



STEAM in Action (Grades K-2)

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Science As A Verb – STEAM in Action, Grades K – 2

Dr. Debbie Silver

What Does STEM Instruction Look Like?

STEM instruction is an integrated/interrelated model that bridges Science, Technology, Engineering, and Mathematics. Through design and problem/project-based learning situations, students begin to weave their understanding of STEM into an interrelated use of skills rather than four discrete subjects. As a result concepts once solely taught in isolation are made relevant and tangible through students' application of these interdisciplinary skills.

Here are the four basic elements for crafting a STEM lesson:

- Question/Problem Posed—Real-world problems/questions are posed to students.
- Inquiry-Based Lesson—Students "conduct original research" through inquiry-based and inspired lessons to test, gather, and analyze data.
- Collaborative Learning—Students work collaboratively to re-design and improve potential solutions.
- Findings Communicated—Solutions and findings are communicated to peer communities

What is STEAM?

STEAM is the same acronym as STEM, except the “A” refers to the arts. The STEAM movement aims to place a significant importance on including arts education into the classroom curriculum. Each discipline is not isolated, but integrated, in order to support deeper understanding and interest. STEAM education allows for more creativity through artistic expression, and is constantly needed in order to promote innovation and intellectual risk. Researchers cite the fact that students are interested in the media and arts for justification of STEAM in schools.

Safety in the Science Classroom Rules of the Laboratory

- Listen to and read all directions.
- Never eat or drink anything during lab.
- Wear safety goggles when directed.
- Report any breakage, chemical spills, or other accidents immediately to the teacher.
- Obtain permission from the teacher before performing experiments you have modified or designed.
- Wash hands thoroughly at the end of the lab.



performing

Using Children's Trade Books For Teaching Science

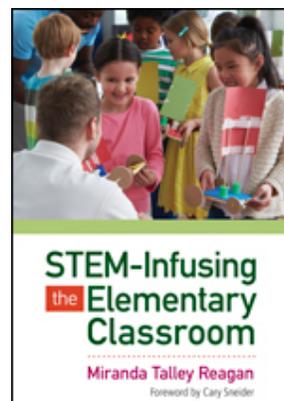
<http://www.nsta.org/publications/ostb/>

<http://www.thereadingnook.com/science/>

For excellent ideas about integrating STEM Lessons:

Miranda Reagan <http://www.maryville-schools.org/site/Default.aspx?PageID=4713>

***STEM-Infusing the Elementary Classroom* by Miranda Reagan**



Expert Advice on Effective STEM Education for Elementary School Teachers by Erin MacPherson

Retrieved from: <http://www.weareteachers.com/hot-topics/special-reports/stem-for-elementary-school>

Task #1: Change Your Lens

Here's the secret: most don't have to overhaul the way they teach in order to become strong STEM educators. "It's all about changing the lens through which we view our teaching practices," says Green. "Elementary teachers need the opportunity and the confidence to be engineers alongside their students," says Dr. Green. This can be as simple as changing the kinds of questions we ask our students. "By adding a few words to your classroom questioning vocabulary—words like *design*, *experiment* and *model*—a whole world of STEM learning can be opened up for students." It's all about tweaking the lessons, activities, homework and language just enough to create an environment where STEM is a natural but effective part of the curriculum.

Task #2: Enlist a Village of STEM Educators

As a teacher, you're always busy innovating, finding new ways and cobbling together resources to help your students learn. But teachers shouldn't have to carry the entire responsibility for STEM education; we need partners. "Community partnerships—both with education businesses and higher education institutions," agrees Dr. Green, "are a key factor in the success of STEM programs."

Ideally, school districts should be receiving donated resources from local businesses and higher education institutions should provide hands-on and in-depth training to teachers. "Both have a huge stake in making sure this generation of students can take on the challenges of STEM," says Green.

