THE EDUCATION FUND

FOR EXCELLENCE IN MIAMI-DADE PUBLIC SCHOOLS

2017-2018

Ideas with IMPACT

idea packet

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Engineering Design Process

Project title: Engineer SciFi- Sling Shot

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What is Engineer SciFi- Sling Shot?

Engineer SciFi- Sling Slot is an a basic robotics activity that focus heavily on the Engineer Design Application Process. This project has been used to help students become innovative thinkers, problem solvers, and producers.

How did this project manifest?

As a science teacher, I have always taught the Engineer Design Cycle, but never spent a large amount of time investing in in the concept. During the 2013-2014 school year, another teacher and I decided to give our classes as a final project instead of a final exam. We used the Engineer Design Process for their final project. I have learned that the Engineer Design process promotes innovative ideas and critical thinking skills. It has always been a goal for my students to acquire talents that will allow them to become citizens that can produce and or improve a product, process, or system. This idea was later used in an Innovator Grant to start Miami Norland Senior High first Robotics Club.

What are some of the benefits from using the Engineer Design Cycle?

1. Promoted high self-esteem: The engineer application project allows students to become confident during accountable talk and an increase in logical scientific questioning.
2. Promoted an growth in academics, usage of science vocabulary and language.
3. Promoted discovery, inquiry, and project based learning.
4. Provides various ways to assess students' learning.

So when you hear the word ENGINEER, do not cringe! It is a way of teaching diverse learners how to think critically, explore, and create.

Correlation of the Next Generation Sunshine State Standards

Standards	Florida Standard	Description and Benchmark
Independent and dependent variables	Standard 2: The Characteristics of Scientific Knowledge	**SC.912.N.1.2** Describe and explain what characterizes science and its methods
Velocity	Standard 12: Motion	**SC.912.P.12.2** Analyze the motion of an object in terms of its position, velocity, and acceleration (with respect to a frame of reference) as functions of time.
Speed	Standard 12: Motion	**SC.912.P.12.2** Analyze the motion of an object in terms of its position, velocity, and acceleration (with respect to a frame of reference) as functions of time.
Kinetic Energy	Standard 10: Energy	**Benchmark: SC.912.P.10.1** Differentiate among various form of energy and recognize that they can be transformed from one form to others.
Potential energy	Standard 10: Energy	**Benchmark: SC.912.P.10.1** Differentiate among various form of energy and recognize that they can be transformed from one form to others.
Mechanical Energy	Standard 10: Energy	**Benchmark: SC.912.P.10.1** Differentiate among various form of energy and recognize that they can be transformed from one form to others.
Force and Motion	Standard 12: Motion	**SC.912.P.12.2** Analyze the motion of an object in terms of its position, velocity, and acceleration (with respect to a frame of reference) as functions of time.
Math	Supporting Idea 7: Data Analysis	**MA.3.S.7.1 /MA.912.S.3.2** Collect, organize, and analyze data sets, determine the best format for the data and present visual summaries.

Safety

Use the VEX Robotic Sling Shoot in accordance with established laboratory safety practices, including, wearing googles, gloves, and any other protective equipment.
Use caution when working with pieces and avoid putting objects in your mouth.

Timer requirements for primary

Teacher preparation: (30-45 minutes)

Student observation and define the problem: (5-7 minutes)

Students create a solution: (5-10 minutes)

Students build a prototype: (time will vary)

Student assessment: (time will vary)

Student improve: (time will vary)

Time requirements Secondary:

Teacher preparation: (30-45 minutes)

Student observation and define the problem: (3-5 minutes)

Students Research and Brainstorm ideas: (10-15 minutes)

Student choose most effective idea: (time may vary)

Students develop prototype and test: (time may vary)

Students evaluate and improve design: (time may vary)

Mastery Objectives

Students will be able to:

