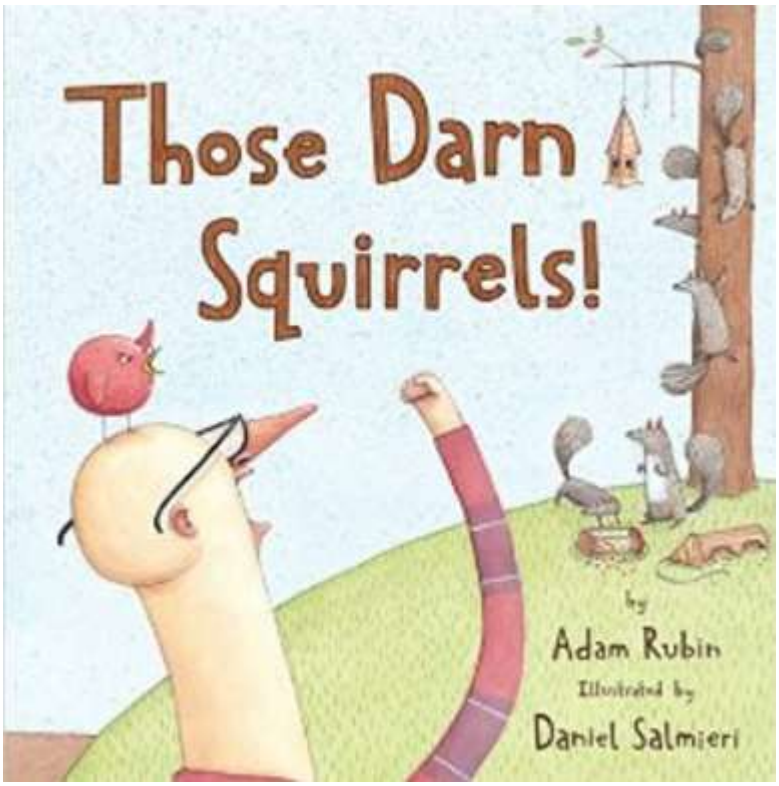
“Squirrel Engineering with the NGSS”

COREIaborate blog post by Douglas Ferguson



[Picture of cover of the “Those Darn Squirrels” Book]

Intro:

Giving credit where credit is due can be squirrelly business, but it’s important. I was first introduced to “Those Darn Squirrels” by Kirk Robbins (@science_4_all) at a training over five years ago. In a nutshell, the squirrels want an old man’s bird feeder and end up designing various ways to get around his defenses including a squirrel launcher. Kirk used the read-aloud as a way to model alternative ways to engage students in scientific thinking, engineering as problem solving, and the design process. I was instantly nuts about this book.

[Picture of 3D printed "squirrels"]

Give the Set Up:

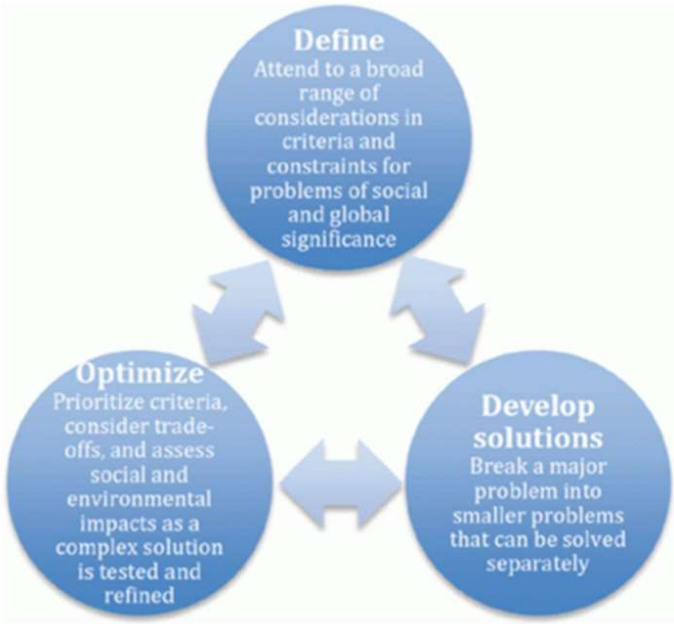
I found paperback copies on sale for $3 each at Amazon.com and then convinced my principal to order a copy for every teacher in the building. I was excited because I was going to run my first Next Generation Science Standards (NGSS) professional development (PD) training for the building and I wanted to have a "door prize" for the staff since it was an optional workshop day. We covered a lot of material, but I wanted there to be some hands-on doing as well as some practical and applied follow-up application from the PD.

