THE EDUCATION FUND

FOR EXCELLENCE IN MIAMI-DADE PUBLIC SCHOOLS

2017-2018

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Engineering is Elementary My Dear Watson!

Engineering is Elementary, My Dear Watson!

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Goals and Objectives – Florida Standards

SC.35.CS-CS.2.2 - Describe how computational thinking can be used to solve real life issues in science and engineering.

SC.35.CS-CS.2.4 - Solve real-world problems in science and engineering using computational thinking skills.

SC.5.N.1.5 - Recognize and explain that authentic scientific investigation frequently does not parallel the steps of "the scientific method."

SC.5.N.1.6 - Recognize and explain the difference between personal opinion/interpretation and verified observation

SC.5.N.2.1 - Recognize and explain that science is grounded in empirical observations that are testable; explanation must always be linked with evidence.

SC.5.N.2.2 - Recognize and explain that when scientific investigations are carried out, the evidence produced by those investigations should be replicable by others.

Engineering Standards

K-2-ETS1-1. Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.

K-2-ETS1-2. Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.

K-2-ETS1-3. Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs.

ETS1.B: Developing Possible Solutions

Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people.

ETS1.C: Optimizing the Design Solution

Because there is always more than one possible solution to a problem, it is useful to compare and test designs.

(3-5-ETS1-1) People's needs and wants change over time, as do their demands for new and improved technologies.

(3-5-ETS1-2) Engineers improve existing technologies or develop new ones to increase their benefits, decrease known risks, and meet societal demands.

(3-5-ETS1-2) At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs.

(3-5-ETS1-3) Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved.

8 Practices in the Next Gen Science and Engineering Standards

1. Asking questions (science) and defining problems (for engineering)
2. Developing and use models
3. Planning and carrying out investigations
4. Analyzing and interpreting data
5. Using mathematics and computational thinking
6. Constructing explanations (science) and designing solutions (engineering)
7. Engaging in argument from evidence
8. Obtaining, evaluating, and communicating information

Course Outline/Overview

Students in grades K-5 will participate in a researched based and classroom tested program called Engineering is Elementary. They will learn about the Engineering design process by reading and/or listening to an Engineering story that guides them to solving a "real-life" problem encountered by the character/s in the story, then using materials to solve the engineering design challenge. By using an inquiry and project based learning approach, students will not only increase their experience in STEM, with a special emphasis on Science and Engineering, but they will also build on their problem solving and literacy skills.

How do you solve a real world problem, or even for that matter a mystery? Children are naturally curious and they love to build things. Even more so, children enjoy figuring “stuff out” and giving them the opportunity to think and figure things out, enables them to work just like real engineers. In this day and age, many of our children would never consider themselves to become engineers when they grow up. Many don’t realize that they actually work like engineers when they’re trying to figure out how to get through a video game, especially when they’re stuck on a level. But yet, they do. They figure it out. In doing this, students are actually going through a process that engineers go through. The engineering process includes the ability to ask, imagine, plan, create and improve. This project will enable your students to participate in activities that first starts off with a book, but not just any book. The characters in the EiE storybooks are diverse, just like them and close to their age. They encounter everyday problems, and most importantly, problems, that with a little imagination and creativity, can be solved with every day materials. This project is innovative because it promotes a problem based approach in learning, which is a great way to teach children to look at "real-life" issues/problems and use and develop skills that will help solve those problems.

It can be easily adaptable using other storybooks (***see sample lesson below***) even if materials from EiE are not purchased. (***Please see resource page for literacy resources***).

Sample Lesson Plans

The following lesson was implemented prior to the end of last school year as a grade level as part of our STEM/Project Based Learning initiative at our school. It can be used with other "Three Little Pigs" adaptations, such as, "Huff and Puff", and "The True Story of the Three Little Pigs". It is a great "engineering" lesson that can be used across the grade levels and curriculum since it covers all the subject areas. I've included the "wolf mask" to attach to a hairdryer to make it more fun!

