THE EDUCATION FUND

FOR EXCELLENCE IN MIAMI-DADE PUBLIC SCHOOLS

2017-2018

Ideas with IMPACT

idea packet

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STEM Squad:

Starting a Robotics Club at Your School

STEM SQUAD:
STARTING A STEM ROBOTICS CLUB

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PROJECT GOAL AND TARGET AUDIENCE

Students in the 21st century need to transition from being consumers of technology to producers of it. Engineering and technology are everywhere. Our students need to be prepared to step in and be the engineers, technicians, and inventors of tomorrow if we are going to continue to progress as a society.

According to the US Department of Commerce, job growth in STEM related fields is expected to far outpace most other fields in the coming decades. As such, it is our responsibility as educators to prepare students for these careers by promoting STEM Education.

> **"In the 21st century, scientific and technological innovations have become increasingly important as we face the benefits and challenges of both globalization and a knowledge-based economy. To succeed in this new information-based and highly technological society, students need to develop their capabilities in STEM to levels much beyond what was considered acceptable in the past" (National Science Foundation).**

The goal of this project is increase student interest in engineering and robotics by creating a club that provides students an outlet to be innovators. This project was completed with approximately 30 Middle School students grades 6-8. This project could be modified to meet the needs of students in grades 4-12.

STANDARDS

NGSS- MIDDLE SCHOOL

MS-ETS1-2. Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.

MS-ETS1-3. Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.

MS-ETS1-4. Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.

MS-PS3-5. Construct, use, and present arguments to support the claim that when the motion energy of an object changes, energy is transferred to or from the object.

FLORIDA STANDARDS- ELA

CCSS.ELA-LITERACY.RST.8.3. Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.

CCSS.ELA-LITERACY.RST.8.4. Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 6-8 texts and topics.

CCSS.ELA-LITERACY.RST.8.7. Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).

CCSS.ELA-LITERACY.WHST.8.7. Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration.

CCSS.ELA-LITERACY.WHST.8.4. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

Full list of Education Standards from VEX Curriculum:

https://content.vexrobotics.com/vexiq/curriculum/VEX-IQ-Curriculum-Education-Standards20170620.pdf

LOGISTICS

Forming any afterschool activity comes with a standard check list that needs to be completed well before any students can benefit from the programming. Make sure to consult with the activities director at your school for a list of site specific requirements. Here are a couple of general reminders about getting started:

1) Consult with your administration. Nothing would be worse than for you to complete all the legwork required to start a new activity to find out that you will not have approval. If you are serious about helping students get excited about engineering and robotics, start with the principal.
2) Secure funding for your program. Whether in the form of an Education Fund mini-grant, Donorschoose project, or PTSA fundraiser, make sure that you are going to have the money you need to purchase robotics kits.
3) Start advertising your club with your own students first. Often times, morning and afternoon announcements go in one ear and out the other. Start small by recruiting some of your own students to stay after school and participate. They will inevitably tell their friends and the club will grow organically.
4) No number is too small. Don't be discouraged if there isn't a standing-room only crowd at your first meeting. Even if your club only services a handful of students you are providing them an invaluable service!

LESSON 1: THE ENGINEERING DESIGN LOOP

Prior to beginning any STEM Engineering design challenge students should have a working understanding of the Engineering Design Loop.

> *The engineering design process is a method by which teams of engineers and scientists work together to develop solutions to problems. As with scientific investigations it is important to first identify the problem that needs to be addressed. Within the engineering design process it is also necessary to consider the design constraints that must be met and the overall desired outcome of the final product. A major step in the design process is the testing and modifications that a model or prototype must undergo until the final design is approved. (NASA, Engineering Design, 2016).*

This lesson/activity is used to help students understand the importance of prototyping and allows them to attempt to reason their way through the Engineering Design Loop.

PART 1: THE MARSHMALLOW CHALLENGE (30-45 MINUTES)

Infographic courtesy of Tom Wujec (https://www.tomwujec.com/design-projects/marshmallow-challenge/).

Complete guidelines for implementing the Marshmallow Challenge in the classroom can be found at https://www.tomwujec.com/design-projects/marshmallow-challenge/

The Marshmallow Challenge teaches two important lessons. First, the importance of fully understanding the constraints of the problem and of actively prototyping throughout an engineering design challenge. Second, this activity emphasizes the importance of utilizing a diverse set of skills within a group. Students often struggle with identifying and utilizing each other's strengths. Teamwork is critical in this challenge.

