

TRANSFORM POTENTIAL TO KINETIC ENERGY

- TESTED IN PROTOTYPE PRACTICE

PHYSICAL SCIENCE

Energy can be produced, used, or released by converting stored energy.

-Apply scientific ideas to design, test and refine a device that converts energy from one form to another. (4-PS3-4) (Clarification Statement:

Examples of evidence relating speed and energy could include change of shape on impact or other results of collisions.)

INNOVATIVE DESIGNER

Students use a variety of technologies within a design process to solve problems by creating new, useful or imaginative solutions.

Students explore and practice how a design process works to generate ideas, consider solutions, plan to solve a problem or create innovative products that are shared with others.

- Students use digital and non-digital tools to plan and manage a design process.
- Students engage in a cyclical design process to develop prototypes and reflect on the role that trial and error plays.
- Students demonstrate perseverance when working with open-ended problems.

DATA, STATISTICS, AND PROBABILITY MEASUREMENT & DATA:

Solve problems involving measurement

Measurement & Data: Represent and interpret data.

- Make a line plot to display a data set of measurements in fractions of a unit ($1/2$, $1/4$, $1/8$). Solve problems involving addition and subtraction of fractions by using information presented in line plots. For example, from a line plot find and interpret the difference in length between the longest and shortest specimens in an insect collection.

Form- How does its shape help or hinder it? How do the materials make a difference? Could we change the form?

Function- Does this work how we expected? Would this function on a large scale? What will keep this from functioning?

Causation- What caused the upward motion? Did the rubber cause the motion, or did the air cause the motion?

Connection- What else in our world moves because of potential energy? Would this type of energy help us solve any other problems?

Change- How did you change your design? How would you change the design in the future? How has rocket technology changed? How did the measurements change?

Critical thinking skills- Acquisition of declarative and procedural knowledge, comprehension, application, analysis, evaluation, metacognition

Self management skills- managing materials and time

Communication skills- communicating with partners, and the teacher, as well as writing your findings and processes.

Social Skills- working with others and solving problems gracefully

Extensions

- Making a graph of straw size compared to distance traveled
- other challenges that we could monitor measurements and data to look for change (this would be the next step in mathematics)
- creating "goals" (hoops) that students could try to shoot through
- They would have to examine the angle and path of motion.

REFLECTIONS:

a. What went well with the engineering design challenge?

I felt like this design challenge was a real success. It had everything a design challenge should have, including failure. By the end my student was in a euphoric state of redesigns and variable testing. The materials were affordable and easy to work with. Even though the launcher didn't work as expected, we learned a valuable lesson about perseverance.

b. What did not go well with the engineering design challenge?

My student's writing ability is far below grade level, which is one of the things we have worked on this summer. Writing out his thoughts and processes was becoming very difficult and he was feeling very defeated and started getting uninterested in the project. I switched to scribing for him in some parts. Additionally, our time limit kept us from measuring distances, so we were unable to complete the mathematics portion.

We really struggled with the construction of the launcher, and at one point he had completely resigned himself saying "I'll never be able to do it." I was so glad that I had the word "fail" in my design cycle because I could point it out and assure him that it was a part of the process. We ended up launching a completely different way, and were able to complete the design cycle with enthusiasm!

c. What concepts were covered (list standards and topics where appropriate)

Physical Science- energy can be produced, used, or released by converting stored energy.

Apply scientific ideas to design, test and refine a device that converts energy from one form to another.

Students use a variety of technologies within a design process to solve problems by creating new, useful or imaginative solutions.

Students explore and practice how a design process works to generate ideas, consider solutions, plan to solve a problem or create innovative products that are shared with others.

d. How did the ED process help teach the science and mathematics concepts?

First, it showed the importance of understanding your constraints and variables. Then it allowed him to understand the importance of designing and planning things out. In a different situation you may not have unlimited resources, so we learned to respect our scientific materials. Failure was the biggest lesson of the day, which is something that scientists, engineers, and mathematicians experience all the time. Finally, he really bought into the redesigning phase. This taught the concept of always improving your process or model.

e. Did I choose an appropriate engineering design process?