- Observe and explain how can a VEX robotic catapult (sling slot) be used to get a ping pong ball into a corn hole with 100% mastery.
- Manipulate the setting of the robotic catapult’s arm to release the ping pong ball into the corn hole.
- Build a robotic catapult using the engineer cycle to compete against classmates in the Engineer SciFi Sling Shot Challenge with 100% mastery.
- Evaluate and test the complete prototype of the robotic catapult with 100% mastery
- Design another way to improve the robotic catapult with 100% mastery
- Retest your designed of the robotic catapult with 100% mastery.
- Describe how potential, kinetic, and mechanical energy is being used with the Vex Robtic Catapult, with 100% mastery.
- Calculate the potential energy of the height for the ping pong ball using the formula- (PE= mgh) with 100% mastery
- Explain the relationship between potential and kinetic energy before and after the ping pong is released with 100% mastery.
- Calculate the acceleration of the ping pong from start until it reaches the corn hole with 100% mastery.
- Calculate the mechanical advantage of the vex robotic catapult by using the formula MA $= F_{out}/ F_{in}$
- Calculate how much force was used to shot the ping pong into the corn hole, using the formula F=mxa, with 100% mastery.

Materials for a class of 25:

- 13 sets of HEXBUG VEX Robotic Catapults
- 2 GoSports Solid Wood Premium Cornhole Sets **or** EastPoint Sports Bean Bag Toss Set - 3 Hole
- Corn hole Vex Robotic instruction
- All materials are included in the Vex kit
- Worksheet- Engineer Design SciFi-Sling Shot

Materials for a class of 20 (teams of 4) –Advance with motors

- 6 sets of HEXBUG VEX IQ Robotics Construction Set
- GoSports Solid Wood Premium Cornhole Sets **or** EastPoint Sports Bean Bag Toss Set - 3 Hole
- HEXBUG VEX IQ Robotics Construction instruction
- All materials are included in the VEX kit
- Worksheet- Engineer Design SciFi-Sling Shot

Background Knowledge:
What is the Engineering Design Cycle? Let us look at each word separately.

Engineer: to design and build; a person who design, build, and maintain a product, process, or system, for public work.
Design: a proposal or drawing used to show the look and purpose or mechanisms of an object before it is produced.
Cycle: a sequence of events that are often repeated in the equivalent direction

It is fair to say that the Engineer Design Cycle can be used to create a product (such as lotion), process (how to get into college), or system (judicial system) by using specific steps to solve a problem or provide a solution. Why do people use this process and how would it be beneficial for students learning in and out of the classroom?

Teaching the Engineer Design Cycle

Identify and define the Problem- Tell the students to look around the classroom or you can take them outside to make an observation. Ask the students, "What is a problem that you see in the classroom or outside?" In this part of the cycle, students will make an observation, using their senses, to recognize a problem. Students can turn their problem into a question. This is similar to a scientific problem statement.

1. How can you use this VEX Robotic Catapult to get the ping pong into the corn hole?

Research- After the students have detected a problem, students will do some research (complete a research paper) to examine what already exits. Some questions that can guide students during their research are:

- Who (individuals, group of people) discovered a problem similar to yours?
- What research have you completed (books, online site, interviews, audio resources, etc.) about your topic? ***Hint-be detailed***
- What information did you find and how does it relate to your problem?

1. How is this VEX Robotic Catapult more effective than catapults used and created in past history?

Brainstorm and develop ideas- Students will think of possible solutions to solve their problems. Brainstorming can be in the following forms (or other research based form):

- Mind map
- Unrestricted writing (free writing)
- List ideas
- Flow chart
- Drawing

1. Determine distance between the VEX Robotic Catapult that will give you a better chance of getting the ping pong in the corn hole.

Choose the most effective idea- Students will select the best logical answer to solve the observed problem.

Create prototype- Students will construct a product, process, and or system that will be used to answer their problem. Prototypes may come in many different forms, some are:

- Working prototype (functional)
- Visual prototype (model not functional)
- Study prototype (similar to a blue print)
- User experience prototype (Used in research)

1. Students will use the working prototype for the VEX Robotic Catapult as their prototype

Test and evaluate – Students will implement and assess their product, process, or system centered on the challenge provided by the instructor.