The Three Little Pigs

Children's' Engineering Activity
(Grades K - 3)

Overview

This lesson is based on the *Three Little Pigs* story. In this activity the students are to imagine that there are no bricks available and that they have to help the third pig by using the Engineering Design Process. They will build a house for the third little pig so that when the wolf comes to visit, he will not huff and puff and blow the house down.

Objectives

Students will be able to:

- Brainstorm several ideas for making a strong house
- Predict which materials will be best for building
- Use prior and new knowledge to design the device
- Compare the suitability of different designs
- Describe in simple terms what an engineer does

Materials

- Straws
- Toothpicks
- Craft sticks
- Linguini
- Plastic cups
- Paper clips
- Shaving Cream (optional)
- Small toy pig
- Hair dryer or fan
- Tape
- Toothpicks
- Marshmallows

Procedure

Introduction

- Ask children what they want to be when they grow up. Ask if anyone wants to be an engineer. Ask if anyone knows what an engineer does. Explain that engineers design things to help people and they figure out how to solve problems.
- If they are not familiar with the story, read "The Three Little Pigs" or selected passages to the students.
- Ask "How could an engineer help the pigs?"

Brainstorm

- What kind of houses did the first two pigs build? What happened to them when the wolf huffed and puffed?
- What type of house could an engineer design and build that wolf would not be able to blow down?
- How will we know if it will be able to stand up to the wolf's huffing and puffing?

Design and Construct

- Provide constraints:
    - Use only the materials provided.
    - There must be room for the pig to stand inside
    - There must be an entrance
- Students work in groups to plan their ideas on paper
- Student teams build their houses

Evaluation of Designs

- Test each design by using a hair dryer or a fan to simulate the huffing and puffing of the wolf.
- If time allows, have the students work on improving their designs.

Wrap-up

- Re-assemble children. Ask a few students to describe their designs telling what worked and what didn't work. What would they do differently next time?

Variation

Assign each group different materials and compare results. For example, one group will use straws and marshmallows; another group will use craft sticks and paper clips.

Language Arts Activity

There are many versions of *The Three Little Pigs.* Read two different versions and have the students find similarities and differences.

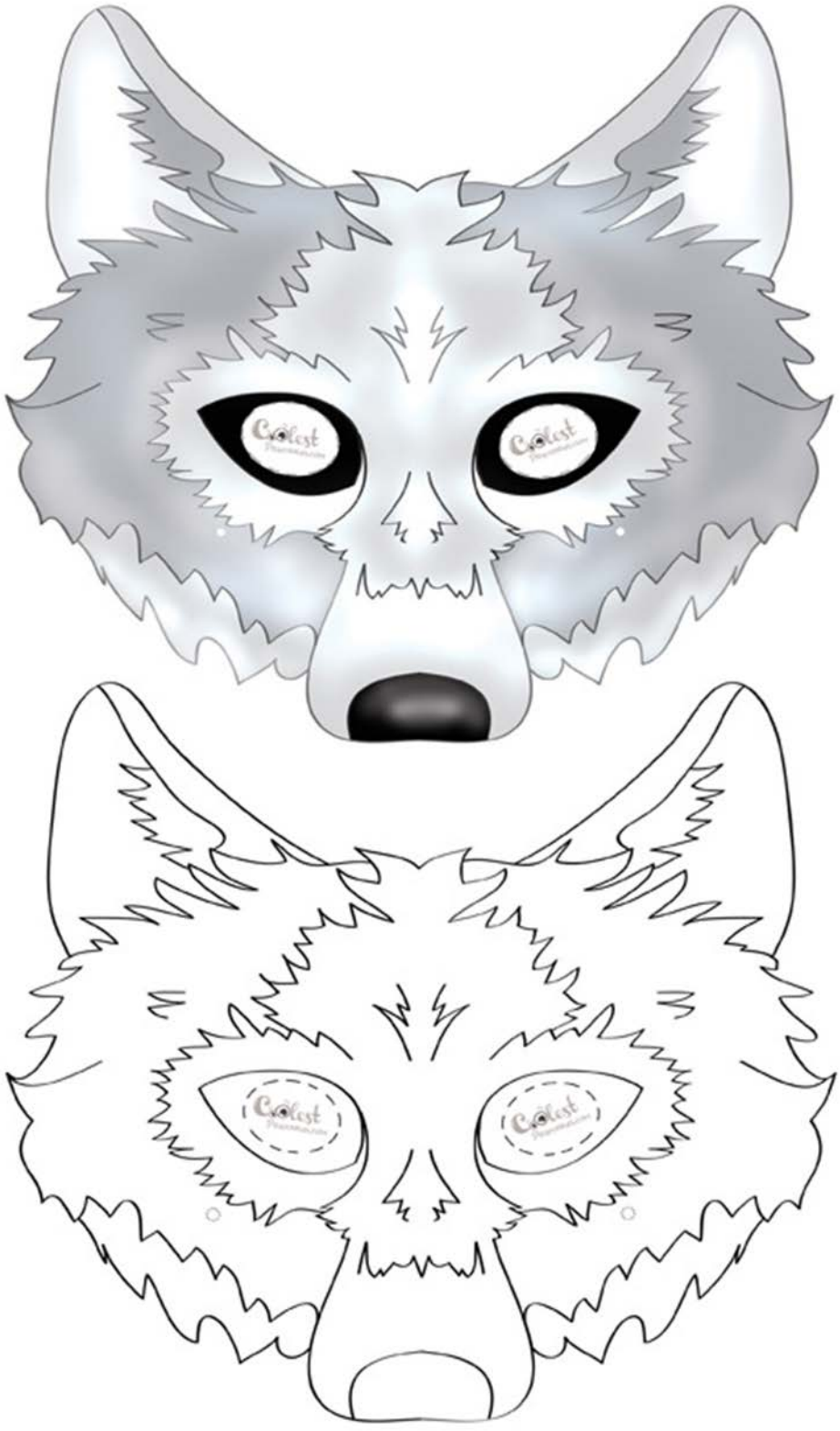
Recommendations:

Artell, Mike. The Three Little Cajun Pigs . New York: Dial Books, 2006. (The pigs build their houses in the swamp and Claude the Alligator is the villain)

Kellogg, Steven. The Three Little Pigs. New York: Morrow Junior Books, 1997 (modern day version with a happy ending)

Marshall, James. The Three Little Pigs. New York : Grosset & Dunlap, 2000 (Classic format of the tale with a few extras)

Standard 8.2 Technology Education, Engineering, and Design: All students will develop an understanding of the nature and impact of technology, engineering, technological design, and the designed world, as they relate to the individual, global society, and the environment.

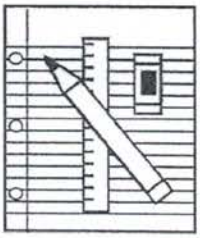


EiE Handout

A

B

Name: _____ Date: _____



Technology Around Us

1. What is your object?_____

2. Draw a picture of your object in this box. Label the parts.

3. What does your object do? What problem does it solve?

_____

_____

_____

4. What material or materials is your object made of?

_____

_____

_____

EiE Handout

A

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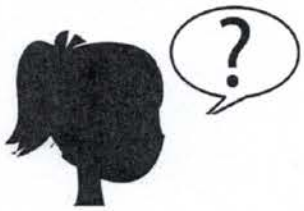


Designing a Water Filter
Engineering Design Process: Ask!

1. Our goal is: _____

_____

2. What criteria will we use to judge our water filters?

_____ _____

_____ _____

3. Describe the "Mystery Water." How is it the same as the contaminated water you tested earlier? How is it different?

_____

_____

_____

_____

4. Which materials do you think will work well to clean the "Mystery Water?" Why?

_____

_____

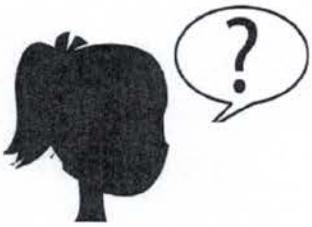
_____

_____

EiE Handout

Name: _____ Date: _____

B



Designing a Water Filter Engineering Design Process: Ask!