I don't think I could have picked a more complex model. This student is diagnosed with ADHD so I struggled to get him through all of the prior steps, since he really wanted to just build-- and then make water balloons.

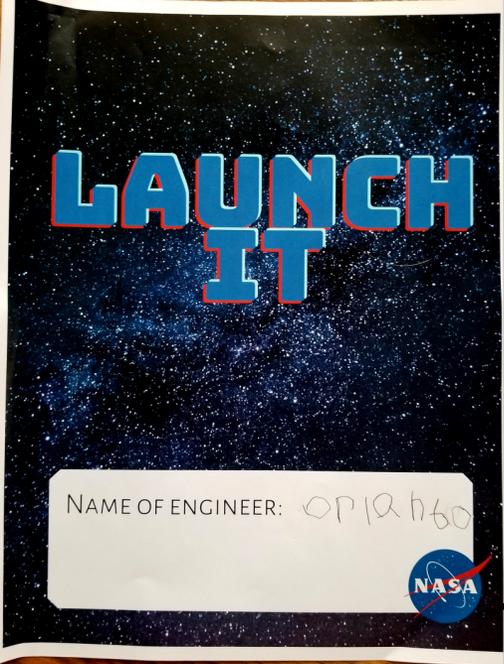
Should I simplify or make more complex?

I think this was a good complexity for him. I tried to give each page in the journal "handwriting" lines to support him. I also scaffolded his writing by having him dictate his thoughts while I wrote them in my journal. He then copied his words onto his own lines.

f. How can I improve this activity to use with future students?

I might look into bigger balloons, and use rubberbands to hold the balloon to the straw. I think I need to perfect a model that works before I can expect my students to create a working launcher. Although, the failure is important as well.

Our project became more about designing a better rocket. In the future with other students I may set up a line with premeasured lines so they can quickly take measurements of how far the rockets glided.



IDENTIFY THE PROBLEM

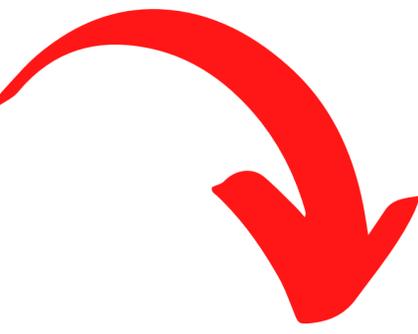
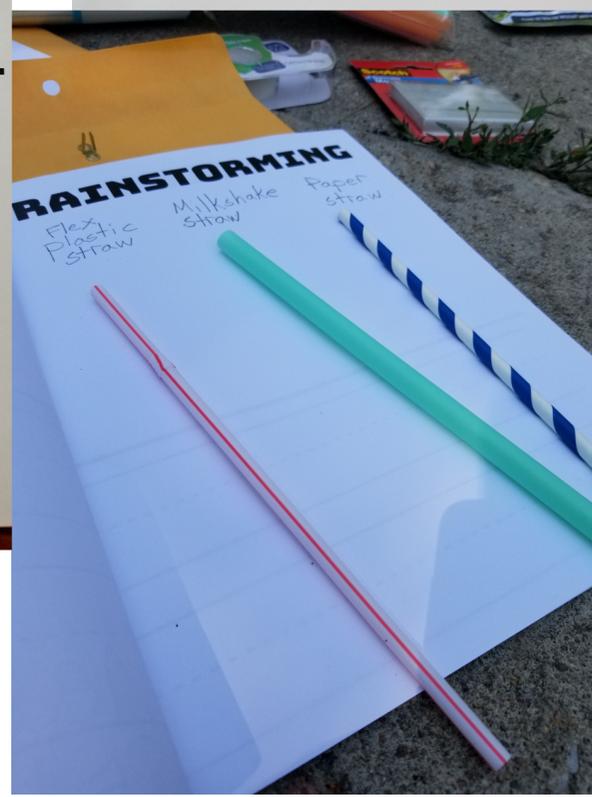
We want to
make a working
rocket