Task #3: Integrate STEM Across the Curriculum

With Common Core, the push to teach reading and writing across the curriculum continues to grow. Likewise, the skills developed through STEM learning need to be integrated. If you're familiar with the STEM to STEAM movement, you'll know that many educators believe that true STEM education can only be accomplished by adding art

into the mix. By adding art and music concepts like design, rhythm and movement to STEM education, students are able to fully visualize STEM concepts.

The principles of STEM—critical thinking, asking good questions, observation and exploration—are truly at the heart of every discipline,” explains Green. School-wide STEM learning would enable teachers to work together to create unified curricular units that weave STEM concepts into every subject in a meaningful way.



Task #4: Give Kids More than Just Access to Technology

The "T" in STEM stands for technology, but exposure to educational technology is not enough for true STEM learning. Exposing kids to tools like computers, iPads, e-readers and apps early on is important, but it's only through guided learning that these tools become an important part of STEM education, argues Green.

“We need to take a whole-child approach to teaching children about technology,” explains Green. “Teachers can help kids make connections across various technologies to real-world concepts simply by strategic questioning and guided learning, especially if they have had access to research-based STEM education and teacher training.”



15 Amazing Apps for STEAM

Retrieved from: <http://www.weareteachers.com/blogs/post/2014/08/09/60-apps-for-teaching-steam>

	Science	Technology	Engineering	Art	Math
K-2	1. Kid Weather	4. Move the Turtle	7. ABC Go	10. PianoBall	13. Mathtopia+
	2. Animals HD	5. Kodable	8. Build a Ship With Kate and Harry	11. Sendy: Steam-Paint Kids Art	14. MathShaker
	3. Body Organs 4 Kids	6. Daisy the Dinosaur	9. Crayons Physics Deluxe	12. Easy Studio	15. Bugs and Numbers



Interactions Between and Around Three Goats and a Bridge

by Cathi Cox-Boniol

Exploring Engineering Design and Energy Interactions

Getting Started:

1. Gather the materials for the learning experience—be sure to include a copy of “The Three Billy Goats Gruff.”
2. Based on the grade level, be sure to determine what will be used to test the bridges.
3. Determine the size of the groups engaging in the experience.
4. Identify a work area that can accommodate the construction and testing of the different bridge structures.
5. Prepare a support system for bridge testing; based on the grade level, be certain that the span is sufficient to provide a challenge.
6. Identify how you will display the different energy interaction components within the room; if having the students create a mural, have adequate butcher paper and a place for display.
7. If needed, modify the writing prompt to meet classroom objectives and goals.
8. Copy Student Challenge Sheets if appropriate.

Materials Needed Per Group of Students:

Assorted bridge building supplies (pipe cleaners, craft sticks, foam sheets, plastic straws, rubber bands, paper clips, card stock/manila folder, etc)

1 glue stick (optional)

Scissors (optional)

Energy Interaction card

Student Challenge Sheets

Procedure:

1. Assemble students into collaborative groups.
2. Read the story of “The Three Billy Goats Gruff.”
3. Challenge each group to construct a bridge that meets the following criteria:
 - The bridge should be designed to hold all three goats and protect them from the troll
 - The bridge must be made from only the materials provided
 - Each group will get no additional materials to build their bridge
 - Each bridge will be placed on a support system with a troll underneath
 - The bridge should be designed to sustain the weight of all three goats
 - Each group has 30 minutes to complete construction and testing of their bridge

4. Engage students in the bridge testing protocol by placing each bridge on the support system and then adding each of the goats to see if it fails.
5. Have the students discuss the best feature of each bridge as well as what they could have done differently to create a stronger bridge.
6. Allow students time to redesign and retest, possibly on the following day.
7. Initiate a discussion with the students about all the components of the environment/ecosystem involved with the goats in the story; if needed, lead the students to list the water, fish or animals in the water, sun, trees, birds in trees, flowers, bees in flowers, bushes, etc.
8. Provide each group with an Energy Interaction card; challenge each group to determine how their card helps provide energy for the goats.
9. Facilitate a discussion about how all of the cards work together to provide energy for the goats.
10. Have the student groups prepare drawings that represent their cards and add them to a classroom mural that shows all of the Energy Interaction components; review how they each contribute to the lives of the goats.
11. Have the students write a paragraph that reflects how their card is an important part of the goat's life.
12. Connect the experience to additional research as well as providing real world applications through field trips, guest speakers, and other enriching opportunities.