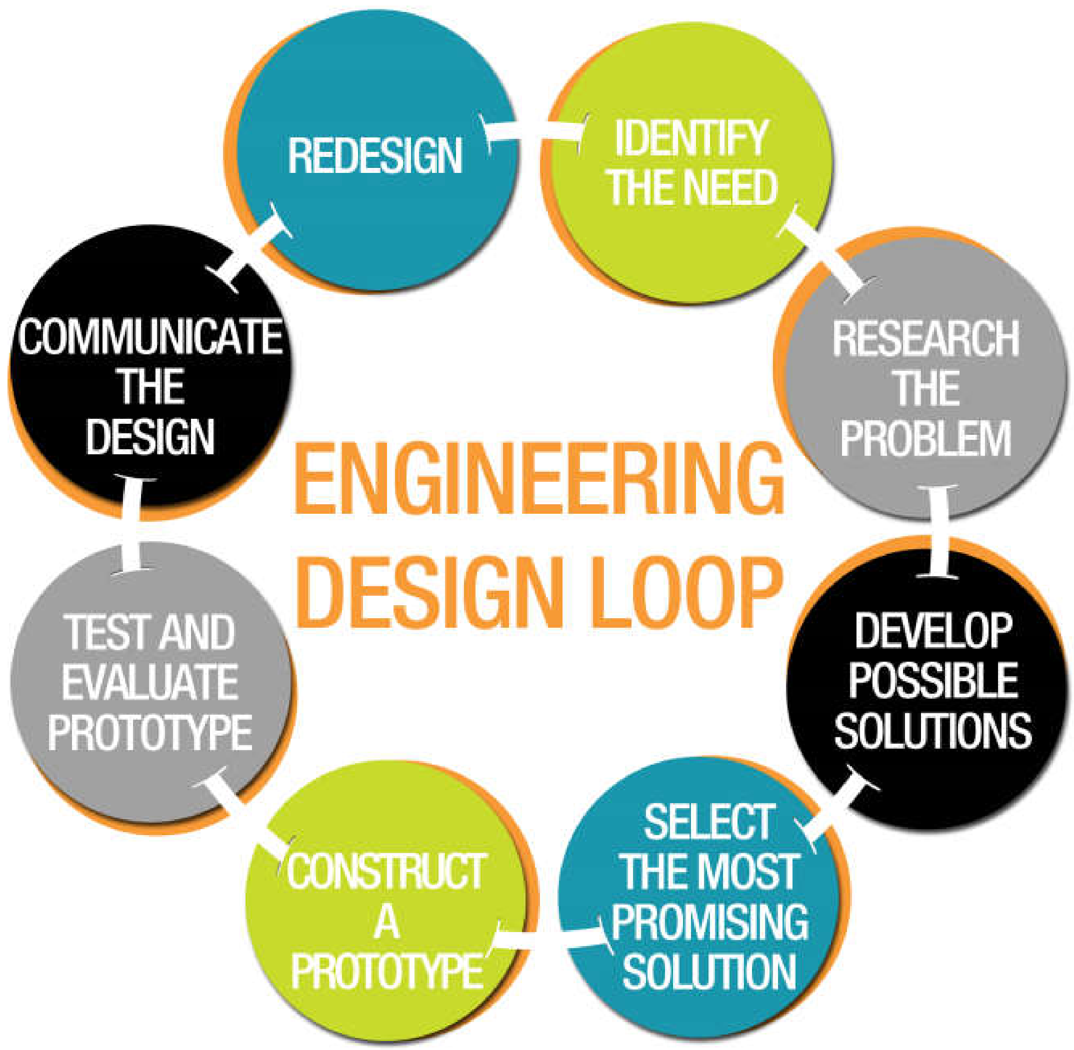
PART 2: DISCOVERING THE ENGINEERING DESIGN LOOP (15-20 MINUTES)

The purpose of this activity is to formally introduce the Engineering Design Loop. Students should be broken into groups of 2-3 individuals to complete the activity. The student handout includes a set of cards to be given to each group. Students are tasked with cutting out the cards and attempting to correctly order the cards to form the Engineering Design Loop. Students should be given about 5 minutes to complete this task.

After small group time, the instructor will lead a discussion that allows students to compare and contrast their individual design loops. The class will work as a group to create a consensus design loop on the board. Finally, the actual Engineering Design Loop (as provided on the next page) will be revealed and the class will discuss any potential differences. It is recommended that this loop is posted somewhere in the classroom as a source of reference.

Engineering Design Loop

A specific and iterative set of steps engineers use to organize their ideas and refine potential solutions to engineering challenges.



Note: There are several different versions of the Engineering Design Loop out there. For the purposes of this lesson we are using the loop provided by: https://www.teachengineering.org/content/cub_/activities/cub_creative/cub_creative_activity1_visualaid_v5_tedl_dwc.pdf

STUDENT HANDOUT

Instructions: Cut out the cards below and use them to build the Engineering Design Loop.

Communicate the design	Test and evaluate the prototype
Research the problem	Identify the need
Redesign	Develop possible solutions
Construct a prototype	Select the best solution

PROJECT 1: PAPER ROBOTICS- HYDRAULIC ARM

MATERIALS

- Recycled cardboard boxes
- Hot glue gun
- Popsicle Sticks
- X-acto knife
- Kabob Sticks
- 1/8" Inner Diameter Plastic Tubing
    - https://www.amazon.com/gp/product/B00E6BB36Y/ref=oh_aui_detailpage_o01_s00?ie=UTF8&psc=1
- Food Coloring
- 10 mL Syringes (No needle)
    - https://www.amazon.com/gp/product/B01JJYMOP6/ref=oh_aui_detailpage_o05_s00?ie=UTF8&psc=1
- Drill
- Paper clips
- Zip-ties
- AA Battery