BRAINSTORMING

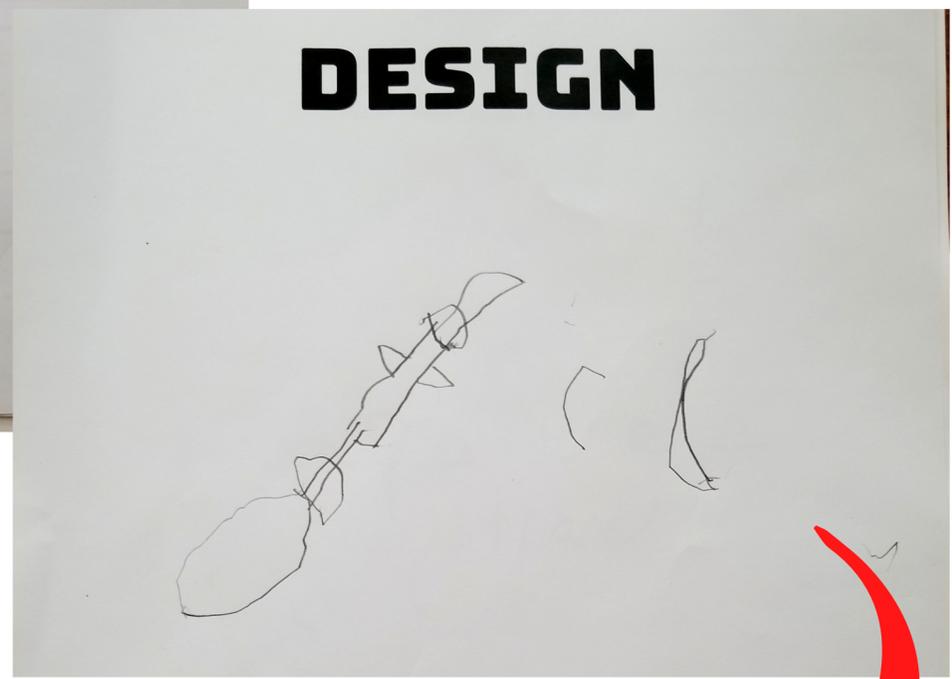
Flex Plastic straw
-bending for a "boost"?

Milkshake straw
Do you think color matters?
"maybe"

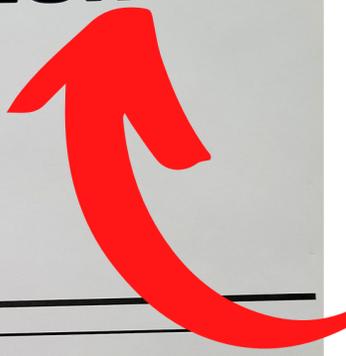
Paper straw
-it goes down this straw very fast, because it's little"



