Building Bridges

(Emphasizing the "E" in STEM)

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For information concerning IMPACT II opportunities including Adapter and Disseminator grants, please contact:

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Introduction

Building Bridges is a project idea that enhances the "21st Century" of learning through the STEM initiative. In order for students to become "21st Century" learners, it is important to expose them to the areas of STEM that will promote problem-solving skills and make them competitive learners, as they move on to middle school and then high school. By learning how to build bridges, students will learn how engineers work and what goes into designing and building a complex, but necessary structure that is used by people in all parts of the world every day. Students will use everyday items, such as, Popsicle sticks, toothpicks, straws, clay, cereal boxes, wood, playing cards...to build their bridges. They will also have to research different types of bridges, sketch the bridge they envision, write a report that provides details on how their bridge will be used, how it makes life easier for everyday activities (and by people) and upon completion, explain the process it took to design and complete their bridge, and how they can improve their bridges.

Goals and Objectives

GRADE 5		
BENCHMARKS	**CLARIFICATIONS (Remarks/Examples)**	**COMMON CORE STATE STANDARDS (CCSS) CONNECTIONS**
SC.5.N.1.1 Define a problem, use appropriate reference materials to support scientific understanding, plan and carry out scientific investigations of various types such as: systematic observations, experiments requiring the identification of variables, collecting and organizing data, interpreting data in charts, tables, and graphics, analyze information, make predictions, and defend conclusions.	Design and evaluate a written procedure or experimental setup. Annually assessed on Grade 5 Science FCAT 2.0. Also assesses SC.3.N.1.1, SC.4.N.1.1, SC.4.N.1.6, SC.5.N.1.2, and SC.5.N.1.4.	**LACC.5.RI.1.3.** Explain the relationships or interactions between two or more individuals, events, ideas, or concepts in a historical, scientific, or technical text based on specific information in the text. **LACC.5.W.3.8.** Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources. **MACC.5.MD.2.2.** Represent and interpret data. **MACC.5.G.1.** Graph points on the coordinate plane to solve real-world and mathematical problems. **MACC.K12.MP.1:** Make sense of problems and persevere in solving them; **MACC.K12.MP.2:** Reason abstractly and quantitatively.
SC.5.N.1.2 Explain the difference between an experiment and other types of scientific investigation.	Explain that an investigation is observing the natural world, without interference, and an experiment involves variables (independent/test and dependent/ outcome) and establishes cause-effect relationships (Schwartz, 2007).	
SC.5.N.1.3 Recognize and explain the need for repeated experimental trials.		**MACC.K12.MP.5:** Use appropriate tools strategically; **MACC.K12.MP.6:** Attend to precision.
SC.5.N.1.4 Identify a control group and explain its importance in an experiment.		**MACC.K12.MP.6:** Attend to precision.
SC.5.N.1.5 Recognize and explain that authentic scientific investigation frequently does not parallel the steps of "the scientific method."		**MACC.K12.MP.1:** Make sense of problems and persevere in solving them; **MACC.K12.MP.2:** Reason abstractly and quantitatively.

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.	Annually assessed on Grade 5 Science FCAT 2.0. Also assesses SC.3.N.1.7, SC.4.N.1.3, SC.4.N.1.7, SC.5.N.1.5, and SC.5.N.1.6.	**LACC.5.W.3.9.** Draw evidence from literary or informational texts to support analysis, reflection, and research. **MACC.K12.MP.1:** Make sense of problems and persevere in solving them; **MACC.K12.MP.2:** Reason abstractly and quantitatively; **MACC.K12.MP.3:** Construct viable arguments and critique the reasoning of others.
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.	Annually assessed on Grade 5 Science FCAT 2.0. Also assesses SC.3.N.1.2, SC.3.N.1.5, SC.4.N.1.2, SC.4.N.1.5, and SC.5.N.1.3.	**LACC.5.SL.1.1.** Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 5 topics and texts, building on others' ideas and expressing their own clearly. **MACC.K12.MP.6:** Attend to precision.

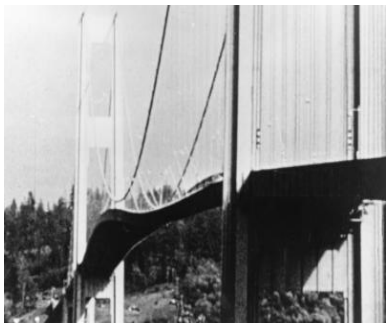
The above chart shows the NGSSS co-related with the Common Core Standards for 5th Grade. In addition, the 8 steps to the new NGSS Framework, currently being considered for adoption Nationwide is listed below. The Science Framework is geared towards preparing our students for fields in STEM using inquiry and engineering as the core foundation.