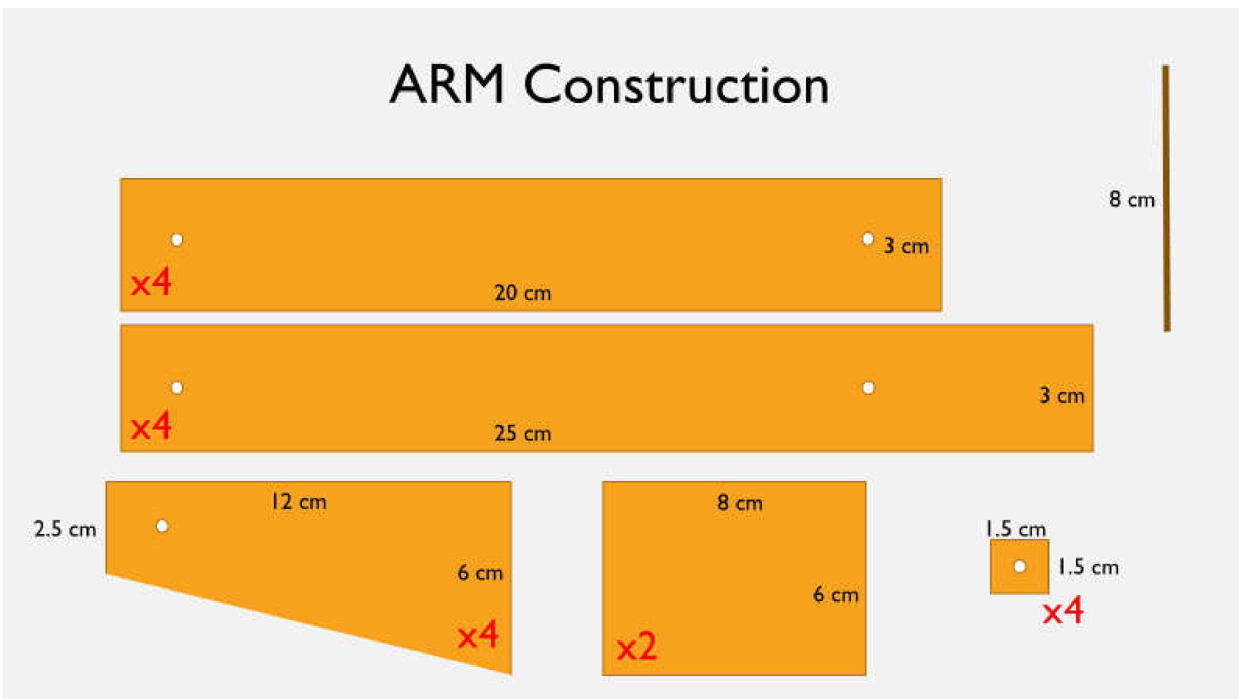
GENERAL CONSIDERATIONS

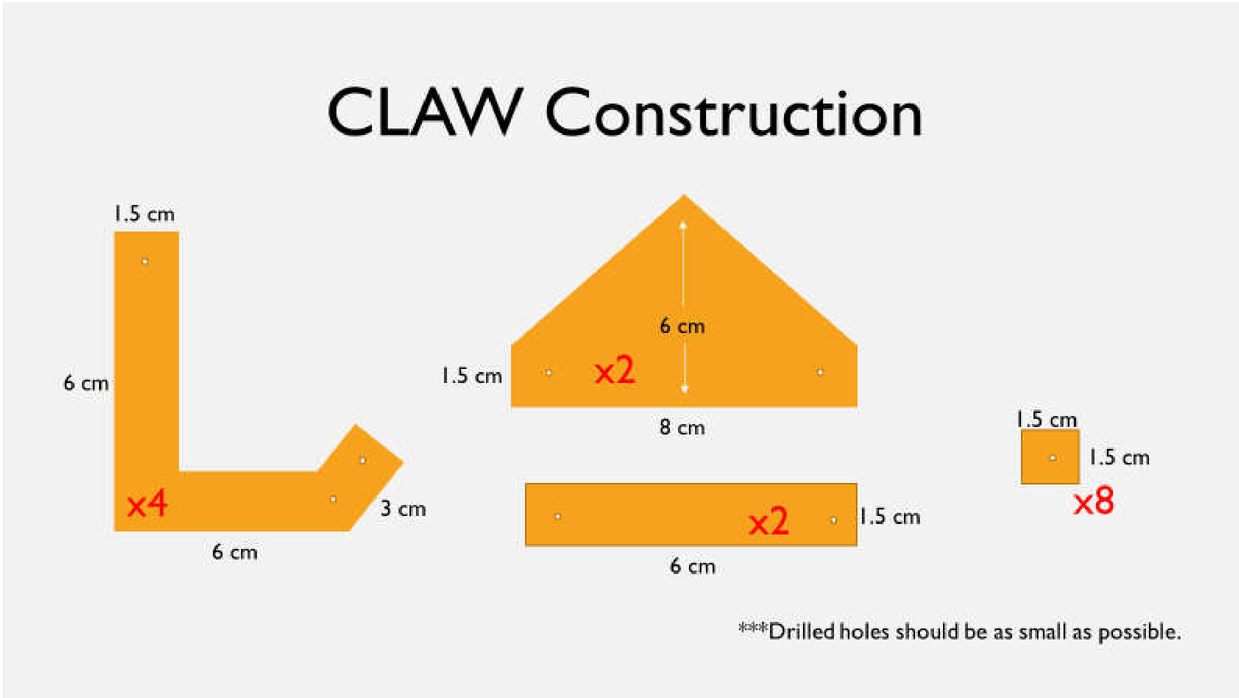
Before beginning this project, make sure that all students are comfortable working with a hot glue gun and x-acto knife, as both are featured heavily in this project. Students should be reminded of how to correctly use both to avoid burns and cuts. If you do not feel comfortable using these tools with students, modifications can be made to the procedure.