1. Students will use the VEX Robotic Catapult's manual to put together the robot and test it from different distances to get the ping pong into the corn hole.

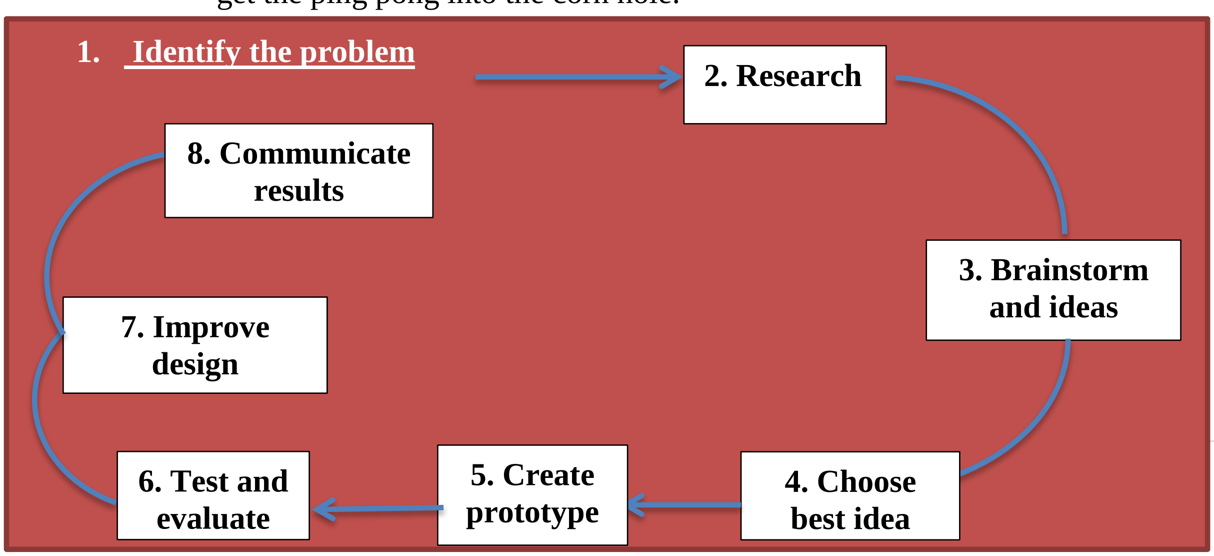
Improve Design- Based on students' observation, students will make adjustments and enhancements to their process, product, or system. Some questions to help make improvements are:

- What function worked when you made your product, process, or system?
- What function did not work and why?
- What alterations or modifications would you make to your product, process, or system, and why?
- How will the alterations or modifications make the prime impact on your design?

1. Students will adjust the VEX Robotic Catapult's arm in different positions to get the ping pong ball into the corn hole.

Communicate results – Students will share their report to the public so that other engineers can replicate their product, process, or system.

1. Students will provide summative conclusion of the engineer cycle and how it was used to get the ping pong into the corn hole.



Introducing the Engineer Design Cycle: Teachers can use strategies below and other researched based strategies as attention grabbers, to activate students' prior knowledge. In addition, these strategies can be used to set the tone of the learning environment

- Hang man
- Charades
- KWLH chart
- Video
- Pictures
- Physical model
- Music
- Think-pair-share

Teacher instruction: Teacher instruction can be designed using any format below or from any research based instruction. Provide instructions that promote accountable talk using scientific vocabulary, team building skills, and collaboration.

- Project based instruction
- Jig-saw
- Guided notes
- Whole group instructions
- Direct instructions
- Explicit instructions
- Interactive notes
- Connell notes
- Student grouping (Assemble the robot working in groups – each person assigned a role (writer, 2 assemblers, engineer design journalist, photographer)

Students' assessments: Students assessments are designed to evaluate all learning styles. Some ways to assess students learning are:

- Written assessment (short and long response Claim evidence reasoning writing, fill in the blank, etc.)
- Multiple choice
- Case studies
- Peer assessment (interviews)
- Verbal assessment
- Rubrics
- Concept maps
- Group presentations
- Role play
- Writing a poem
- Singing a song/rap
- Skit
- Concept maps
- Create a video

Name: ____

Date: ______________________ **Period:** ___________

Engineer SciFi –Sling Slot Game Challenge

Playing the Game

Objective: Launch a ping pong ball into a corn hole using the VEX Robotic Catapult with 100% mastery.

