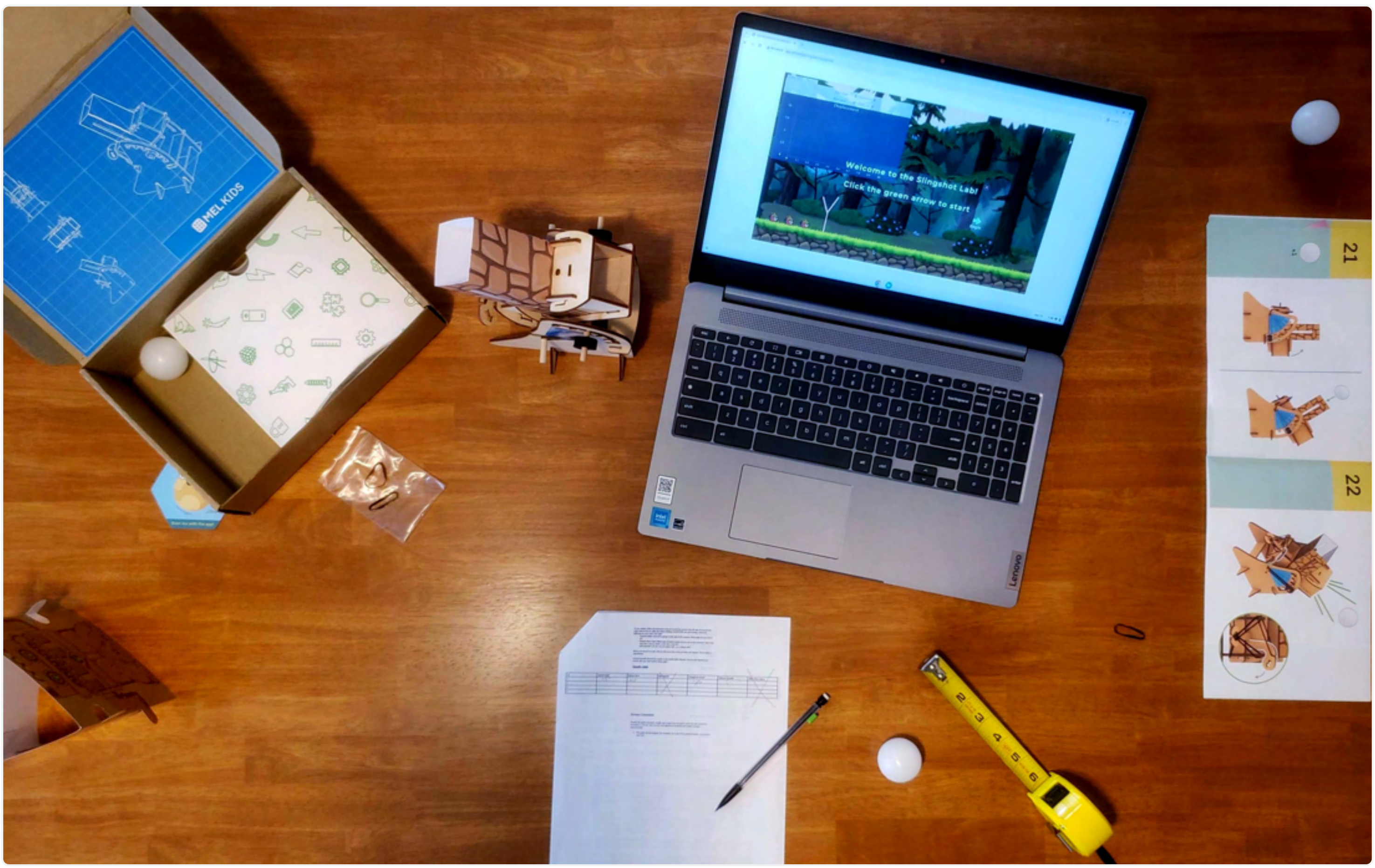
Let's Play Engineer: Inspiring Future Engineers through Play

Latitude Lab Report
November 28, 2024



Written by: Christopher Obiozor
Reviewed by: Chinwe Orie

Intro

What does an engineer do?