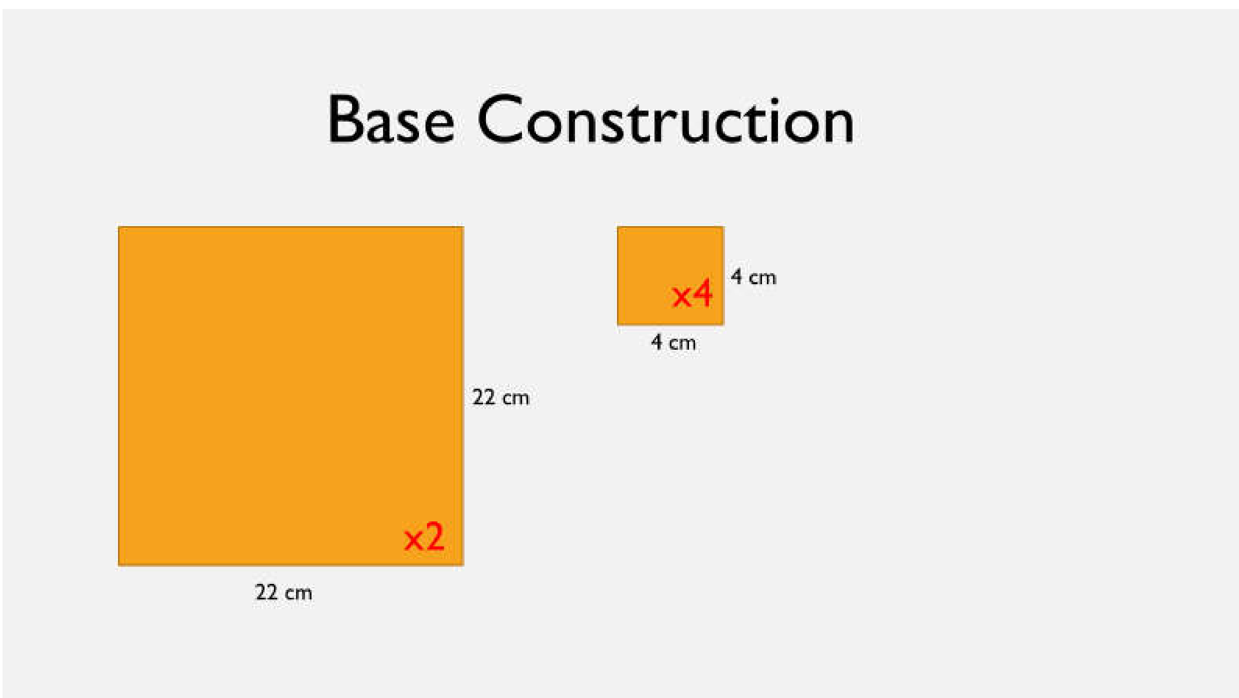
PREPARING CARDBOARD PIECES FOR ASSEMBLY

The first step to constructing the Hydraulic Robotic Hand is pre-cutting the necessary carboard pieces. Students will need to cut the following pieces ahead of time to be able to follow the instructions for assembling the hydraulic arm. Students should be encouraged to modify the design during assembly, but starting with the suggested pieces is helpful.

While the slides below do not describe every piece that is needed, they do describe all the major components.




CLAW Construction
1.5 cm
6 cm
x4
6 cm
3 cm
6 cm
1.5 cm
x2
8 cm
1.5 cm
x2
1.5 cm
6 cm
1.5 cm
1.5 cm
x8
***Drilled holes should be as small as possible.


Base Construction
x2
22 cm
22 cm
x4
4 cm
4 cm

ASSEMBLY INSTRUCTIONS

Video Assembly Instructions:

https://makezine.com/2017/03/30/making-an-impressive-robotic-arm-from-cardboard/

STUDENT COMPETITION

Students love turning a project into an opportunity to compete against one another. Once students have had the opportunity to construct their hydraulic arm they should be given time to modify it to prepare for the tasks below.

TASK 1: Move an empty can from one platform to another. This is a timed task with a maximum of 120 seconds.

TASK 2: Have the hydraulic arm hold a cup (or bottle) and slowly fill it with water. The task ends when the hydraulic arm fails or the cup/bottle is full of water.

“Winning categories” could include fastest arm, strongest arm, best overall arm, most creatively modified arm, etc. As with most engineering design tasks, adding a low-stakes competition motivates students to put their best work forward.

PROJECT 2: VEX IQ

VEX IQ is specifically made for robotics novices, both students and teachers alike. Many teachers shy away from robotics because they are afraid that they are complicated. The truth of the matter is, however, VEX provides a wealth of teacher support and your students could very easily build their first robot and be ready to compete by simply following the instructions sent with the kit. For some teachers and students that would not be enough information, so VEX has published a series of lesson plans that walk teachers and students through the basics of robotics. Below you will find links to these lessons:

A) "It's Your Future" introduces students to STEM Education

    https://www.vexrobotics.com/vexiq/education/iq-curriculum/its-your-future

B) "Let's Get Started" breaks down what is included in your first VEX IQ Clawbot kit. It provides an overview of the different kinds of parts that are found in the kit.

    https://www.vexrobotics.com/vexiq/education/iq-curriculum/lets-get-started/using-vexiq-hardware

C) "Your First Robot" assists students in building their first VEX IQ Clawbot and describes the Engineering Design Process.

    https://www.vexrobotics.com/vexiq/education/iq-curriculum/your-first-robot/build-instructions

D) “Simple Machines and Motion”

https://www.vexrobotics.com/vexiq/education/iq-curriculum/simple-machines-and-motion

E) “Chain Reaction Challenge” provides an engineer design challenge for students using pieces from the VEX IQ Kit.

https://www.vexrobotics.com/vexiq/education/iq-curriculum/chain-reaction-challenge/rules

F) “Key concepts” introduces students to important physics concepts such as fraction, center of gravity, motion, and mechanical advantage.

https://www.vexrobotics.com/vexiq/education/iq-curriculum/key-concepts

G) “Mechanisms”

https://www.vexrobotics.com/vexiq/education/iq-curriculum/mechanisms

H) “Highrise Challenge”

https://www.vexrobotics.com/vexiq/education/iq-curriculum/highrise-challenge

I) “Smart Machines”

https://www.vexrobotics.com/vexiq/education/iq-curriculum/smart-machines

J) “Chain Reaction Programming Challenge”

https://www.vexrobotics.com/vexiq/education/iq-curriculum/chain-reaction-programming-challenge

K) "Smarter Machines"

https://www.vexrobotics.com/vexiq/education/iq-curriculum/smarter-machines

L) "Highrise Programming Challenge"

https://www.vexrobotics.com/vexiq/education/iq-curriculum/highrise-programming-challenge

PROJECT 3: INDEPENDENT STUDENT PROJECTS

After the students complete their VEX IQ Clawbot and have exhausted the resources provided by VEX, students can be charged with developing their own student projects.