DESIGN



SHARE THE SOLUTION



short wings
normal straw

REDESIGN



TEST AND EVALUATE

works	doesn't work



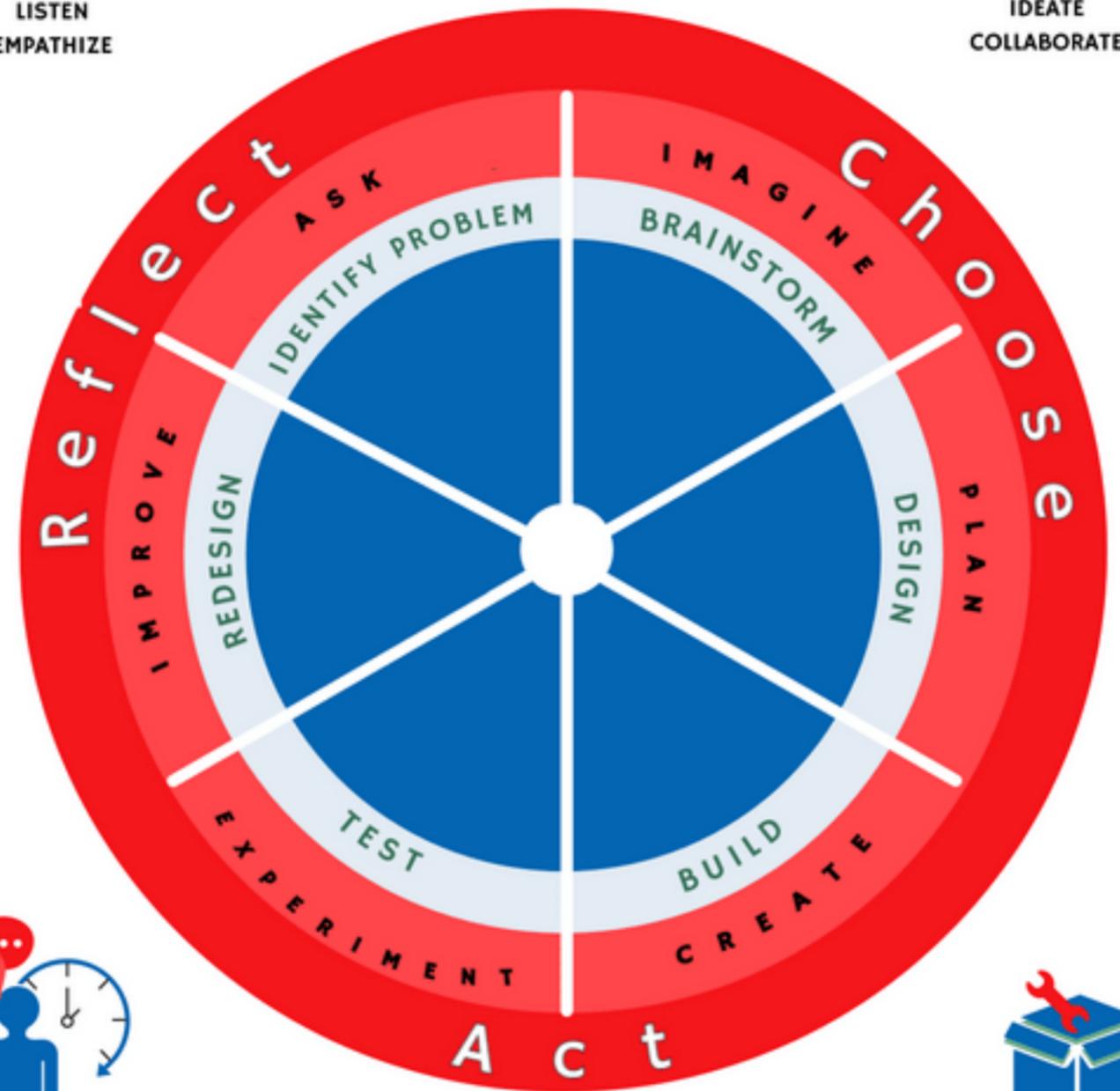
LAUNCH IT



LOOK
LISTEN
EMPATHIZE



NAVIGATE IDEAS
IDEATE
COLLABORATE



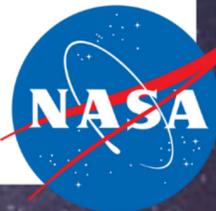
FAIL EARLY
DISCOVER GLITCHES
LAUNCH
AUTHENTIC FEEDBACK



PROTOTYPE
DRAFT
REBUILD

NAME OF ENGINEER:

Ms. Ellison



This is the cover and first page of the journal.

IDENTIFY THE PROBLEM

Project: Launch a Straw Rocket

We need to create a launcher that effectively stores potential energy in a balloon.

It has to launch a larger straw that is closed off at one end.

We want to create this to see if different variables can change the speed and distance of a rocket. Variables like wings, angle of launch, weight, and possibly more.

