College or career?

{ Why not both? }
STEM & PBL

Learning for the 21st Century
Creating schools for the 21st Century requires less time looking in the rearview mirror and more vision anticipating the road ahead.

The world has changed far more in the past 100 years than in any other century in history. The reason is not political or economic but technological — technologies that flowed directly from advances in basic science.

(Stephen Hawking)
Change is Inevitable
The Economy and the Workforce Needs Have Changed
Purpose of STEM Education

• Scientists and engineers who will continue the research and development that is central to the economic growth of our country

• Technologically proficient workers who are capable of dealing with the demands of a science based, high technology workforce

• Scientifically literate voters and citizens who make intelligent decisions about public policy and who understand the world around them.

Bipartisan STEM Education Caucus for Members of Congress
http://stemedcaucus2.org/
# The STEM Difference 2010

## Table 1. Average Hourly Earnings of Full-Time Private Wage and Salary Workers in STEM Occupations by Educational Attainment, 2010

<table>
<thead>
<tr>
<th>Education Attainment</th>
<th>Average hourly earnings</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>STEM</td>
<td>Non-STEM</td>
</tr>
<tr>
<td>High school diploma or less</td>
<td>$24.82</td>
<td>$15.55</td>
</tr>
<tr>
<td>Some college or associate degree</td>
<td>$26.63</td>
<td>$19.02</td>
</tr>
<tr>
<td>Bachelor's degree only</td>
<td>$35.81</td>
<td>$28.27</td>
</tr>
<tr>
<td>Graduate degree</td>
<td>$40.69</td>
<td>$36.22</td>
</tr>
</tbody>
</table>

The STEM Difference 2015

Table 1. Average Hourly Earnings of Full-Time Private Wage and Salary Workers in STEM Occupations by Educational Attainment, 2015

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</tr>
<tr>
<td>Some college or associate degree</td>
<td>$30.79</td>
<td>$19.09</td>
</tr>
<tr>
<td>Bachelor's degree only</td>
<td>$39.28</td>
<td>$28.34</td>
</tr>
<tr>
<td>Graduate degree</td>
<td>$45.37</td>
<td>$35.16</td>
</tr>
</tbody>
</table>

What Drives Educational Change

Top Ten Skills

Leadership
Ability to work in a team
Problem-solving skills
Communication skills (written)
Communication skills (verbal)
Strong work ethic
Analytical/quantitative skills
Initiative
Flexibility/adaptability
Technical skills

National Association of Colleges and Employers (NACE)

http://www.naceweb.org/s11182015/employers-look-for-in-new-hires.aspx#sthash.ipsKzMXm.dpuf
Why STEM?

- Introduce yourself to the group
- Discuss what you hope to accomplish today
Seven Elements of Project-Based Learning

- Standards Based
- Assessment
- Student Centered
- Collaboration
- Real World Connection
- Extended Time Frame
- Communication
Six As of Project Based Learning

- Authenticity
- Academic Rigor
- Applied Learning
- Academic Exploration
- Adult Connection
- Assessment Practices

From Buck Institute Web site
http://www.bie.org
Project Based Learning

Classroom context

• Students working in groups
• Students collaborating with one another
• Students constructing, contributing, and synthesizing information

Buck Institute for Education:
http://www.bie.org/pbl/pbloverview/definition.php
Project Based Learning

• Carry out self-directed learning activities
• Discoverer, integrator, and presenter of ideas
• Students define their own tasks and work independently for large blocks of time
• Communicate, show affect, produce, take responsibility

Buck Institute for Education:
http://www.bie.org/pbl/pbloverview/definition.php
Project Based Learning Emphasizes

Short-term goals

• Understanding and application of complex ideas and processes
• Mastery of integrated skills

Buck Institute for Education:
http://www.bie.org/pbl/pbloverview/definition.php
Project Based Learning Emphasizes

Long-range goals

• Depth of knowledge
• Graduates who have the dispositions and skills to engage in sustained, autonomous, lifelong learning

Buck Institute for Education:
http://www.bie.org/pbl/pbloverview/definition.php
Activity vs PBL Assignment
PBL VS. EDUTAINMENT

<table>
<thead>
<tr>
<th>Fun projects</th>
<th>PBL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teacher directed</td>
<td>Inquiry based</td>
</tr>
<tr>
<td>Highly structured</td>
<td>Open-ended</td>
</tr>
<tr>
<td>Summative</td>
<td>On-going</td>
</tr>
<tr>
<td>Thematic</td>
<td>Driving question/challenge</td>
</tr>
<tr>
<td>Fun</td>
<td>Engaging</td>
</tr>
<tr>
<td>Answer giving</td>
<td>Problem solving</td>
</tr>
<tr>
<td>De-contextualized – School world</td>
<td>Contextualized – Real world</td>
</tr>
</tbody>
</table>
Middle Grades STEM Projects

Course 1
- Computer Science: Coding
- Logistics: Sound the Alarm
- Manufacturing: 3D Imaging
- Material Science: Reducing Waste
- Renewable Energy: Harnessing the Wind
- STEM: Bridging the Gap