PHASE 1: PROJECT PROPOSALS WITH DONORSCHOOSE

Students will work in small groups to propose independent STEM related projects. Some successful projects that students have completed include:

- Robotic Hand
  - http://yaegerco.com/HandKit%20class%20ed%20909.pdf
- Prosthetic Hands with E-Nable
  - http://enablingthefuture.org/
- 3D Printed Drones
  - http://www.hovership.com/guides/3dfly-quad-assembly/
  - https://www.getfpv.com/3dfly-micro-quad-kit-frsky.html?gclid=CjwKCAjwk4vMBRAgEiwA4ftLs2xfIMDWeE6m2KyuC3pEc7QlUS5fhI-Mp1nQ6_S2dQQS0CwjjaT5yRoCELEQAvD_BwE
- 3D Printed RC Cars
  - http://makezine.com/projects/3d-print-badass-rc-race-car/
- Underwater ROVs
  - https://nmsmonitor.blob.core.windows.net/monitor-prod/media/archive/publications/education/rov_manual.pdf

The sky is the limit with independent projects. I usually post a list of potential projects for students who need some assistance in selecting a project, but I often have many students that have a unique idea they want to pursue.

Once they have an idea for what they want to build, students work together to research the necessary materials and submit a project proposal to DonorsChoose. If you have a reliable source of funding, the project proposal could be submitted to that source instead (PTSA, school funds, fundraiser, etc) for approval.

DONORSCHOOSE PROJECT APPLICATION


DonorsChoose.org

Got an idea? Make it happen.

We know 2,033,266 people who are ready to get you books, laptops, field trips, and just about anything else you can imagine for your school.

How It Works

1 **Think up a project.** Request books, technology, field trips—anything you've been dreaming of for your school.

2 **Get your teacher to post it.** You'll need to ask a teacher to post your project on our site.

3 **Tell everyone you know.** We know more than 2 million people who can chip in to fund your project. The more people you tell, the better.

4 **Your materials arrive.** Once your project is funded, we'll send everything you asked for straight to your school.

Frequently Asked Questions

How do I know if I can create projects for this website?

As long as you are older than 13 years old and you're in grades 7-12 in a public school or public charter school, you can partner with a teacher for creating your project.

What kinds of things can I ask for?

You can ask for books, calculators, robots, graphic novels, costumes, paper, team jerseys, plants, pencils, cameras, tools, paint, musical instruments—whatever your school, class, club, sports team, or performing group needs. If you can think it up, we can help you get it.

What are my chances?

90% of student-led projects on the site reach their goal. Heads-up: projects that cost less than $400 are the most likely to be funded.

Create Your Project

Project Writing Checklist

☐ **Tell a story**. Think about what you need, and be clear and specific. How will this project help you and your classmates? Your job is to convince readers to donate!

☐ **Use YOUR voice.** Donors want to help students like you get the things you need. Your writing should show your personality. (Just keep it school-appropriate, please.)

☐ **Check your writing.** Spelling and grammar aren't just things your teacher likes to bug you about. Some donors won't give to a project that has writing errors.

Project Title: ____

This is your chance to hook readers in. Make it interesting and catchy!

What resources do you need to make your project a success?

This should be a short sentence, like "We need a dozen chess sets to practice for a city-wide tournament."

We need ____

____

____

What is your project idea?

What goal are you trying to accomplish?

____

____

____

____

____

____

____

____

____

____

____

____

How will you—with your teacher's help—be a leader in bringing this project to life?

Usually, teachers are in charge of classroom materials and school projects. Not today! Your awesome teacher is encouraging you to take the lead. Explain how you'll make this project happen.

Why is this project important to you and your school community?
What problem or challenge will your project solve?

Forms can be accessed here:
https://storage.donorschoose.net/dc_prod/docs/DonorsChoose.org-StudentLedProjects-StudentPacket.pdf?v=1476813479055

PHASE 2: STUDENT PROJECTS

Over the course of several months of meetings, students will progress on independent projects. Students should be minimally supported in their endeavors so that the result is truly their own. The best resource for helping students complete these kinds of projects is Google and YouTube. My students relied heavily on both while working on their projects. Having had no previous experience working with RC cars, drones, or prosthetic hands, I too needed to do a lot of research to be in a position to help if needed, but in the end many of the students will take on the challenge of being independent.

PHASE 3: SHARING THEIR WORK

After any project, it is a best practice to have students develop presentations and have them share their work with others. In this instance, a maker fair is very appropriate. A maker fair is much like a science fair. Students should create a visual display to accompany their physical project. These displays are then set up in a communal space, such as the media center, and the students stand by their visual displays and talk to people about their creations.

Students, teachers, administrators, and even parents should be encouraged to attend so that they can see the kind of projects students in the club are taking on. Additionally, this serves as an excellent recruiting tool for the club as more students see the creative license that club members are given.