Rules:

- Create a team of up to 4 people and with a team name
- As a group solves 3 mathematic brain teaser problems to get an extra turn (problems will come from your teacher.
- Determine the distance you want to launch your VEX robotic catapult. You may manipulate the distance between the catapult and the corn hole board.
- Set your robotic catapult to the desired distance
- Launch the ping pong to go in to the corn hole.
- If the ping pong makes it in the hole, it is worth 10 points.
- If the ping pong hits the board, it is worth 5 points.
- Each team will have 3 turns to get 20 points
- A team will receive an extra turn if all mathematic problems are answered correctly.
- Write down your score in the chart below.
- Your team may be disqualified if a member of your team is distracting another team by the following: yelling gestures, blocking corn hole board, horse play during the competition environment (classroom, library, outside, etc.)
- Answer the questions below to receive a grade

Trials	**Distance from corn hole board**	**Points**
1		
2		
3		
Total		

1. What strategies did your team find most helpful when launching the ping pong in to the catapult? How did you improve the position of the catapult to achieve 20 points?
   ____

   ____

   ____

   ____

Students' worksheets and assessments

Name: ________________________________

Date: _________________ Period: ________

Engineer Design SciFi-Sling Shot

<u>Physics: Engineering Cycle:</u>

<u>PROBLEM:</u>

____

<u>RESEARCH:</u>

____

____

____

____

____

<u>BRAINSTORM AND IDEAS:</u>

____

____

____

____

____

<u>CHOOSE THE MOST EFFECTIVE IDEA:</u>

____

____

<u>CREATE YOUR PROTOTYPE:</u> Strategize on how you are going to assemble the VEX Robotic Catapult within your group.

____

____

1. Draw your plan. Label each of the materials.

TEST AND EVALUATE:

2. Did you successfully build your VEX Robotic Catapult? If not, explain why did it fail?

IMPROVE DESGIN:

3. What adjustments could you make to your procedures? If you have time, make the adjustments and test it again.

COMMUNICATE RESULTS:

3. Summarize the Engineer Design Cycle using the activity of the VEX Robotic Catapult. How can this investigation be applied in the real world? Provide at least 3 examples. ***Hint-be sure to use quantitative and qualitative data***