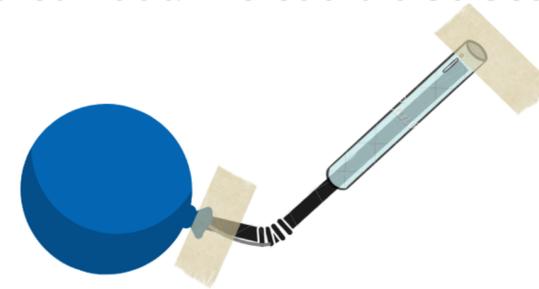
Constraints: 3 hours to work
Must be made with existing materials
Budget= 20 dollars

Specifications: Milkshake straw- 23 cm long, diameter 1 cm
Plastic bendy straw- 21 cm long, diameter 0.5 cm
Paper straw- 19.5 cm long, diameter 0.5 cm
Balloons- 30 cm latex party balloons
Mounting Putty- scotch brand, volume= 48 cm³
Tape - office works brand, 19 mm wide x 16.4 meters

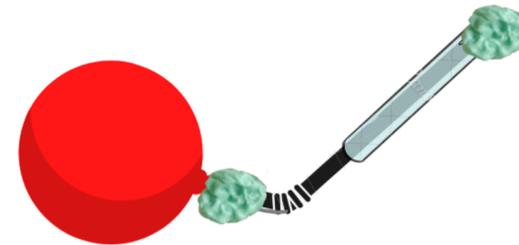
BRAINSTORMING

Some solutions that may work:

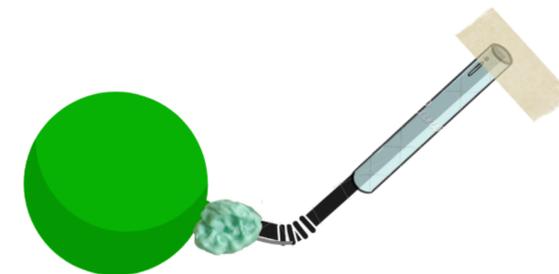
We could seal the balloon to the straw with tape so that air doesn't leak out. We could also seal the rocket straw with tape.



We could seal the balloon-launcher with putty so that air doesn't leak out. We could also seal the rocket straw with putty.



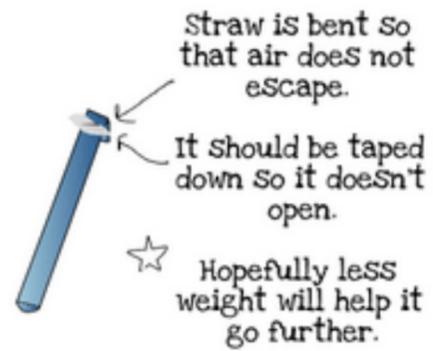
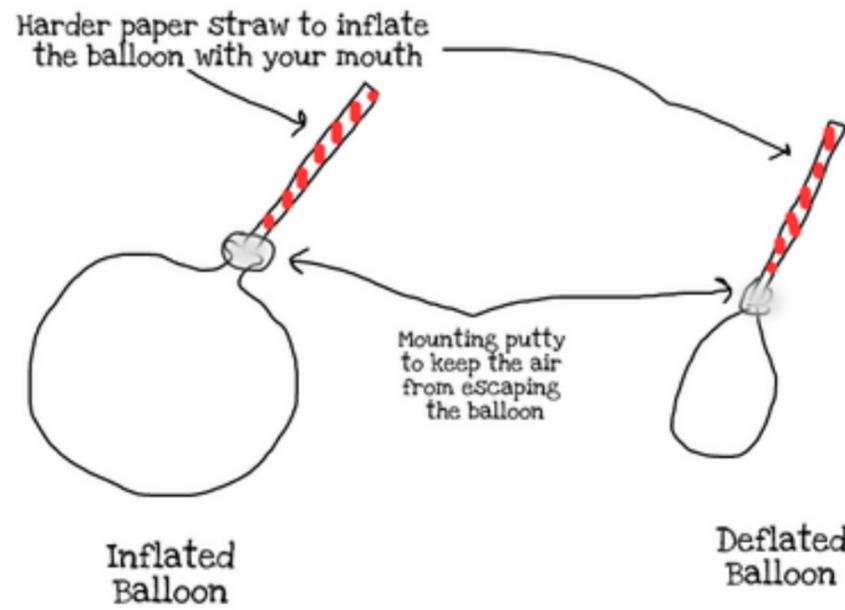
We could seal the balloon-launcher with putty and the straw with tape.