RESOURCES

Cardboard Hydraulic Arm:

https://makezine.com/2017/03/30/making-an-impressive-robotic-arm-from-cardboard/

Dadeschools SECME:

http://science.dadeschools.net/secme/default.html

Marshmallow Challenge:

https://www.tomwujec.com/design-projects/marshmallow-challenge/

NASA Engineering Design Process:

https://www.nasa.gov/pdf/630754main_NASAsBESTActivityGuide6-8.pdf

MDCPS SECME:

http://science.dadeschools.net/secme/default.html

VEX IQ:

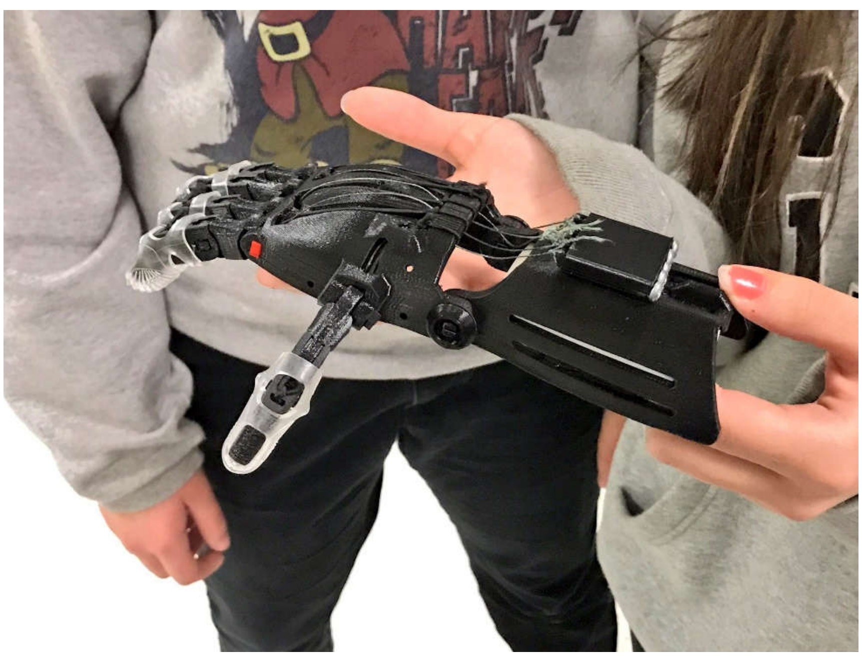
https://www.vexrobotics.com/vexiq

VEX IQ Curriculum and Lessons:

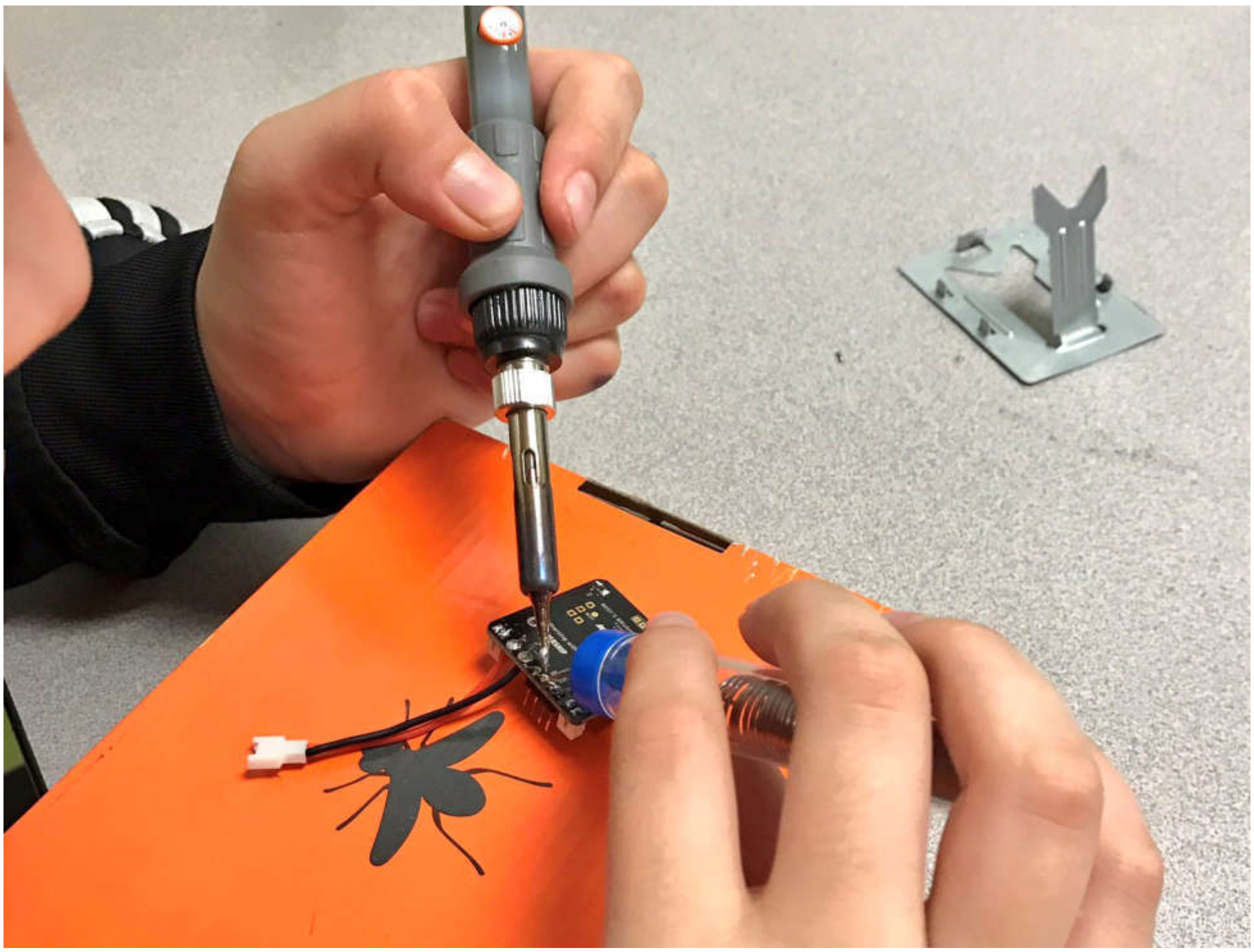
https://www.vexrobotics.com/vexiq/education/iq-curriculum

