STEM and Project Based Learning

Presenters: Erika Bradshaw and Kristi Kimble
Objectives

- Understand why STEM is such a hot topic right now.
- Learn ways to incorporate STEM into your classroom.
- Understand how PBL can be used as an interdisciplinary tool to incorporate STEM.
About Me:

- Erika Bradshaw
- Middle Math Science Teacher
- Vice President of Canyons Education Association
- Endorsed in ESL, Education Technology, and Math Level IV.
- Currently pursuing a doctorate in Education Leadership and Policy at the University of Utah.
About Me:

- Kristi Kimble:
  - Middle School Science Teacher
  - Works at one of 3 STEM designated middle schools in the state.
  - Was a Northrop Grumman/NSTA fellow this past year.
  - During the year I was immersed in everything STEM. Attended conferences and workshops all over the country. Job shadowed engineers at Northrop Grumman. Developed a project that was implemented into my classroom after attending all of the above.
Why is STEM the “buzz” word at the moment?
What is NOT engineered?
What’s in a landfill?

- Steel, Aluminum
- Paper
- Oil
- Bio-mass, Nitrogen
- Gold, Copper, Silver

Why don’t we use this Stuff?

We don’t know how.
We need to interest students in STEM, because they are the jobs of the future.

- We are teaching students for jobs we don’t even know exist yet?
## What you teach, where people work

<table>
<thead>
<tr>
<th>What you teach</th>
<th>Work Titles</th>
<th>Degrees awarded</th>
<th>“Number of Jobs” (BLS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physics</td>
<td>Physicist</td>
<td>5,557</td>
<td>20,000</td>
</tr>
<tr>
<td>Chemistry</td>
<td>Chemist</td>
<td>13,714</td>
<td>98,400</td>
</tr>
<tr>
<td>Biology</td>
<td>Biologist</td>
<td>104,633</td>
<td>32,050</td>
</tr>
<tr>
<td>Math</td>
<td>Mathematician</td>
<td>20,980</td>
<td>3,500</td>
</tr>
<tr>
<td>English</td>
<td>Writer/Editor</td>
<td>50,404</td>
<td>136,500</td>
</tr>
<tr>
<td>Social Science &amp; History</td>
<td>Varied Historian</td>
<td>173,096</td>
<td>241,100 (Mostly Psy) 3,500</td>
</tr>
<tr>
<td>Teacher</td>
<td></td>
<td>98,854</td>
<td>5,105,310</td>
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<tr>
<td>Accountant</td>
<td></td>
<td>207,570</td>
<td>1,332,700</td>
</tr>
<tr>
<td>RN</td>
<td></td>
<td>198,770</td>
<td>2,751,000</td>
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<tr>
<td>Engineer</td>
<td></td>
<td>92,162</td>
<td>1,360,300</td>
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<tr>
<td>Computer/Software Analyst</td>
<td></td>
<td>47,960</td>
<td>77,700HW + 1,114,000SW</td>
</tr>
</tbody>
</table>

What’s going on?

https://www.youtube.com/watch?v=HxuEHhERFIQ

Many students that enter into a STEM degree do not finish.

One thing I heard time and time again was that Engineering is tough!!! Students need to learn early on how to work through tough problems.

Only about 25% of all STEM related bachelor degrees are earned by women.  
Math and Science are important

- Math and Science let us do fun stuff
  - Rockets
  - Video games
  - Amusement parks
  - Cell phones
  - Movie special effects

- Math and Science allow us to do important things
  - Safe air travel
  - Roads and Bridges
  - Fresh water
  - Fuel economy
  - Microfibers
  - CAT-Scan, MRI, SonoScan, etc.
Where are the engineering challenges around us?

• In America
  • How do we use less gas/oil?
  • How do we keep our food safe?
  • What are the next new products people want?
  • How do we diagnose and treat disease?

• Around the world
  • How do we get clean drinking water to everybody?
  • How do we build shelters that people can afford?
  • Where can we get enough food to feed everybody?
  • How do we get around the world faster?
  • How do we keep the internet secure?
Where to start?

- Great Book
Four key STEM Objectives for the Classroom Applications:

- Promotes creative problem solving using real world applications.
- Developing STEM literate citizens;
- Raising awareness of the importance of being life-long learners
- Modeling the skills of a collaborative work force
Neil says it best!!!