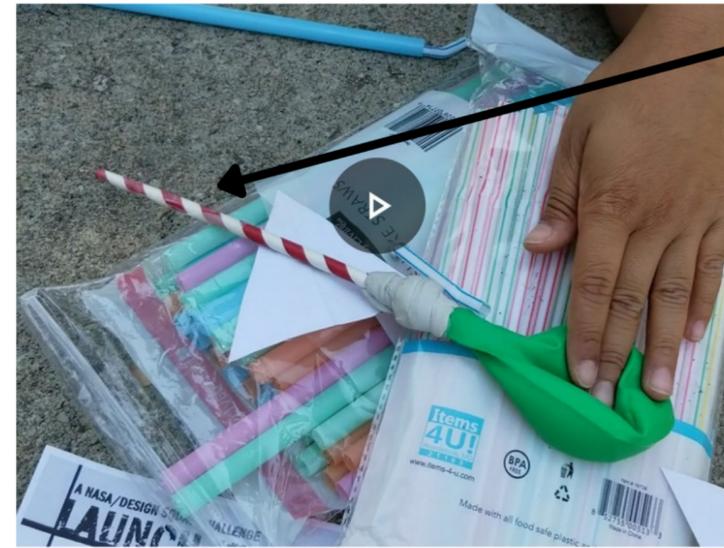
Student versions should have lines for writing, and perhaps even skeleton sentences/sentence frames.

DESIGN

After working with the materials, we believe this is the best design.



BUILD



The straw has been cut and tapered to try using the smaller plastic straw as the rocket. We wanted the lunch tube to be just slightly smaller than the rocket tube.