STUDENT WORK SAMPLES

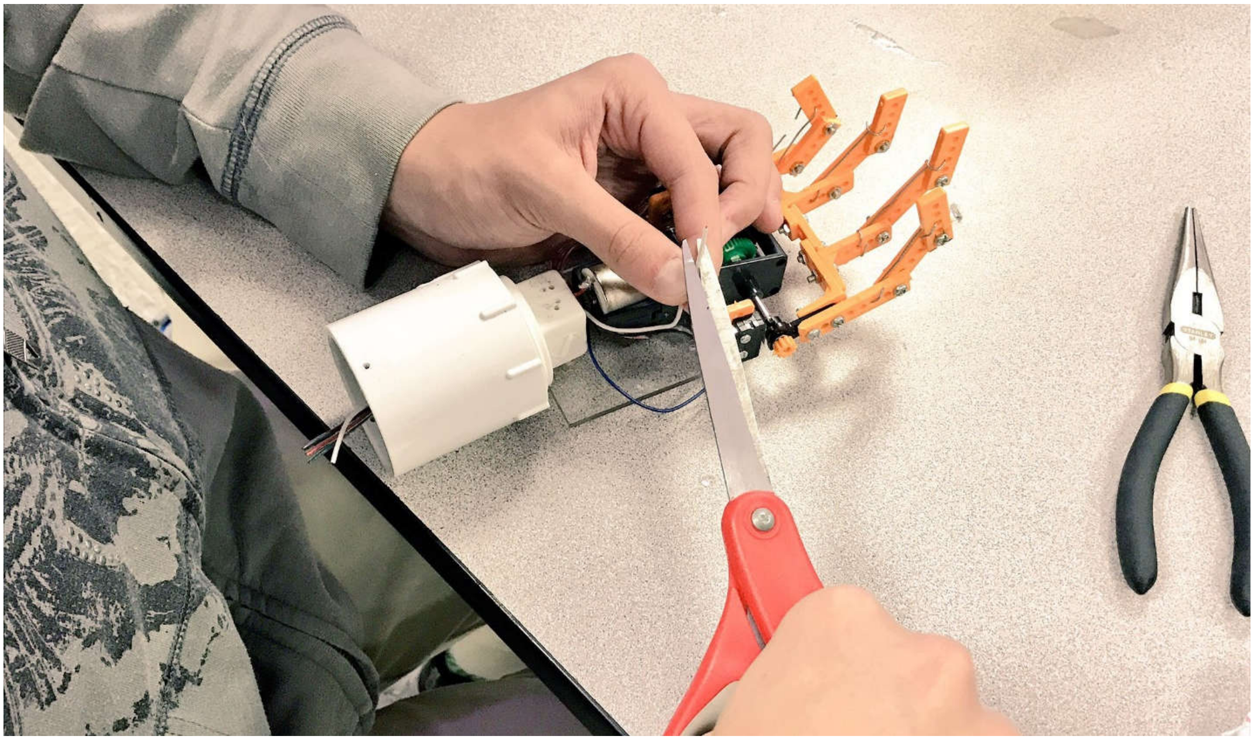
VEX IQ Clawbot.