Course 2
- Aerospace: Eye in the Sky
- Biotechnology: Artificial Selection and Cloning
- Energy and Power: What Happened to the Lights
- Food Science: Product Creation
- Health Science: Outbreak
- Informatics: Take a Tour
The desire to create is one of the deepest yearnings of the human soul.
STEM is Like Jambalaya
Standards Addressed

- Career Technical Standards
- English Language Arts College- and Career-Readiness Standards
- Mathematics College- and Career-Readiness Standards
- The Next Generation Science Standards
- 21st-Century Skills
- All Aspects of Industry Attributes
Project Flow

- Design
- Build
- Test
- Analyze and Evaluate
- Iterate
- Finalize
- Communicate
Essential Question

- *This question is an open-ended question that goes beyond yes/no answer forcing students to justify their response using evidence/data.*
Purpose

Why do students need to complete the project and what should they expect to learn.
Project Description

- Provides a Role for Student
- Presents an Problem
- Places the Problem in Context
- Provides a Literacy Task
- Sets Deliverables
- Establishes the Authentic Audience
Enduring Learning Concepts

These are specific topical areas listed in bullet form that are the large concepts central to the project.
Essential Learning

- A listing of the specific aspects of the learning required in order to successfully determine a solution to the identified project or problem.
Standards

- Describe student learning

3. Find x.

Here it is
Enabling Learning Activities

- Identify what students will do to relate the design process to the learning. This shows a progression through the project.
Project Walk Through

- Narrative of the workflow of the students as they solve the problem.
Design/Problem-Solving Process

- A series of steps that lead to the development of a new product, system or solution to a problem.
- The process includes a series of steps that ensure that solutions most likely to succeed are created.
- There is no “THE design process.”
Engineering Design Process

**ASK / INQUIRE**
- Identified Criteria and Constraints; Refined Problem Statement

**IMAGINE**
- Brainstormed List of Design Solutions; Design Brief

**PLAN**
- Individual Designs; Decision Matrix; Testing Protocol; Management Plan

**CREATE**
- Team Prototype

**TEST**
- Prototype Test Results and Analysis

**IMPROVE**
- Recommendations for Improvement

**COMMUNICATE**
- Final Prototype; Final Written Document; Presentation
Ask/Inquire

- Introduce the authentic role and Essential Question
- Conduct preliminary research
  - Read and reflect upon journal articles about content area
  - Research dependent vocabulary
- Identify criteria and constraints for the problem
- Refine the problem statement
Problem Statement

- Vision Statement
- Issue Statement
- Method Statement
Imagine

- Create the project management plan
- Conduct research relating to the problem statement
- Brainstorm possible solutions
- Create a design brief
Design Brief

- Problem Statement or Description:
- Goals:
- Resources and Budget:
- Constraints:
- Time Needed:
- Solution Analysis including planned solutions and sketches:
Planning

- Research the viability of possible solutions
- Design testing methods for critical assumptions
- Create optimization matrix for decision making and select solution
Testing Protocol

- Introduction
- Strategy
- Data Collection Plan
- Measurement Capability
- Definition of Success
- Test Conditions
- Logistics
- Analysis
- Conclusion
Create

- Develop, refine and document selected solution
- Create a prototype
Design Documentation

- Elements of successful design documentation include but are not limited to scope of work definition and design development.

- Each design might include conceptual drawings, assembly drawings, parts’ list, parts drawings, process drawings/flowcharts, data design, architecture design, etc.
Experiment/Evaluate

- Test and acquire data
- Analyze test data
Improve

- Refine and iterate the design
- Finalize documentation of design
- Analyze results, summarize knowledge gained and evaluate the proposed improvement
Communicate

- Prepare communication plan for authentic audience
- Prepare reports, design documentation, design proposals and/or presentations for the authentic audience
- Present/defend to an authentic audience with feedback
Creating a Plan

- Identify and Recruit a STEM Oversite Team

Discuss with your group who should be on the oversite team, and who will be the leader.
Creating a Plan

Identify the Type and Scope of the STEM Plan

What type of program is needed?
Which students will it serve?
What types of information can be gained through collaboration?
Creating a Plan

- Prepare an Implementation Plan

Discuss needs to support a program
What order will these needs be addressed?
What resources are necessary for success?
Creating a Plan

Preparing a Budget

What items will need to be included?
What is the budget timeline?
What restrictions are on the budget?
Creating a Plan

- Identify the Teacher

What skill sets are necessary?
What qualities are the most desirable?
What training is necessary?
What support should be available?
Creating a Plan

Classroom Space

What are the room/space needs for the program?
When should equipment be ordered?
Creating a Plan

- Evaluating the Program and Teacher

What should the successful program look like?
How can we encourage students failing forward?
Getting Schools involved in Middle Grade STEM

What are your schools and districts currently doing to engage middle school students in STEM?

What obstacles do you see that would prevent a school from adapting the SREB Middle Grades STEM Curriculum?