- https://www.youtube.com/watch?v=5RoBCQ5tYKQ

- We need to teach students STEM even if they are not going into a STEM field. Teaching students how to think, problem solve, and stick with tough questions is good for everyone.
Students learn concepts and skills separately in each discipline, but in reference to a common theme.

Students learn concepts and skills from two or more disciplines that are tightly linked so as to deepen knowledge and skills.

By undertaking real-world problems or projects, students apply their knowledge and skills from two or more disciplines and help to shape the learning experience.
What is a STEM Lesson?

- A STEM lesson is not a cookie cutter experiment.

- Example: Give students directions and materials on how to create a solar oven and have them make the solar oven.

- How can this be changed to create a good STEM lesson.

- If the lesson is to construct a Solar Cooker and measure and graph temperature change over time it IS A STEM lesson because it combines science, technology, and mathematics.
An even better STEM Lesson

- If the students are also asked to design a solar cooker, then measure how it performs compared with other Solar Cookers, it IS A GREAT STEM LESSON because it combines science, technology, mathematics, and engineering.
What is a STEM Lesson cont.

- Is it necessary to include engineering in order for a lesson to qualify as STEM?

- No. If a lesson combines two or more STEM fields it qualifies as STEM. However, adding the technology and engineering pieces can greatly enrich a lesson by adding creativity and relevance to a lesson.
Math Activity-Activities like these foster creative thinking and problem solving.

- Without using measuring tools, list the polygons in order from least to greatest by their perimeters. Justify your answers.

- Without using measuring tools, list the polygons in order from least to greatest by their areas. Justify your answers.
Find the area, using the small square as the unit of area.

- 2 small triangles
- medium triangle
- large triangle
- 2 small triangles, 1 square
- 2 large triangles
First construct the polygon using your tangrams and then find the area.
If the square below has an area of 1, find the value of each of the Tangram pieces.

Using all 7 of the Tangram pieces make other convex polygons that would have the same area.
Bill the Goat is the mascot of the United States Naval Academy. Over 200 years ago, goats lived on Navy ships to provide milk, cheeses, food, and sometimes, even served as pets. Because of this history, Bill the goat was deemed the official USNA mascot in 1893. Today, Bill makes his appearances at Navy sports events and boosts morale.

Imagine that Bill is brought out onto the Navy-Marine Corps Memorial Stadium field. Unless you have binoculars, Bill is very hard to see! Your job as an engineer is to use the engineering design process to create a complex machine to move Bill from the field to the top row in the stadium. A complex machine is a device composed of multiple simple machines such as wheels and axles, levers, screws, pulleys, inclined planes, and wedges.
Have students focus on the design process in engineering.

During a speech given by Bill Nye he talked about the design process and compared it to a Ford Pinto. If you have all the technology and best materials in the world, if your design is bad you’re still left with a Pinto.
Engineering Design: Herd the Goat

- You can only use the materials given in your classroom.
- You must draw a design before building and get it approved by an adult.
- You must include at least three (3) different types of simple machines.
- Your complex machine must move Bill from the field (<1 inch off ground) to the highest row in the stadium (≥12 inches above the lowest point). Bill does not have to start at the ground, but must touch the ground at some point.
- The goat must be protected at the highest elevation either within the machine or by being placed onto the platform.
<table>
<thead>
<tr>
<th>Task</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Task</strong></td>
</tr>
<tr>
<td><strong>Successfully Met (2 pts)</strong></td>
</tr>
<tr>
<td><strong>Partially Met (1 pt)</strong></td>
</tr>
<tr>
<td><strong>Did Not Meet (0 pts)</strong></td>
</tr>
</tbody>
</table>

Only one human interaction was made with the machine.

The goat touches ground level (0-1 inch) at some point in the machine (success) or the goat was 2-3 inches from the ground at some point (partially).

The goat is elevated to 12 or more inches by the machine (success). The goat is elevated to 5-11 inches by the machine (partial).

The goat was contained at the highest elevation inside the machine or on platform.

One simple machine was used.

Two simple machines were used.

Three simple machines were used.

Additional simple machines were used (2 pts per extra machine).

Teamwork

Creativity
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