The eight practices of science and engineering that the *Framework* identifies as essential for all students to learn and describes in detail are listed below:

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

The following chart is from the NGSS website, www.nextgenscience.org . Here you will find a more extensive explanation of the Next Generation Science Standards. This particular chart is specific to Practice #2 shown above in the Framework.

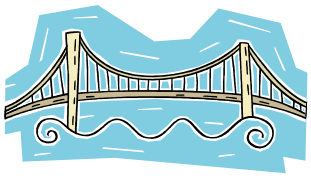
Grades K-2	Grades 3-5	Grades 6-8	Grades 9-12
Modeling in K–2 builds on prior experiences and progresses to include using and developing models (i.e., diagram, drawing, physical replica, diorama, dramatization, or storyboard) that represent concrete events or design solutions. · Distinguish between a model and the actual object, process, and/or events the model represents. · Compare models to identify common features and differences. · Develop and/or use a model to represent amounts, relationships, relative scales (bigger, smaller), and/or patterns in the natural and designed world(s). · Develop a simple model based on evidence to represent a proposed object or tool.	Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions. · Identify limitations of models. · Collaboratively develop and/or revise a model based on evidence that shows the relationships among variables for frequent and regular occurring events. · Develop a model using an analogy, example, or abstract representation to describe a scientific principle or design solution. · Develop and/or use models to describe and/or predict phenomena. · Develop a diagram or simple physical prototype to convey a proposed object, tool, or process. · Use a model to test cause and effect relationships or interactions concerning the functioning of a natural or designed system.	Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. · Evaluate limitations of a model for a proposed object or tool. · Develop or modify a model—based on evidence – to match what happens if a variable or component of a system is changed. · Use and/or develop a model of simple systems with uncertain and less predictable factors. · Develop and/or revise a model to show the relationships among variables, including those that are not observable but predict observable phenomena. · Develop and/or use a model to predict and/or describe phenomena. · Develop a model to describe unobservable mechanisms. · Develop and/or use a model to generate data to test ideas about phenomena in natural or designed systems, including those representing inputs and outputs, and those at unobservable scales.	Modeling in 9–12 builds on K–8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds. · Evaluate merits and limitations of two different models of the same proposed tool, process, mechanism or system in order to select or revise a model that best fits the evidence or design criteria. · Design a test of a model to ascertain its reliability. · Develop, revise, and/or use a model based on evidence to illustrate and/or predict the relationships between systems or between components of a system. · Develop and/or use multiple types of models to provide mechanistic accounts and/or predict phenomena, and move flexibly between model types based on merits and limitations. · Develop a complex model that allows for manipulation and testing of a proposed process or system. · Develop and/or use a model (including mathematical and computational) to generate data to support explanations, predict phenomena, analyze systems, and/or solve problems.



Course Description and Overview

Students in 5th grade will participate in the STEM initiative using the component of engineering in designing, creating, and building bridges using materials easily accessible. Building Bridges will introduce students to the skills utilized by engineers through the process of problem-solving, researching, designing and building bridges. This project will be implemented during and outside of school and will incorporate parental/guardian involvement.

As a result of this project, students will learn what STEM (Science, Technology, Engineering, and Math) is, what it involves, how STEM relates to our everyday lives, what engineers do, what necessary skills are involved within STEM, such as, how to problem-solve, how to research and re-evaluate their designs, how to improve on what they build, and how "bridges" relate to "real-life".



"Building Bridges"

Fifth Grade: Student Name_____
Teacher:_____

Design Challenge: Make sure you research what type of bridge you would like to build. Be creative. Make a few sketches of your design before you actually start to build it. That's what great engineers do!