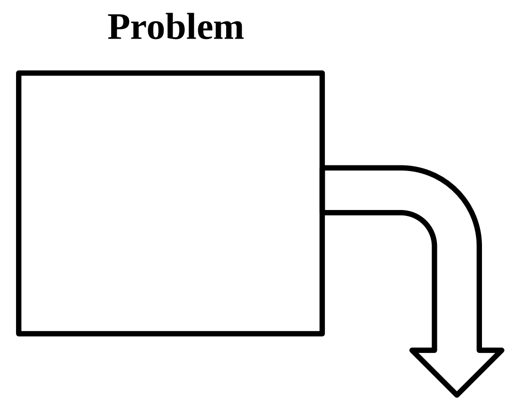
Name ______________________________

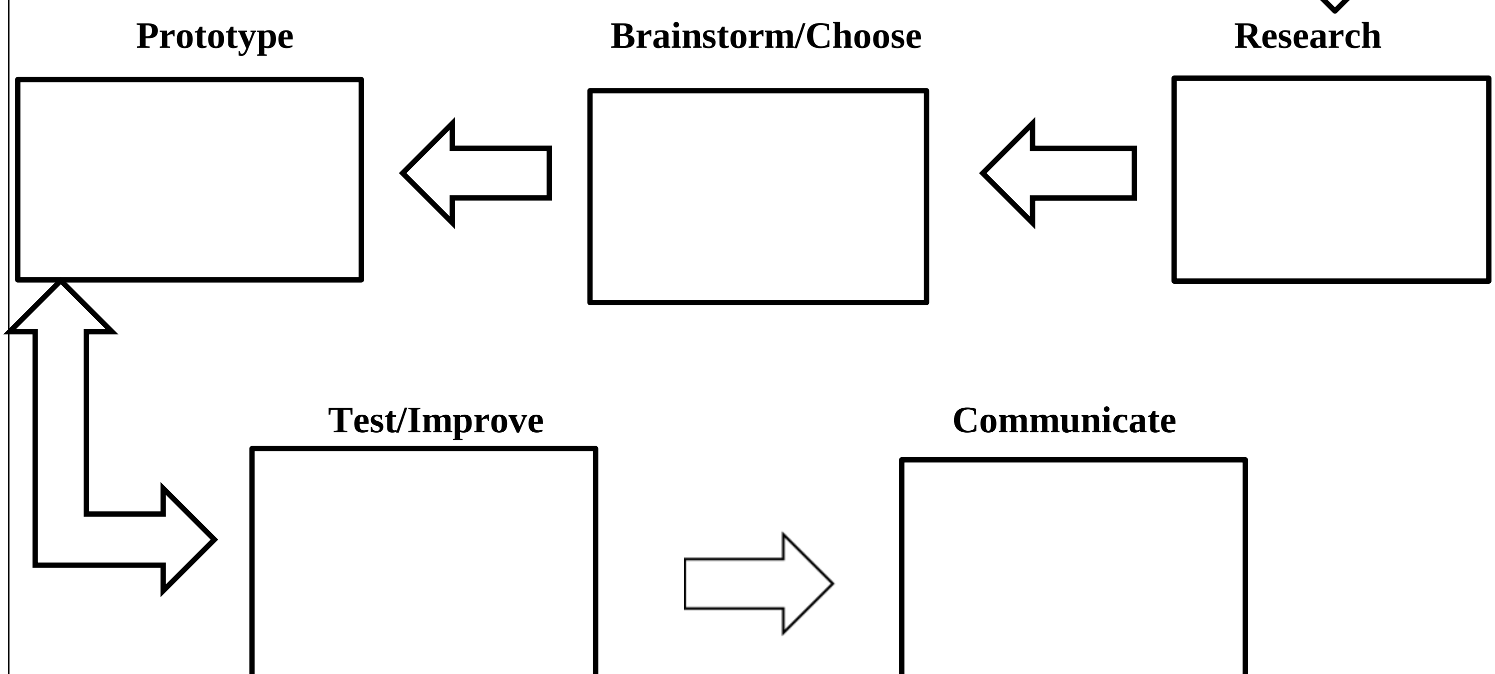
Date________________ Period: ________

Engineering Design Cycle-Flow chart

Direction(s):

Find a partner and analyze each topic above every box. Draw or write a description in the boxes for each step in the Engineering Design Process. You will have 10 minutes to complete this section.





Cut alongside the dotted line

Direction(s): Create 3 questions about the engineer design cycle for your partner to answer on the back of this paper.

1. ____
2. ____
3. ____

Engineer Design Cycle Final Project

Background: The engineering design process is a procedure that you use to create or improve a product, process or system. You can start anywhere in the process; however, most engineers begin at ASK or IMPROVE. Failure is always a part of the process ... so is learning from failure!

You and one classmate will use the Engineering Cycle to come up with a new and improved product, process, our system: (must be approved by the teacher):__________________________

- Product (lip balm water bottle, hair dye, perfume)
- Process (state testing, getting into a magnet program, getting into college,)
- System (criminal justice system, cliques/peer groups, privilege and oppression)

Your product will be an accumulation of all five assignments, ____ grades each. Your product must be bound in some way (stapled, in a binder etc.). And it must include an assignment for all five of the steps—see below for details

Ask: **One Page double spaced paper** (500 words) answering the following: Who originally invented the design? What research have you completed on your idea (include resources-books, online research, interview, etc.)? What is your design supposed to do? What do you think could keep it from working? How will you test your design (describe each steps)? _______/100 pts. **Due: ______**

