan.edu>

Cc: nguzman@riversideunified.org; owen2118225@gmail.com

Subject: Interview Request for Our High School EDD Project on STEM Toys and Girls in STEM

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