Criteria: Your Bridge must:

- Be at least 12" long
- Support 1-2 lbs. (or equivalent metric weight)
- Hold the weight for at least 5 minutes
- Label right, acute and/or obtuse angles
- A way to get on and off the bridge (toy car…)
- Optional: colorful & attractive

Examples of Materials you can use:

- Cardboard or cardboard tubes
- Paper clips, straws, toothpicks, popsicle sticks
- Construction paper, tape, Styrofoam, egg cartons, string
- Poster board, food items

Research: Look up the following bridges and decide which one you would like to build:

- Beam bridge
- Suspension bridge
- Arch bridge
- Cantilever bridge

Student Name:_____Teacher:_____

Draw or describe some possible bridges:

First Sketch	Second Sketch
Third Sketch	Final Sketch

****Make sure you label all the parts with the materials you think you will use.**

Notes below: (These notes can be what problems/solutions to create your bridge, how you solve them, what materials worked or didn't worked, what you had to change/adjust while making your bridge…)

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

Test your Bridge:

- **Is your bridge at least 12" long?**

  Yes No

- **Does your bridge support/hold at least 1-2 pounds or the metric equivalent?**

  Yes No

- **Does your bridge hold this weight for at least five minutes?**

  Yes No

- **Does your bridge contain right, acute, or obtuse angles?**

  Yes No

- **Is there a way to get onto and off your bridge?**

  Yes No

- **Is your project neat and colorful?**

  Yes No

Evaluate your Bridge:

What would you have done differently?_____

_____

_____

What could you add to it to make it better?_____

_____

_____

What was the easiest part to build/what was the most difficult?_____

_____

_____

How does this bridge relate to "real-life"? How would it be used? Where would it be located?

_____

_____

_____

_____

_____

_____

Lesson Plan

Essential Question: How are structures built and how are they important in our world? **(Use this question following the second part of the lesson; provide students first with the engagement/inquiry below first).**

Engagement and Explore: Provide students, working in groups, a zip loc bag with one marble, 4-6 bendable straws, 2-3 index cards, one small Dixie cup, one small marble, a cube size piece of clay, toothpicks (optional), and masking tape.

Explain to them that they will be building a structure that will provide a "road way" for the marble and it must be able to travel down the structure till it ends up in the small cup. Tell students that the "tallest" structure will "win". Each student within their group, should first sketch in their journal an idea they may have and then as a group, discuss each other's ideas and come to a consensus as to which model sketched they will build. (This will give the student's the opportunity to share their ideas, sketches and begin teaching them the importance of collaboration.) **Do not give them any more instructions. Allow the students to work together in designing and building their structure. (You will walk around the room and provide feedback to any questions they may have with guidance, not answers…)**

Explanation: Once all groups are finished with building their structure, give them a few minutes to test their design. As they are testing their design have students give you verbal explanations as to why they chose their design and observe whether their goal of the marble ending up in the cup (as well as how high the structure is) was accomplished. Once all the groups have given you a verbal explanation, have the students go back to their journals and write what they observed and guide them to answer the following questions:

1) Did your structure meet the criteria of providing a "road way" for the marble to reach its destination without falling off the track?
2) Would you have done something different or changed it in any way?
3) Were there any materials that you did not used and why?
4) What materials were the most useful? Least useful?
5) How does your structure relate to our everyday lives?

There are other questions you can add or replace, as long as it leads to the "extension" lesson, which is the ultimate objective of the lesson.

Engagement and Extension: The following week have the students watch the "Bill Nye, the Science Guy" video on building structures. It is a great tool to introduce the lesson on Building Bridges. If your media center does not have this video, any other short clip on bridges will suffice. In addition, as a further engagement, you can read one of the books provided on the book list. During this time, you can then go over certain vocabulary as "personal terms", the purpose being that students will begin to understand what a structure is and that a "bridge" is a

structure used all over the world for traveling and transferring. The vocabulary will then be more meaningful than having them look up the words "structure, engineering, designing…"

Elaborate and Evaluation: Students are now ready (after the second week) to take home the parent letter explaining that they will be working on designing and building a bridge. They will research bridges, sketch their designs, re-design if necessary, and complete a written report with their bridge. (This will be part of the evaluation). The evaluation component has a rubric that students will use as a checklist to ensure they have met all the criteria of building their bridge.