This question helped kick-off the experiential STEM activity we developed to engage summer camp youth in STEM through key engineering practices. It was prompted by conversations with our friends Ruth Anne Wolfe, founder of Community Happens Here, and Kendell Bobo, a director at the Cincinnati Recreation Center (CRC) in the Prairie Ridge neighborhood. They wanted to broaden the career aspirations for young people in Prairie Ridge, especially for minorities. So we created this experience to inspire youth to take an interest in STEM and ultimately pursue engineering careers. Why was this important for a group of 3rd, 4th, and 5th graders? The studies are clear, STEM interventions during and outside of school-time are critical for engaging youth before positive attitudes to STEM start to wane, most often around age 10 (1). Successful intervention activities make engineering accessible and engaging. Latitude's Be an Engineer for a Day (BAED) program helped campers practice the creative and critical problem-solving skills used by engineers through three key engineering practices. This highly-engaging and standards-compliant STEM lab introduced the engineering design process in a manner that left learners enthusiastically expressing an organic interest in becoming engineers.

Problem Statement

How can we engage youth in STEM during out-of-school time?

To answer this question, we first investigated what youth already liked to do, then considered factors that might increase or diminish their engagement. After interviews and visits to the CRC, we learned that 12-15yrs was the average age of the kids who visited after school. Kendell said this group demonstrated the most interest in collaborative and interactive activities like basketball, Fortnite, and dance parties. We wondered...why are youth so interested in activities like Fortnite? A common theme in both sports and video games is the self-efficacy participants experience when they can make tangible progress towards a clear goal. Similarly, social events like dance parties contribute to identity formation. Likewise, self-efficacy and identity also play a notable role in children's STEM attitudes, but the perception of science as difficult and the lack of role-models can erode positive sentiments among middle and high schoolers (1).

Goal

Strategy

An activity that could rival basketball or Fortnite would have to be just as hands-on to be equally engaging. These games have a complex mix of competition, creativity, and interactivity. That's also the recipe for creating engaging STEM activities (1), and it hints at why children enjoy the *practical* aspects of science (1). So we decided to adapt a popular video game, Angry Birds^TM, into a hybrid STEM lab that introduced the creative design process engineers use to apply science to real problems. By pairing an interactive virtual lab with a constructive building challenge, we could gamify science and engineering to make them more accessible and fun.

Scope

This would require us to both outline the curriculum and identify materials for the hands-on exercise, and further adapt a video game to provide a learning experience that could be built upon. We started by designing an activity that mimicked the central game mechanic in Angry Birds, launching a projectile. Few things give youth a greater sense of self-confidence than building something on their own. We decided that they would work in groups to each build an apparatus that could launch a small ball at different launch angels to test how angle affected distance traveled. To iteratively improve their approach, we needed to design a way for them to easily and accurately collect and interpret data on their past attempts.

The curriculum clarified the additional features required to use the video game as a representative simulation to aid problem-solving in the hands-on activity. We would need a way to measure launch angle and distance traveled so that learners could accurately gauge the angle they were launching their game characters and understand its effect on the trajectory. Students would use this video game to interactively explore the fundamental motion of free-falling projectiles, then apply those scientific insights to solve the hands-on challenge.

We shared an outline of the program curriculum with Kendell at the CRC and Ruth, both gave positive feedback and full support. Though initially designed for 11-13yr olds, we found that the program was easily adapted to the younger 8-10yr olds we ultimately ran it with during the summer camp.

Outcomes

Enabling students to design and evaluate unique solutions based on their own experimental data makes engineering more relatable, even personable.

Cultivating Critical and Creative Thinkers

The BAED program engaged youth in important practices that cultivate an engineering mindset. When asked what they learned from the activity, 7 out of the 18 students expressed a learning outcome directly related to at least one key engineering practice, with the most common practices mentioned being:

1. **"Work effectively in teams" (3)**
2. **"Apply science and math knowledge to problem-solving" (3)**
3. **"Persist through and learn from failure" (3)**

When youth engage in these practices, they gain experience and become fluent in the systematic thinking skills used universally by all engineers (3).