Safety Notes:

Participants should be reminded of the safe handling of scissors; in addition, the work area should be clear of obstacles. Movement throughout the work area should be careful.

Teacher Notes:

The following Next Generation Science Standards can be addressed through this learning experience:

K-2-ETS1 Engineering Design

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.

2-LS2 Ecosystems: Interactions, Energy, and Dynamics

LS2.A: Interdependent Relationships in Ecosystems

Plants depend on water and light to grow (2-LS2-1)

Plants depend on animals for pollination or to move their seeds around (2-LS2-2)

Interactions Between and Around Three Goats and a Bridge



Challenge Guidelines:

Building a Bridge to Protect the Goats:

- The bridge should hold all three goats
- The bridge should protect the goats from the troll
- The bridge must be made from only the materials provided
- Each group will get no additional materials to build their bridge
- Each bridge will be placed on a support system with a troll underneath
- The bridge should be designed to hold the weight of all three goats
- Each group has 30 minutes to complete construction and testing of their bridge

SUN

WATER

TREES

BIRDS

ANIMALS

FLOWERS

FISH

INSECTS

Traveling Bunny Activity



by Cathi Cox-Boniol

Read the story “The Runaway Bunny” by Margaret Wise Brown. In the story, Baby Bunny keeps trying to run away and Mommy Bunny must figure out ways to find him. Cause and effect is one of the main themes in this story.

CHALLENGE:

Working with your partner, design and create a container that the Mommy Bunny can use to safely and successfully carry her bunny with her wherever she goes. Your bunny must be able to be transported around the room so that he doesn't fall out or get hurt and must be able to rest safely and comfortably.

CRITERIA:

Your container must . . .

- Have at least one moving part
- Have an opening large enough to put the bunny in and take him out
- Have a cover or door on the opening to keep the bunny safe inside
- Have another opening so that your bunny can look out and see where he is going but it must be small enough to keep the bunny securely inside
- Have a handle so that you can carry it
- Hold your bunny inside, safely and comfortably
- Be decorated neatly

MATERIALS:

Cardboard
Brads
Tape (12 inches)
Glue
Pipe cleaners
Construction paper
Straws
Craft sticks (max of 10)
Twist ties (max of 3)
Boxes
Yarn

TOOLS:

Scissors
Markers
Pencils
Ruler
Push pin paper drill
Bunny model



Observations

Using Science Notebooks

(Lisa Rogers and Belinda Basca, 2011)

Students have ownership of their work.

- free to revisit, make changes, make additions
- increased responsibility
- good for self-reflection

Focus feedback on positive aspect of work.

- careful to pose questions without approval or disapproval
- proposed ideas for further research or observation

Use notebooks to inform teaching practices.

- provide insight into understanding of concepts
- tool to evaluate my own teaching
- helps with differentiation

Provide adequate time for reflection.

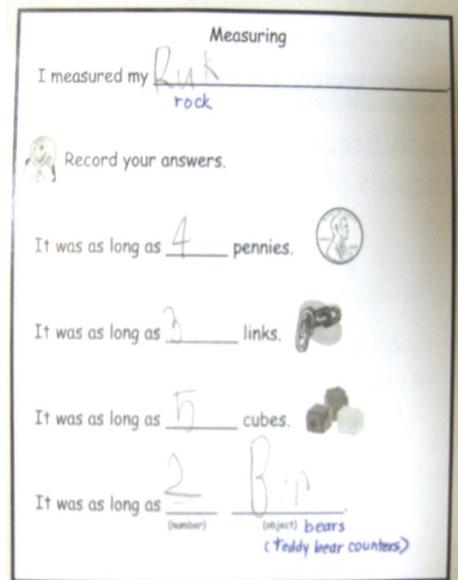
- students need time to record, interpret, and form conclusions
- plan for this when making lesson plans

Focus on scientific literacy rather than science literacy.