****Do not make this a Mandatory assignment. The whole purpose of this lesson is to get students excited about the engineering component in STEM, have them begin to think about Science in a whole new way, integrate Math (to minimize fear, especially for those students that have difficulty with math), use technology and learn how to research, begin to write their thoughts and ideas, which will lead them to have more questions which they can record and research, get parent's, family members/guardians involved, and provide students with the opportunity to do something outside of school that is fun and learning-based at the same time!**

****As the year progresses, I extendthe lessons to include "Building a Community" and Building a Space Rocket, Launcher or Lunar Rover. Again, these activities were not mandatory and students had the option of using different materials. If you would like more information on these lessons, please email me.**

SAMPLE PARENT LETTER (ENGLISH)

"Building Bridges"

September 18, 2012

Dear Parents,

The students this year will be participating in projects that will enhance their scientific skills in the area of engineering as part of the STEM initiative. We will be working on a few projects that encourages them to design, create, build and also problem-solve using their thinking skills and teamwork. The first project is listed below. The students have already been exposed to the "foundation" of building a structure in the Science Lab with me and Ms. Daniels, by designing and building a bridge with their team members. We are extending this activity to the home. I have listed several websites below that will assist them with researching bridges, the type of bridge they will be building, and come up with their design and materials needed. They may also create and design a bridge from materials they have at home such as toothpicks, popsicle sticks, pipe-cleaners, straws, food, wood, paper, playing cards…As part of the project they must also turn in a 2 page written report accompanying their "bridge". Each student will turn in their project **no later than October 12th, 2012**. One project will be chosen from each of the four 5th grade classes as the "winner" based on their design, effort, creativity, and written report (a total of 4 winners). A panel of teachers will score the bridges using a rubric provided by me. The winning projects will be displayed in the Media Center. We would greatly appreciate your participation and cooperation by encouraging your child to do their very best!

Thank you,

Ms. Gomez
Science Coach
Websites:
http://www.pbs.org/wgbh/buildingbig/bridge/
http://www.instructables.com/id/Popsicle-Stick-Bridge/
http://pbskids.org/zoom/activities/sci/
http://www.kids-fun-science.com/physical-science-activities.html
http://www.ehow.com/info_8297542_crafts-kids-bridges.html
http://www.ehow.com/how_10052209_make-bridges-toothpicks-kids.html
http://www.pbs.org/wgbh/nova/
http://www.exploratorium.edu/structures/
http://www.learner.org/catalog/resources/activities/sact9806/sact9806-2.html
http://www.pbs.org/wgbh/nova/tech/build-bridge-p1.html
http://www.bcps.org/offices/lis/models/3%20Bridges/index.htm

Books on Bridges:
Bridge to Terabithia (Fiction) by Katherine Paterson
Bridges! Amazing Structures To Design, Build And Test (Turtleback School & Library Binding Edition) (Kaleidoscope Kids Books (Pb))
Let's Try It Out with Towers and Bridges: Hands-On Early-Learning Science Activities by Seymour Simon
Bridges by Seymour Simon
Bridges: From my side to yours by Jan Adkins

SAMPLE PARENT LETTER (SPANISH)

Queridos Padres,

Los estudiantes este ano van a estar participando en proyectos que mejoraran sus abilidades cientificas en el area de ingeneria como parte de la iniciativa STEM (Ciencia, Tecnologia, Ingeneria Y Matematicas). Nosotros vamos a trabajar en pocos proyectos que los motivaran a disenar, crear, construer, y tambien resolver problemas usuando sus habilidades mentales y como trabajar en equipos.

El primer proyecto esta abajo. Los estudiantes han estado trabajando en la base de la construccion del Puente en el laboratorio de Ciencias con la profesora Ms. Daniels y conmigo, Ms. Gomez, para disenar y construer un Puente con sus miembros de equipo. Nosotros estamos extendiendo esta actividad a la casa. Yo les tengo muchas listas de websites que los asistira con el tipo de Puente que van a construir los estudiantes y con los materials necesarios. Ellos tambien pueden construir un Puente con materials que tienen en casa como por ejemplo: palillos de diente, paletas de helado, absorbents, comida, Madera, paperl, o tarjetas. Como parte del proyecto ellos tambien pueden escribir un reporte de 2 paginas acompanado de su Puente. Cada estudiante debe entregar su proyecto no mas tardar del 12 de Octubre del 2012. Un proyecto por cada quinto (5th) grado sera seleccionado ganador por su diseno, esfuerzo, creatividad y su reporte escrito.

Los profesores del jurado daran un grado y los ganadores seran exhibidos en la biblioteca.

Nosotros queremos apreciar su participacion y colaboracion por motivar y ayudar a su hijo/a en ser el mejor.