> *"[I] learned how you need to persevere to be a good engineer"*
> *~CRC Youth*

> *"[I] learned that teamwork is a big part of building stuff"*
> *~CRC Youth*

Hands-On Learning

By analyzing how properties like launch speed or gravity force affected the flight path of their player, learners engaged in NGSS Science and Engineering Practices (SEP) SEP-4 and SEP-6 (4). Enabling students to design and evaluate unique solutions informed by self-generated experimental data can make engineering more relatable, even personable.

By introducing middle-schoolers to simulation as an important tool in an engineer's toolbox, Latitude prepares a foundational learning experience that transfers to High School, where the NGSS Engineering Design performance expectations will prompt them to, "Use a computer simulation to model the impact of proposed solutions..."(4). When early STEM learning experiences are later built upon in secondary school, it supports a learning progression that facilitates positive STEM attitudes from students.

Inspiring Black Engineers

What should I do to become an engineer like you?

This paraphrases what the campers asked their lab coaches at the end of the session. This question underscores the influence of roles models for helping youth develop positive STEM identities and persevere in their progression as STEM professionals (1).

Because we know that, "...young people often focus on who they want to be rather than what they want to be," (1) role models are especially important for youth from communities that are underrepresented in STEM (1). As an example of this, the opportunity for the Black youth to engage with lab coaches who are Black engineers is an invaluable experience that can keep them engaged with STEM.

Highlights

Over the course of an hour and a half, we guided youth through the engineering design process as they took what they learned about projectile motion from the simulation, tested their chosen launch angle to hit the target, recorded and analyzed their results (i.e., distance traveled), and then refined their approach with their new insights.

Slingshot Lab: *A Projectile Motion Simulation*

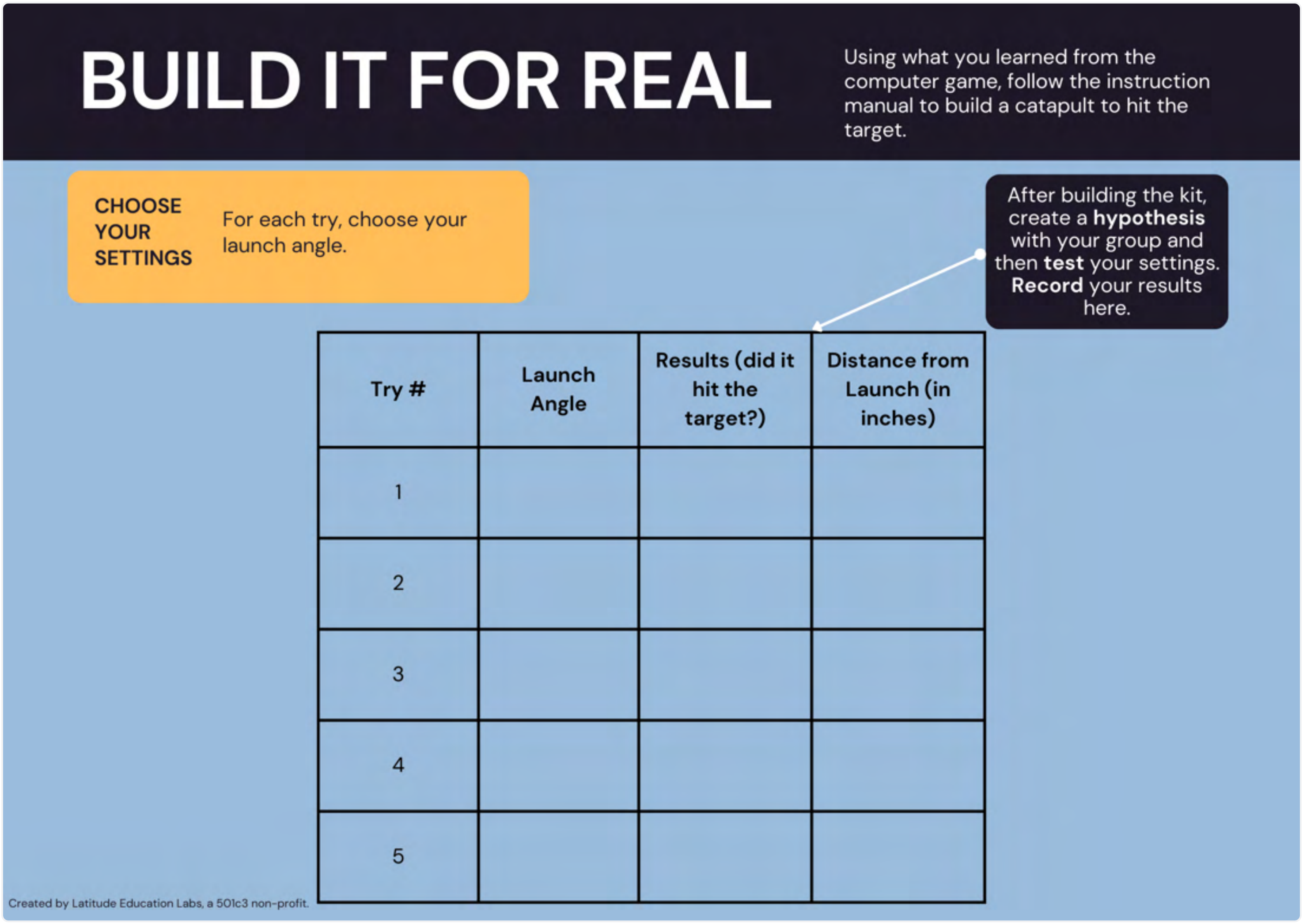
Working in groups of three to four, day campers explored Newtonian physics concepts by engaging with a familiar video game. Real-time charts of displacement and velocity presented scientific insights into the kinematics of free-fall in a graphical way that was accessible regardless of math attainment.