- science literacy* focuses accumulating facts
- scientific literacy* emphasizes scientific ways of knowing and processing
- focus on “how” they can an answer over “what” the answer is:
 - how detailed are the drawings and observations?
 - are the measurements accurately labeled?
 - are conclusions based on observations?
 - if one student’s observations differ from the class’s, does the student give reasons for this difference?

Figure 2.

Students’ observations on weighing and measuring.



Cool STEAM Websites for Kids

(retrieved from: <http://www.mastersindatascience.org/blog/the-ultimate-stem-guide-for-kids-239-cool-sites-about-science-technology-engineering-and-math/>)

- **Funology**: At Funology, science is bound to get interactive. Make a tornado with water. Build a Jurassic Park terrarium. Or, simply torment your siblings with endless jokes about bugs and insects.
- **Helping Your Child Learn Mathematics**: Your parents might be interested in this. Curated by the U.S. Department of Education, this website contains math activities (to be completed at home, at the store and on the go) for preschoolers and elementary kids.
- **Kids Do Ecology**: Every kid should be an ecological hero. Learn about biomes, blue whales and data collecting. You can even create your own classroom experiment. Available en Español.
- **Kids.gov**: From imaginary jungles to ion experiments, Kids.gov has plenty of resources for a rainy day. Watch an animation on thunder and lightning or take a virtual field trip to the National Zoo.
- **The Kids' Science Challenge (KSC)**: Hands-on science activities, games, cool videos, scavenger hunts ... this website is full of fun stuff. KSC also hosts a free, nationwide science competition for students in grades three to six.
- **NASA Kids' Club**: At NASA Kids' Club, it's perfectly okay to fool around in space. You can use your science and math skills to explore Mars, construct a fleet of rockets or search for NASA spinoffs in your garage.
- **NASA Space Place**: Build your own spacecraft, play space volcanoes or browse through a gallery of sun images. When you're at the Space Place, the universe is the limit.
- **National Geographic Kids**: Which do you think is cuter: the puffer fish or the clown fish? On this website, you can vote in polls, take part in experiments, watch videos, play puzzles and learn amazing facts.
- **Weather Wiz Kids**: Meet meteorologist Crystal Wicker. She's put together a website that explains everything about the weather. Find fun facts, games, flashcards and photos, plus get answers to your meteorological questions.
- **TechRocket**: Learn programming languages, graphic design in Photoshop, and more!

PBS Kids

1. **Cyberchase**: Help Jackie, Matt and Inez use math to protect the digital universe from evil. Don't worry: Cyberchase has lots of math games, videos and activities to aid you in your quest.
2. **Design Squad Nation**: Design anything (!) your mind might imagine. Through Design Squad challenges, videos and tutorials, you'll discover all there is to know about engineering principles.
3. **The Cat in the Hat Knows a Lot About That!**: Pre-K STEM games, activities and videos galore. The adventurous Cat in the Hat is even ready to lead you on an exotic math safari adventure

4. **The Greens**: Wondering what you can do to protect the planet? The Greens have some great ideas, including games, activity guides and their very own carbon calculator.
5. **Lifeboat to Mars**: Explore the world of biology with this free online game. In one simulation (Microland) you control hungry microbes. In another (Ecoland), you have to balance out the space station's ecosystem.
6. **Zoom**: Hot science and cool ideas. You'll find all kinds of activities and experiments on Zoom's website, including things like lemon juice rockets, crazy straw bridges and bubble cities.