****(Please change accordingly and add your name. You can also add the websites and books listed on the previous page. My students translated for their parents)**

Book Resource List

Building Bridges: Amazing Structures to Design, Build and Test by Carol A. Johmann: $10.36

The Ghost of the Golden Gate Bridge by Carole Marsh $7.99

Brooklyn Bridge by Lynn Curlee $15.08

Draw 50 Buildings and Other Structures: The Step-by Step Way to Draw Castles, Cathedrals, Skyscrapers, and Bridges, and So Much More…by Lee J. Ames: $9.99

Bridge Building: Bridge Designs and How They Work (High Five Reading) by Diana Briscoe $9.00

The Family under the Bridge by Natalie Savage Carlson and Garth Williams $5.99

Golden Gate Bridge: History and Design of an Icon by Donald MacDonald and Ira Nadel $11.58

Where is London Bridge? A Kid's Guide to London by Penelope Dyan and John D. Weigand $11.95

Famous Bridges of the World: Measuring Length, Weight, and Volume by Yolonda Maxwell $10.00

Building Toothpick Bridges (Math Projects: Grades: 5-8) by Jeanne Pollard and Dale Seymour $ 16.47

Bridge to Terabithia (Fiction) by Katherine Paterson

Bridges! Amazing Structures To Design, Build And Test (Turtleback School & Library Binding Edition) (Kaleidoscope Kids Books)

Let's Try It Out with Towers and Bridges: Hands-On Early-Learning Science Activities by Seymour Simon

Bridges by Seymour Simon

Bridges: From my side to yours by Jan Adkins

Material List

STEM items for activities – All items were found on Amazon.com, unless otherwise indicated.

Chenille Kraft Natural Wood Craft Sticks, Jumbo Size Wood 500 per box (3776-01)

Toothpicks – School Smart Flat toothpicks Pack (2500)

Marbles – FS-USA/Mega Marbles Good Job jar 200 marbles per jar

Index cards – Penda Hex Oxford Ruled Index Cards 500 per pack

Straws – Flexible Straws Disposable

Masking Tape

Clay (can be found in the science kits)

Zip loc Bags

Dixie Cups (small)

**Other items can be used to extend the lesson. Items can be purchased at the Dollar Tree, Wal-Mart, and Target, Kmart or any craft store.

STEM Websites for Building Bridges

http://www.pbs.org/wgbh/buildingbig/bridge/

http://www.instructables.com/id/Popsicle-Stick-Bridge/

http://pbskids.org/zoom/activities/sci/

http://www.kids-fun-science.com/physical-science-activities.html

http://www.ehow.com/info_8297542_crafts-kids-bridges.html

http://www.ehow.com/how_10052209_make-bridges-toothpicks-kids.html

http://www.pbs.org/wgbh/nova/

http://www.exploratorium.edu/structures/

http://www.learner.org/catalog/resources/activities/sact9806/sact9806-2.html

http://www.pbs.org/wgbh/nova/tech/build-bridge-p1.html

http://www.bcps.org/offices/lis/models/3%20Bridges/index.htm

STEM

www.stem-works.com

www.girlstart.org

http://stemfriday.wordpress.com

http://imaginationsoup.net

http://simaero.rti.org

www.tryengineering.org

www.girlsrisenet.org

www.childrens.enigneering.com

http://scigirlsconnect.org

http://pbskids.org/designsquad/

www.nasa.gov/audience/foreducators/best/

www.tryengineering.org

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

The Education Fund's

Adapter Grant Application

M-DCPS teachers, media specialists, counselors or assistant principals may request funds to implement an IMPACT II idea, teaching strategy or project from the Idea EXPO workshops and/or curriculum ideas profiled annually in the *Ideas with IMPACT* catalogs from 1990 to the current year, 2013-14.

Most catalogs can be viewed at The Education Fund web site at www.educationfund.org under the heading, Publications. How-to booklets for each idea can be accessed at www.educationfund.org under Publications. They are listed under Curriculum Idea Packets.

- Open to all K-12 M-DCPS teachers, counselors, media specialists
- Quick and easy reporting requirements
- Grants range from $150 - $400. **ROBOTIC grants up to $500.**
- Grant recipients recognized at an Awards Reception in late January.

To apply, you must contact the teacher (the Disseminator) who developed the idea. Contact may be made by attending a workshop at the Idea EXPO given by the IMPACT II disseminator teacher.

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 June 15th.
APPLICATION DEADLINE: December 10th.

Apply online at www.educationfund.org.

For more information contact:
Lorna Pranger Valle
The Education Fund
305-892-5099, ext. 18;
Lvalle@educationfund.org