It was no surprise at all how much fun the students had while playing the lab, but we could also tell they were learning a lot along the way. After testing different values for gravity force and launch speed, students were able to define these terms in their own words. They explained how those settings changed the trajectory of their character and referenced the graphs of position over time to support their claims. Analyzing data to intuit the relationship between forces and motion is core to the performance expectations they'll encounter as they continue their science progression (e.g., NGSS HS-PS2-1).

Engineering Test Bed

Next, we had students build a Projectile Canon using the MEL STEM kit. The canon featured a variable launch angle settings that helped us align it with the curriculum and it was also the easiest to build of the two options we tested.

The campers used these canons to apply their understanding of projectile motion and tested different launch angles to hit the target. After each trial, they measured the distance traveled and wrote their results and settings in a table. Before their next attempt, each group was asked to interpret their previous results and explain their new approach.



BUILD IT FOR REAL

Using what you learned from the computer game, follow the instruction manual to build a catapult to hit the target.

CHOOSE YOUR SETTINGS For each try, choose your launch angle.

After building the kit, create a **hypothesis** with your group and then **test** your settings. **Record** your results here.

Try #	Launch Angle	Results (did it hit the target?)	Distance from Launch (in inches)
1			
2			
3			
4			
5			

Created by Latitude Education Labs, a 501c3 non-profit.

This activity successfully used the power of play and competition to engage students in science exploration and engineering applications. This can keep youth engaged as they progress in their STEM education because these activities, "... a) link theory with practical activity; b) are designed to illustrate the real-world relevance of the maths and science curricula; c) provide opportunities for follow-up reflection to add value for participants."(1)

Refs

1. When Stem? A Question of Age. Institution of Mechanical Engineers.
2. Springate, I, Harland, J, Lord, P and Straw S (2009). Evaluation of the 2008–09 DCSF-funded Specialist Schools and Academies Trust STEM Pathfinder Programme. Slough: NFER.
3. Engineering Mindset. Million Girls Moonshot
4. NGSS Grade-Level Standards: Grades Nine through Twelve Engineering Design.
5. NGSS Grade-Level Standards: Grades Nine through Twelve Physical Science