Imagine: **One brainstorming worksheet in any form**. Apply knowledge and creativity to brainstorm ideas together. Possible formats below:
Flow chart, list, pictures, free write, web, Venn diagram _____/100 pts. **Due: _____**

Plan: **One 3-minute "pitch" to your teacher (Why should someone use your design?)**. Your pitch may be in the form of a PowerPoint but does not have to be. You may NOT read directly from a paper but rather pitch, or argue, your plan to me. Please include the following in your pitch: Consider your materials, resources: drawing, sketch, outline, map, plot, diagram, draft, representation, scheme, model. ______/100 pts. **Due:____**

Create: **Your creation can be in ANY of the following formats: a physical model, video, blue print, essay/paper, Prezi, PowerPoint.** Follow the plan. Test it out and compare your results to what you wanted or expected. ***Your creation must be a product*** (you can't just talk about it, it needs to be in a form listed above) _______/200 pts. **Due: ______**

***If you have an idea that is not listed above please check with me before approved. ***

Improve: **One full page analysis of results**. Analyze your test results. You must answer the following questions: What worked when you made your creation? What didn't work? What would you do differently when you do it again? What change would make the biggest impact on meeting your goal? _______/100 pts. **Due: _______**

Name: ______________________________________ Date: __________ Period: _____

Acceleration

Acceleration: a change of rate in velocity; change in speed; constant, negative, or positive change in speed or direction

Objective: ____

____

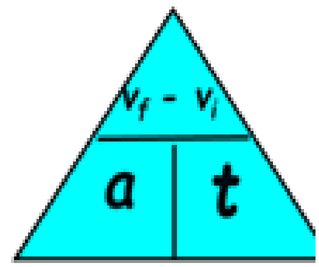
Formula: Acceleration = Final velocity – initial velocity/ time

A= Acceleration (m/s^2)

V_i = Initial velocity (m/s)

V_f = Final velocity (m/s)

T = Time (s)



Direction(s): Use the chart below to determine the acceleration of the VEX Robotics Ping pong into the corn hole.

Trials of ping pong	Initial velocity **(m/s)**	Final velocity **(m/s)**	Time **(s)**	Acceleration **(m/s^2)**
1				
2				
3				
Average				

Practice Problem(s): Use the average data from above to fill in the blanks

A. A ping pong starts at ______ m/s. _______ Seconds later, its velocity is _______ m/s. What is the ping pong' average acceleration?

B. Your VEX Catapult ping pong is not landing in the corn hole. You need to modify your acceleration. Create a problem to show the change in acceleration. *Hint ***look at the data table above****

____

____

____

____

Name: ____ Date: __________ Period: _____

Newton's Second Law of Motion

Newton's 2^{nd} Law- The acceleration of an object is directly proportional to the net force acting on it and inversely proportional to its mass.

Force: is a push or pull on an object

Objective: ____

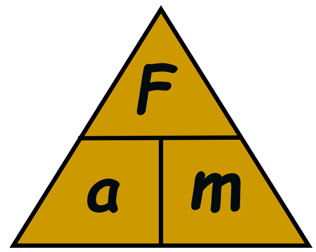
____

Formula: Force = mass x acceleration

F= Force -Newtons (N)

A= Acceleration (m/s^2)

m = mass (kg)



Direction(s): Use the chart below to determine the force of the VEX Robotics arm that is used to eject the ping pong.

Trials of ping pong	Acceleration **(m/s^2)**	Mass **(kg)**	Force **(N)**
1			
2			
3			
Average			

Practice Problem(s): Use the average data from above to answer A and or B.

A. How much force does it take to get the VEX Robotics' ping pong into the corn hole?

B. Your VEX Catapult ping pong is not landing in the corn hole. You need to modify you're the catapults arm. Create a problem to show how you have modified the amount of force exerted from the catapult. *Hint ***look at the data table above****

____

____

____

____

Name: ______________________________________ Date: __________ Period: _____

Gravitational Potential Energy

Potential: stored energy, amount of stored energy is based on position. The higher an object the more potential energy it will have. The lower the object the less potential energy it will have. Potential energy is directly related to Kinetic energy.