The Launcher's final design

The Rocket's first design

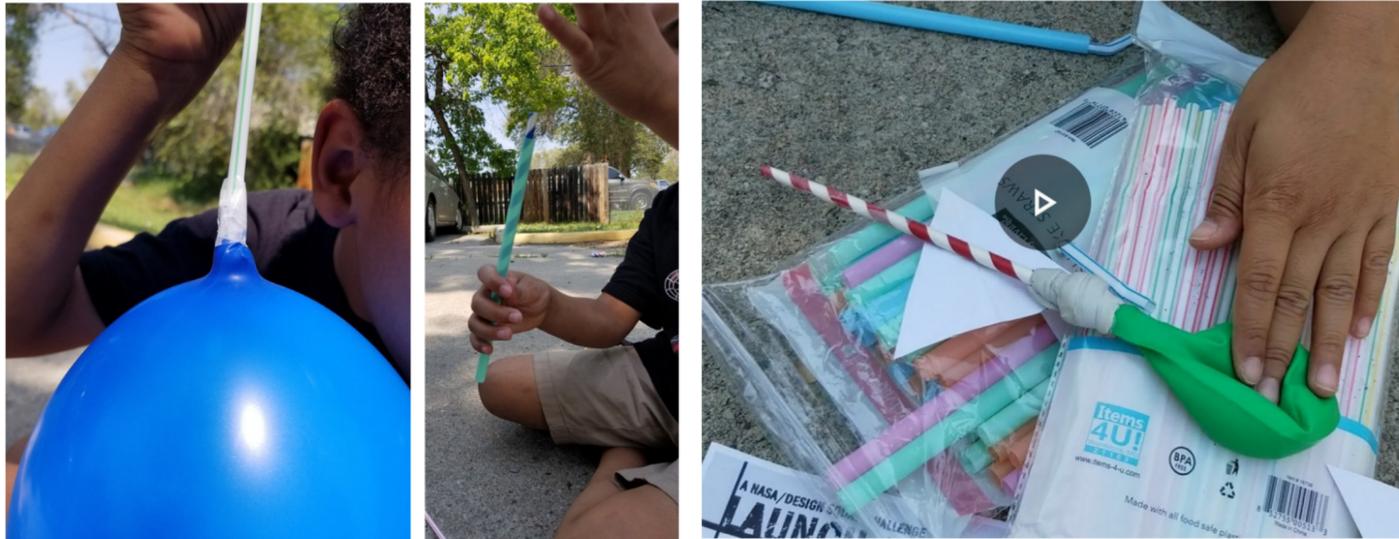


tape

TEST AND EVALUATE

TEST AND EVALUATE

Now that we had an effective way to launch the rockets, we wanted to test how to make the best rocket. Our specs for the materials stayed the same, but our need had changed. We wanted to design rockets that would glide the furthest.



Our launcher did not meet our need for a functioning "rocket" launcher. We tested out the tape and the putty in the design process, and learned that the putty did a better job of sealing the balloon to the straw. After that we tested which straw would let the rocket move off of it with the least friction. We decided the hard paper straw moved through it the best. However, even with a full balloon, with no leaks, and a streamlined straw, none of our rocket models could get more than a few centimeters up the straw. If you tapped the rocket a little, it would clear the launcher by about 4cm.

We theorized that perhaps the rocket was too heavy, so we tried shorter lengths of straw rocket, but that seemed to make the problem worse. We tried closing it with putty instead of tape to check if that variable was the issue. It seemed as though a lot of the air was escaping down the sides of the thicker milkshake straw.

After trying our best to problem solve with the launcher, we decided to try just blowing on the straw to launch. Our lungs, we decided, were kind of like balloons.

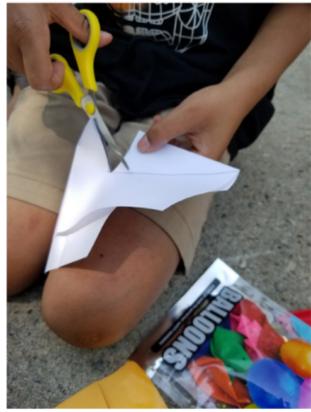


After launching different lengths of milkshake straws, we discovered that the longer, 23 cm, straw glided the furthest (design 4).

We hypothesized this could be because more air was building up inside of the straw.

Our next step was to optimize and redesign our rocket to glide even further.

REDESIGN



We tried designing different wings to help it glide. We discovered shorter wings worked better than taller wings. However, if you make the wings short and stick out long they will let the rocket do "tricks" like spinning.



Short wings work well for flying straight, and two sets of wings facing different directions seemed to help with stability.



We hypothesized that perhaps it would go further if the rocket straw was even longer, since the longer version (number 4) did so well. However, the two straw version didn't work with any of the wings because of the extra weight.



The two sets of wings facing different directions did not work when one of the sets was long wings.

SHARE THE SOLUTION



After several tests, the single milkshake straw, folded and fastened with tape was the best rocket base. The wings that helped it glide the furthest were about 8 inches tall and about 8 inches wide, cut into triangles, and taped to the bottom of the straw. The wings are made out of regular copy paper.

The rocket flew the furthest when the bendy straw was at about 45 degrees. The lungs of a nine year old, and the lungs of a 30 year had the same success with launching the straw rocket.

Future investigations should look at more stable wing materials like construction paper or foam, and find other ways of launching the rocket like compressed air.