Science Games and Apps

- **Amazing Alex App**: Amazing Alex has a lot of crazy physics challenges in need of your inventive solutions. You can even build and create your own. Brought to you by the creators of Angry Birds.
- **Angry Birds Space App**: Those whacky (and wildly successful) birds are now playing their physics puzzles in space, where gravity does some pretty strange things!
- **Every Body Has a Brain!**: Plunge headfirst into your amazing brain with songs, animations and mini-games. The complete game is available for purchase as a CD-ROM or digital download.
- **Geo Walk: 3D World Factbook App**: Geography nuts rejoice! This educational app contains pictures and facts on hundreds of places, plants and animals.
- **Kinectic City**: An amazing collection of science experiments, games, activities and challenges. You might choose to run the blood cell relay race or use a computer model to build your own interstellar slush business.
- **Max and the Magic Marker App**: In this fun physics-based game, you're in complete control of Max and his incredible magic marker. There are 15 puzzle levels, with challenges, secrets and rewards in each.
- **Move the Turtle: Programming for Kids App**: You don't have to be a computer genius to code! With this app, any kid can learn the ABCs of programming in a graphic environment.
- **Seasons! App**: Everywhere you go, always take the weather with you. In this app, you'll learn how to identify various weather situations in different seasons. For kids age 3 to 6.
- **Sid's Science Fair App**: Sid from PBS' "Sid the Science Kid" has three science games for your entertainment pleasure: Gabriela's "Collection Inspection," May's "Chart It!" and Gerald's "Time Machine." For kids age 3 to 6.
- **Team Umizoomi**: The cheerful animated characters from Nick Jr.'s TV program offer lots of math games and activities for preschoolers.

Math Games and Apps

- **Geometry Quest App**: Travel the world by solving geometry challenges along the way. You'll receive passport stamps for perfect quests. Covers Common Core standards 3MD, 3G, 4MD, 5G, 6G, 7G and 8G.
- **Math Blaster**: Do you have what it takes to save the galaxy? You're going to need your math skills to complete your training missions in this free online game.
- **MathBoard App**: One for the parents. This useful app walks kids through the steps to

- solving addition, subtraction, multiplication and division equations. There's a handy scratchboard area where kids can work problems out by hand.
- **Motion Math: Pizza! App:** Pizza, pizza! In this math-based game, you buy ingredients, design signature pizzas and sell them to customers (hopefully at a profit).
 - **Motion Math: Questimate! App:** How fast is the world's fastest train? How many jellybeans fill up a soccer ball? In Questimate!, you get to make up your own questions.
 - **Mystery Math Town:** Your mission, should you choose to accept it, is to rescue the fireflies hidden in Mystery Math Town. Be warned: you'll need your math skills to unlock all the rooms and passages on your quest!
 - **Numbers League:** In the Numbers League, only math can save the day. You'll use everything from addition to negative numbers to assemble a team of superheroes and capture a horde of villains.
 - **Umigo:** Bored with everything? The crazy characters at UMIGO might have the answer. Their interactive games are just right for building math and critical thinking skills.

Helpful Internet Sites for Grades Elementary

***Science Lesson Plans**

<http://www.prekinders.com/science-page/>

Superior website for ideas and resources for primary science teachers. Click on the tab for science.

***Siemens Science Day, Learn by Doing**

<http://www.siemensscienceday.com/activities/hands-on-science-activities.cfm>

Great activities for grades K-3 with tools and videos that will engage your students in earth science, life science, and physical science.

***Super Science Pre-K Science Activities**

<http://bestpractices.gsu.edu/sites/bestpractices.gsu.edu/files/Best%20Practices%20-%20Science%20Activities.pdf>

From Georgia State University, excellent PDF file of activities for Pre-K Science. Lots of simple, engaging activities to supplement larger ideas.

Periodical for Elementary Science Teachers

Science and Children (elementary—a journal of the National Science Teachers Association) 3140 N. Washington Blvd., Arlington, VA 22201 <http://www.nsta.org>

LIST OF RELATED CITATIONS

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