Goal: Design a filter to clean contaminated water.

1. The criteria we will use to judge our water filters are:

_____

_____

2. Circle the materials you think will be the best to use in your water filter design.

Screen	Paper Filter	Sand and Gravel
		

Cheesecloth	Cotton Balls
	

3. Why do you think these materials will be the best to use?

_____

_____

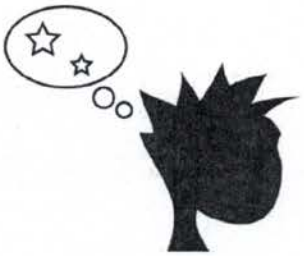
_____

EiE Handout

A

B

Name: _____ Date: _____



Designing a Water Filter
Engineering Design Process: Imagine!

How will you filter the contaminated water?

- Brainstorm ideas.
- Draw pictures of your ideas in the boxes below.
- Circle the idea that you think will work the best.

Idea #1	Idea #2
Idea #3	Idea #4

Resources

The resources listed below will serve as a guide to finding stories and activities, as well as, other lessons that can be integrated in your lesson planning and instruction. Keep in mind that if you teach Reading, some of the stories that are part of the District's curriculum and pacing guide may be "tweaked" and adapted to STEM. There are so many resources available to teachers, but the reality is we may not have the time to find them all. At the same time, some resources may not "fit" the concepts we need our students to learn and know in assisting them with testing, though our goal should be to encourage both our boys and girls in learning and making connections that promote critical thinking and problem solving skills. With all of this in mind, I hope those listed below will help you on your first step in emphasizing the "E" in STEM and investing in our "future engineers!"

EiE Story Books (can be purchased from the website): www.eie.org

- Saving Salila's Turtle
- Paulo's Parachute Mission
- Leif Catches the Wind
- Lerato Cooks Up A Plan
- A Gift from Fadil
- Gayla and Natasha's Rocky Adventure
- Suman Crosses the Karnali River
- Tehya's Pollution Solution

Literature and Engineering Connection

(these can be purchased at different book stores: i.e. Barnes and Noble, Amazon, or in the School Library)

- The Three Little Pigs (Steven Kellog)
- "The True Story of the Three Little Pigs" by Jon Scieszka
- The Three Billy Goats Gruff (Norway and Germany versions online if needed)
- Goldilocks and the Three Bears (Jan Brett)
- Jack and the Beanstalk (by Paragon)
- Yertle the Turtle (Dr. Seuss)
- Curious George and the Hot Air Balloon (H. A. Rey, Margret Rey)
- Dogzilla (Dav Pilkey)
- Franklin is Lost (Paulette Bourgeois)
- Curious George: The Boat Show (H. A. Rey, Margret Rey)
- Huff and Puff (Claudia Rueda)
- The Most Magnificent Thing (Ashley Spires)
- The Invention of Hugo Cabret (Brian Selznick)
- Rosie Revere, Engineer (Andrea Beaty)
- What Do You Do with an Idea? (Kobi Yamada)
- Hello Ruby, Adventures in Coding (Linda Liukas)
- The Boy Who Harnessed the Wind by William Kamkwamba *Elementary (there is older a version that is better suited to middle and high school students)
- Engineering for Every Kid: Easy Activities That Make Science Fun! by Janice VanCleave
- Tinkering: Kids Learn by Making Stuff by Curt Gabrielson

Websites

The websites listed below should serve as a guide to help you on your endeavor to implement engineering practices in your instruction.

http://www.sps186.org/downloads/basic/610716/the_true_story_of_the_three_little_pigs1.pdf
(to be used with "The True Story of the Three Little Pigs" by Jon Scieszka)

www.stem-works.com

www.tryengineering.com

www.eie.org

www.imaginationsoup.net

www.girlsrisenet.org

www.childrens.engineering.com

http://pbskids.org/designsquad/

www.engineeringsights.org

http://stem.firstbook.org

www.stemnet.org

www.stemfinity.com

http://newtonstem.org

www.mos.org/eie

www.stemforkids.net

www.istemnetwork.org

http://stemcollaborative.org

http://kidsactivitiesblog.com/53474/giant-paper-pinwheels

Materials

The following materials can be altered to meet your classroom needs and the lesson you are implementing. They serve as a guide. In addition, some materials can be recycled, and a letter can be sent home to parents requesting to donate some of these materials. I have collected paper towel rolls, bathroom tissue rolls, bottle caps, small containers and small cups, cheesecloth, cotton balls (most science kits have these), popsicle sticks, toothpicks, and aluminum foil.