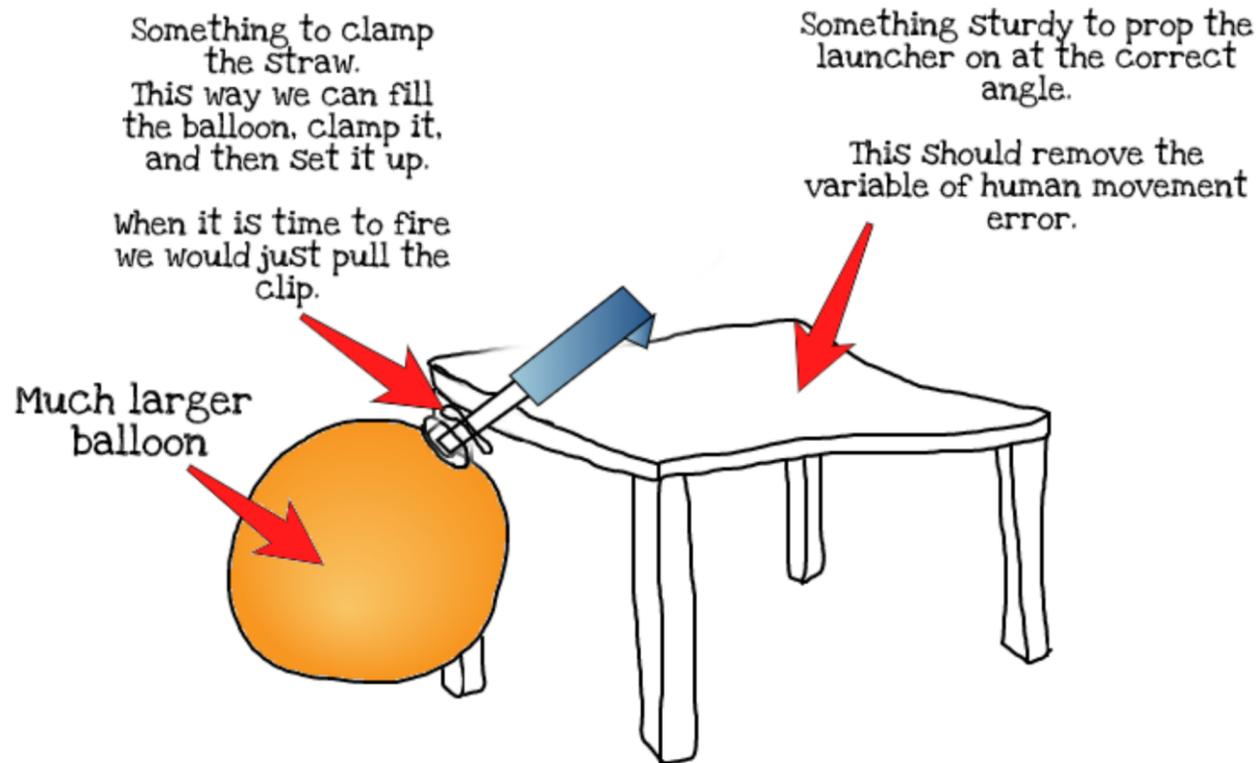
REFLECTION

If I were to try this engineering project in the future, I would go out and buy bigger balloons, that could hopefully store more potential energy. I would also try to find straws that are closer in diameter so they can sit close to each other.

I think an alternative to a balloon could be a "stomp" pad.



However, I did not attempt to attach the balloon launcher to something solid, and that variable could change the results.



TEACHER PERSPECTIVE

The balloon launcher can be very frustrating.

However, the failure of the balloon can create a really authentic moment to learn about failure and redesigning your plan.

Students who are not careful with the materials may bend the straws to the point where they will not work well, they can also over stretch the putty. This can be avoided by talking about respecting the materials before hand.

The journal may not need pages for "build" and "redesign." The students may want to draw something, but chances are they are in an unstoppable state of inspiration, and asking them to stop and write what they are doing can be very distracting/deflating.

You can interview them about the process afterwards and take note together on what you did for each step.

Make sure students label their straws with their names, otherwise spit will get passed around. :)