[Picture of teachers designing squirrel launchers]

The Aha Moment:

So I devised a lesson series that would take advantage of the "Those Darn Squirrels" book that each staff member received. The premise was a vehicle for introducing the new NGSS engineering standards. After introducing the standards and reading the book, teachers took the role of the squirrels and had to use a Ziploc bag full of everyday objects to design a squirrel launcher to help the squirrels. The

constraints were that they could only use the materials in the bag and they only had so much time. The success criteria focused simply on the distance launched. I've rarely seen staff get so into an activity before. They designed feverishly and were very competitive while thoroughly enjoying themselves. The follow-up is what I'd like to talk about though, because we took this mini-lesson with the staff and mirrored it through a series of lessons in each classroom 3rd-6th grade at my school. The result was one of the most successful lesson series that I've ever taught.



[Picture of NGSS Design Process]

<u>Organize Based on the Three NGSS Engineering Standards:</u>

Standard 1: 3-5-ETS1-1: Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.

Standard 2: 3-5-ETS1-2: Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.

Standard 2: 3-5-ETS1-3: Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.

Design Process: We looked at the NGSS Design process and talked about how we were going to work through one cycle of this. The focus was on practice and experience for later application. The more modalities engaged in learning then the more likely the learning is to stick. So I wanted everyone to hear, see, and do as much as possible. The NGSS engineering design cycle has three parts and each part relates to one of the three K-5 engineering standards. By making this connection, hopefully everyone was able to see the big picture and context for integration as well as application.

[Picture of F.A.I.L. Poster]

Lesson Summary:

Basic Lesson Progression: Learn about NGSS engineering standards in general, but with a focus on constraints and criteria for success (3-5-ETS1-1). Learn about the engineering design process. Talk about failure as a key part of the design process and reframing failure through F.A.I.L. (First Attempt In Learning). Work in groups to brainstorm and draft and group design before ever touching the materials. After teacher approval, build the first prototype. Group launch with feedback from the other engineering teams. Wow, they went far! We lined up meter sticks to measure (metric because we're scientists). The designs were as varied as the students and between 14 classrooms almost no two designs were the same. Group discussion and debrief followed. Design next steps if there was more time to continue.

[Picture of Student Designs]

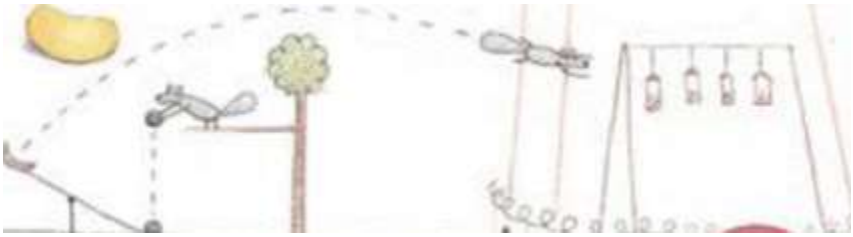
We Want More:

Students begged there teachers for more and I had to double the amount of kits so that teachers could do follow-up lessons focused on the iteration portion of the design process. Students were driven, engaged, and motivated to improve.

[Picture from the Engineering Fellows Project]

Tie into Engineering Fellows Project:

I applied for and was selected as an inaugural member of the Washington STEM (@washingtonstem) and Washington MESA (@WashingtonMESA) Engineering Fellowship Program (#EngineeringFellows) in partnership with the University of Washington. I submitted this project and mine was one of two projects chosen from the teacher applicants. My project idea was then chosen by most of the teachers and became one of the most popular projects within the group. One teacher used this as a back-to-school family project for whole school and made 500 kits! A teacher also used this as a community-building activity for her class. One teacher even used it as the first STEM project that she'd ever taught in her class. I am beyond excited and humbled by this. I am reinvigorated to revisit and improve the project after learning from their experiences.



[Squirrel Blueprints]

Links & Resources:

My Previous Blog Post on Making: http://corelaboratewa.org/a-movement-in-the-making/

Link to Those Darn Squirrels: https://www.amazon.com/Those-Darn-Squirrels-Adam-Rubin/dp/0547576811

Link to Kirk Robbin's Website: https://teachscience4all.org/

Link to Kirk's "Those Darn Squirrels" that I learned about only after designing mine (whoops!): https://teachscience4all.org/ngss-resources/

Pictures on Martin Sortun Website: https://teacher.kent.k12.wa.us/manage/page/mod/AlbumSet/viewAlbum?id=11831

Washington STEM Engineering Fellows Link: http://www.washingtonstem.org/Our-Approach/STEM-Innovation/engineering/engineering-fellows#.V-bnVPArLic

Washington MESA Engineering Fellows Link: http://washingtonmesa.org/blog/2016/3/2/engineering-fellows

Engineering Disciplinary Core Ideas from Next Generation Science Standards: http://www.nextgenscience.org/dci-arrangement/3-5-ets1-engineering-design

NGSS Engineering at the National Science Teachers Association: http://ngss.nsta.org/DisplayStandard.aspx?view=topic&id=23

Teach Engineering K12 Curriculum: https://www.teachengineering.org/

Instructables website merges engineering with inexpensive craft projects: http://www.instructables.com/

Maker Ed Organization: http://makered.org/