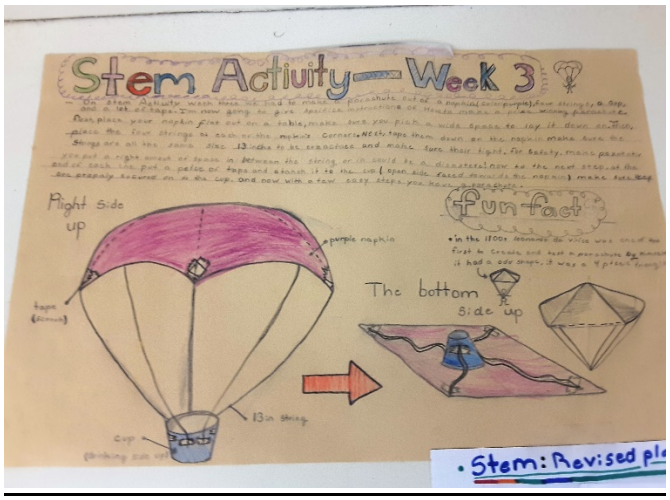
EiE online store –

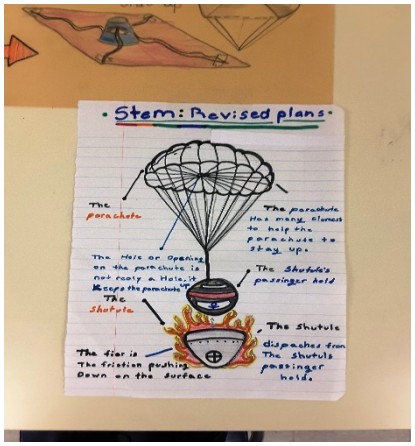
Teacher Guide - Designing Windmills
Teacher Guide - Designing Solar Ovens
Teacher Guide - Designing Aid Drop Packages/Parachutes
"Paolo's Parachute Mission" Illustrated Storybook(s)
"Lerato Cooks Up a Plan" Illustrated Storybook(s
"Hikaru's Toy Troubles" Illustrated Storybook(s)
"Leif Catches the Wind" Illustrated Storybook(s)

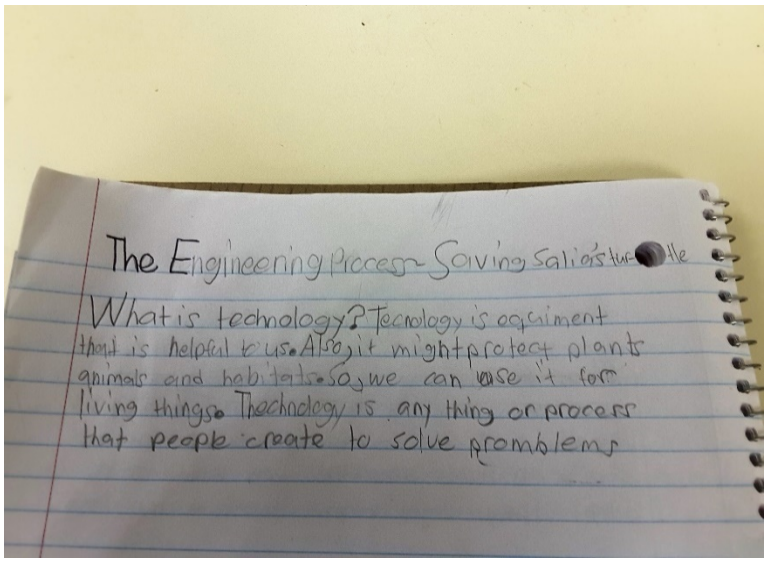
Walmart – (sample materials)