Gravitational Potential Energy: objects that falls; energy stored by objects due to their position above Earth's surface; all objects on Earth accelerate at $9.8 m/s^2$.

Objective: ____

____

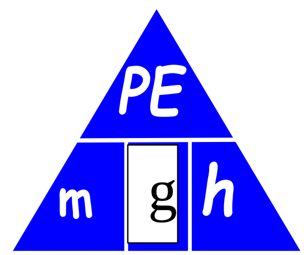
Formula: Potential Energy = mass **x** gravity **x** height

PE= Joules (J)

m = mass (kg)

g = gravity ($9.8\ m/s^2$)

h = height-meters (m)



Direction(s): Use the chart below to determine the how much potential energy is stored in the VEX Robotic ping pong before it is launched into the corn hole.

Trials of ping pong	Mass **(kg))**	Gravity **($9.8\ m/s^2$)**	Height-meters **(m)**	PE= Joules **(J)**
1				
2				
3				
Average				

Practice Problem(s): Use the data table above to answer question A and or B.

A. What is the average potential energy does the VEX Robotics' ping pong has before it is launched?
B. Calculate the missing variables using the triangle above.

Mass **(kg))**	Gravity **($9.8\ m/s^2$)**	Height-meters **(m)**	PE= Joules **(J)**
		46 m	20J
67g			
85kg		10m	
17kg			14J

Name: ____ Date: __________ Period: _____

Mechanical Advantage

Mechanical advantage: the ratio between the output force and input force; load and effort.
Force: is a push or pull on an object

Objective: ____

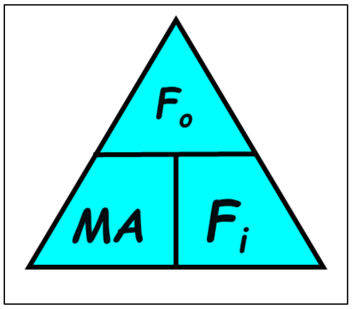
____

Formula: Mechanical Advantage = F_o / F_i

F_o= Output force (N)

F_i= Input force (N)

MA= Mechanical Advantage



Direction(s): Use the chart below to determine the mechanical advantage used to turn the arm of a VEX Robotics catapult.

Trials of ping pong	F_o= Output force (N)	F_i = Input force (N)	MA= Mechanical Advantage
1	10N	7N	
2			46
3		22N	13
Average			

Practice Problem(s): Use the average data from above to answer A.

A. Explain how could you increase and decrease the mechanical advantage of your catapult's arm. Create a problem to show how you have modified the mechanical advantage the catapult. ****Hint-look at the data table above****

____

____

____

____

Name:________________ Date: ____ Period: __

Engineering Design-Neon Lights Party

Your design challenge: Design a neon lights party for your friends! Think about how you would form a neon lights party for your friends. Look at each step in the engineer design cycle and explain each step for your foam party.

Engineering Design Process Steps:

1. Ask:

____

____

2. Picture:

3. Plan:

____

____

4. Create:

____

____

5. Improve:

____

____

Name: ______________________

Date: _____________ Period:____

Engineer Design Cycle

Directions: Today you are going to creatively go through the engineer design cycle. Take a moment to think about something in the world that you want to make better. Fill in each box with **YOUR THOUGHTS by drawing or writing**.

What am I designing?

What materials will I use?

How will I make it better?

Draw your design!

How did your design turn out? Better or worse than the original product?

Project title: Engineer SciFi- Sling Shot

Disseminator: Anike Sakariyawo

Contact information

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School: Miami Norland Senior High

School mail code: 7381

For information concerning Ideas with IMPACT opportunities including Adapter and Disseminator grants, please contact**: Edwina Lau**

Edwina Lau, Ideas with IMPACT Program Director | The Education Fund | 305-558-4544, Ext. 113 | Email: elau@educationfund.org | www.educationfund.org

Note: All activities may be modified and or changed to meet and assess students' needs.

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

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