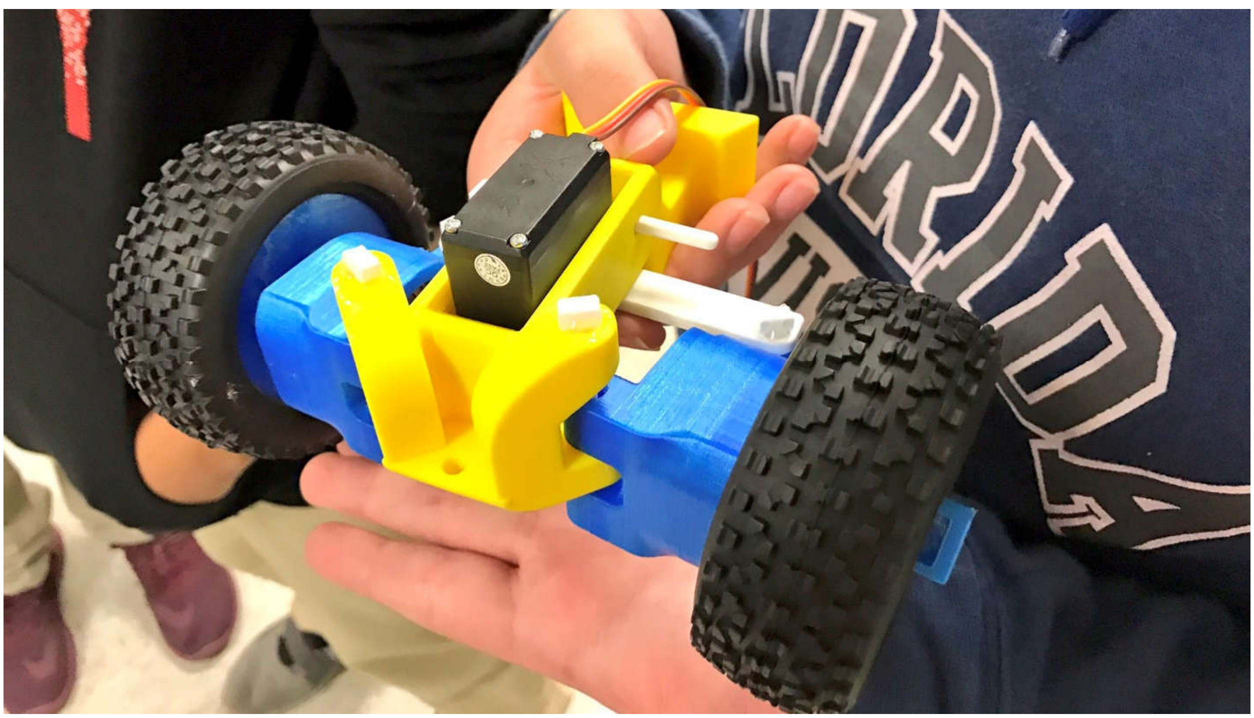
Prosthetic Hand



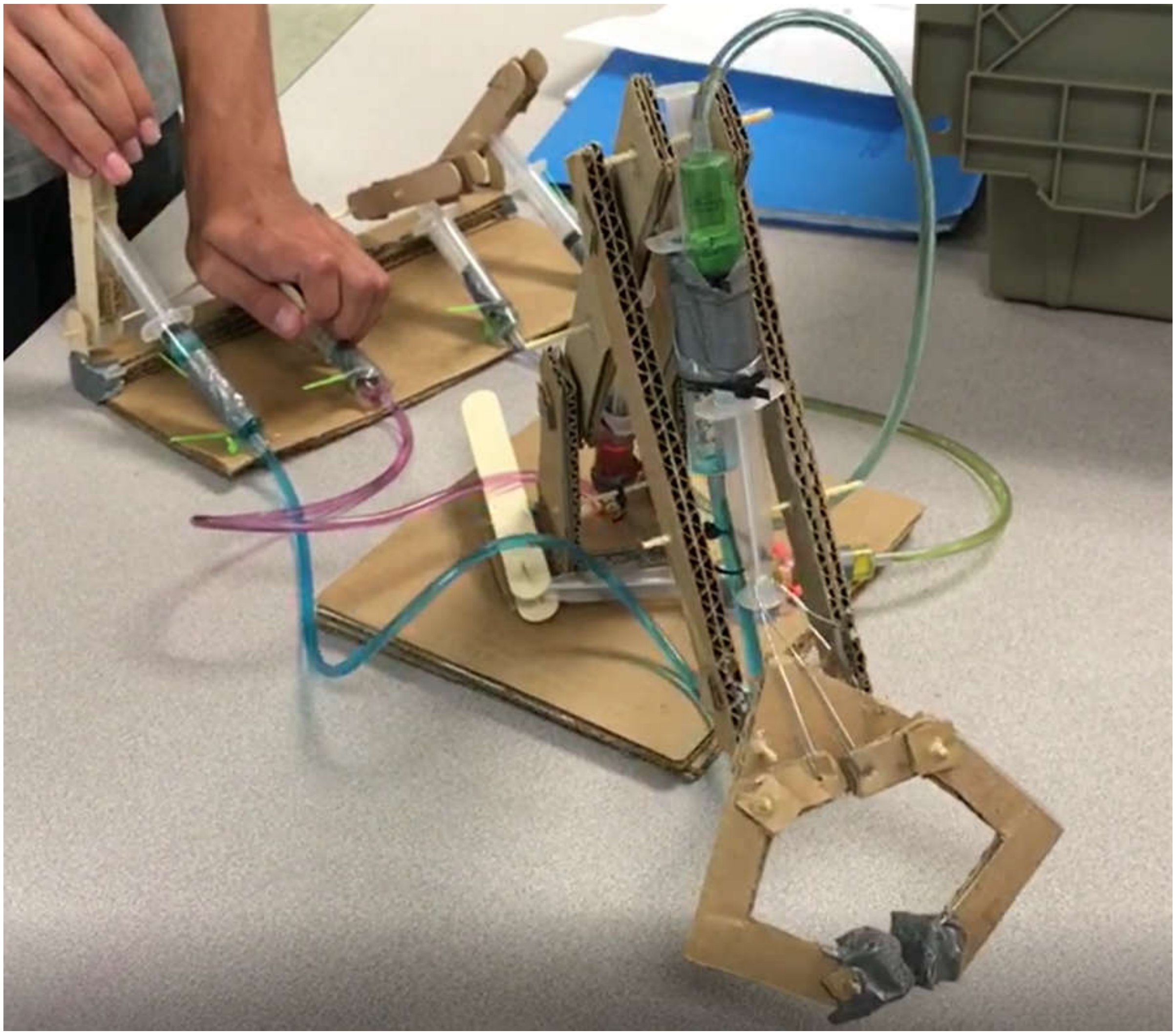
3D Printed Drone



Robotic Hand



Remote Controlled Car



Cardboard Hydraulic Arm

THE EDUCATION FUND

FOR EXCELLENCE IN MIAMI-DADE PUBLIC SCHOOLS

Apply for an Ideas with IMPACT Adapter Grant!

All Miami-Dade County public school teachers, media specialists, counselors or assistant principals may request funds to implement any project idea, teaching strategy or project from the 2017 Idea EXPO workshops and/or curriculum ideas profiled annually in the ***Ideas with IMPACT*** catalogs from 1990 to the current year, 2017-18. Most catalogs can be viewed on The Education Fund's website at educationfund.org under the heading, "Publications."

- Open to all K-12 M-DCPS teachers, counselors, media specialists
- Quick and easy reporting requirements
- Grants range from $150 - $400
- Grant recipients recognized at an Awards Reception

To apply, you must contact the teacher who developed the idea before submitting your application. Contact can be made by attending a workshop given by the disseminator, communicating via email or telephone, by visiting the disseminator in their classroom, or by having the disseminator visit your classroom.

Project funds are to be spent within the current school year or an extension may be requested. An expense report with receipts is required by Friday, June 1, 2018.

APPLICATION DEADLINE:
December 13, 2017

Apply online at educationfund.org

For more information, contact:

Edwina Lau, Program Director
305.558.4544, ext. 113
elau@educationfund.org

THE EDUCATION FUND
FOR EXCELLENCE IN MIAMI-DADE PUBLIC SCHOOLS

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