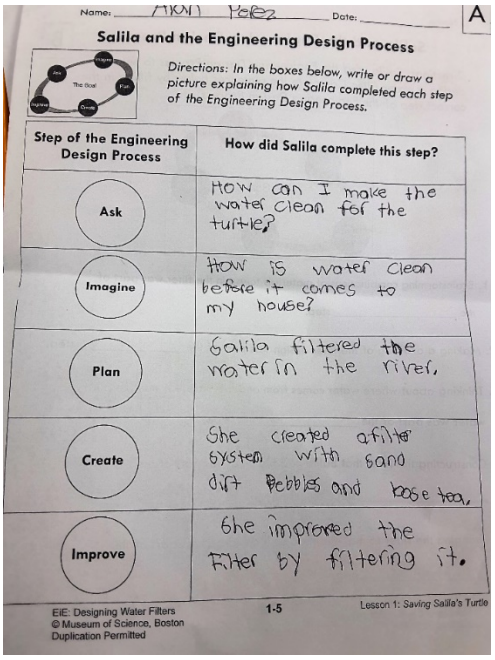
100 Count Coffee Filters
String - Quality Park All Purpose
Secureline Lehigh Jute Twine
Masking Tape 3-Pack
Craft and Hobby Peel and Stick Rubber Magnetic Tape 10ft
Index Cards 100 per pack
ACCO Smooth Economy Paper Clips - Jumbo 100 per pack 10 boxes ppk
Aluminum Foil 300 sq.ft.
3M Aluminum Sandpaper 9in. x 11in.
Dixie Cups
Safe-T 3-in-1 Bullseye Compass 10 pk
Color Tissue Paper Sheets 10 pk.
Jumbo Popsicle Sticks
Regular Popsicle Sticks
Toothpicks
Sand
Soil
Hot Glue Gun
Glue Sticks

Student Work & Pictures









Name: Mary Perez Date: A

Salila and the Engineering Design Process

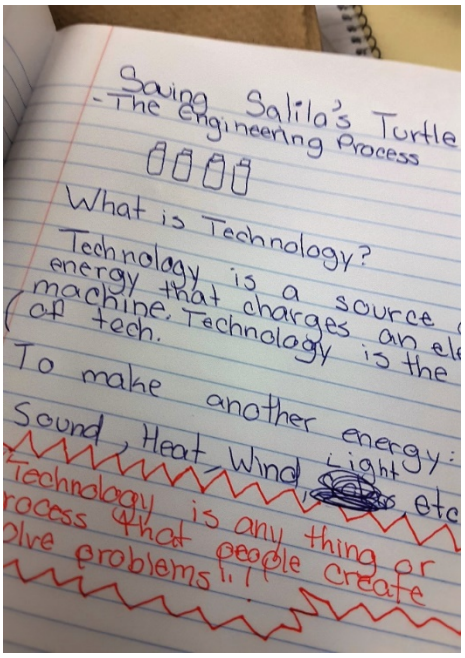
Directions: In the boxes below, write or draw a picture explaining how Salila completed each step of the Engineering Design Process.

Step of the Engineering Design Process	How did Salila complete this step?
Ask	How can I make the water clean for the turtle?
Imagine	How is water clean before it comes to my house?
Plan	Salila filtered the water in the river.
Create	She created a filter system with sand dirt Pebbles and loose tea.
Improve	She improved the filter by filtering it.

EiE: Designing Water Filters
© Museum of Science, Boston
Duplication Permitted

1-5

Lesson 1: Saving Salila's Turtle



Saving Salila's Turtle
-The Engineering Process

What is Technology?

Technology is a source
energy that charges an el
machine. Technology is the
of tech.

To make another energy:

Sound, Heat, Wind, Light etc

Technology is any thing or
rocess that people create
olve problems!!

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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For opening minds, creating opportunities, and helping to create a brighter future, Ford Salutes The Education Fund.

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