Haberlach Lab #1 WAMC

Math Concept(s):

Using concrete representations and modeling to address real world problems including elements of measurement, interpreting data and vector quantities as indicated in the CCSSM listed below.

Source / Text:

Lab: Modified from Easy and Cheap STEM Ideas with Paper

Curriculum: Agile Mind Digital Curriculum: Algebra I

Topic 2: Multiple Representations in the Real World

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Attach the following documents:

- Lab Instructions
- Student Handout(s)
- Rubric and/or Assessment Tool

Short Description (Be sure to include where in your instruction this lab takes place):

This lab takes place at the end of the first week of Topic 2 Multiple Representations in the Real World in our Agile Mind Algebra I curriculum. Every Friday we do "hands on" projects, called STEM challenges that connect the math that we are studying to real world applications that include elements of the other STEM disciplines, as well as topics of interest to students. Making an actual paper model of a span bridge and testing it will provide students with the opportunity to make, study, and learn from modeling with concrete representations of span bridges made of paper and tape. Concurrently, I use this activity in an iterative way by revisiting it every Friday over three weeks to introduce the engineering design process as a problem-solving method to students, as well as extend the math concepts to include numerical and graphical representations in math modeling and a short introduction to systems thinking, forces, and vectors quantities in Week #2.

Lab Plan

Lab Title: Paper Span Bridges Week 1

Prerequisite skills: The student must be proficient at measuring distance (length/height) with a ruler in inches.

Lab objectives: The main objective of this lab is for the student to gain understanding of how to use a concrete model to make sense of and solve a problem. This lab will also serve to introduce students to the engineering design process, different of types of bridges, and improve their understanding of constructing structures for strength and stability. Students will also learn to organize data to understand possible correlations and make predictions.

Standards: *(Note SPECIFIC relationship to Science, Technology, and/or Engineering)*

Mathematics K–12 Learning Standards:

- CCSS.MATH.CONTENT.HSN. Q. A.2.; CCSS.MATH.CONTENT.HSN. Q. A3.: CCSS.MATH.CONTENT.HSS.ID.B.5; CCSS.MATH.CONTENT.HSS.ID.B.6 CCSS.MATH.CONTENT.HSN.VM.A.;

Standards for Mathematical Practice:

- Make sense of problems and persevere in solving them.
- Reason abstractly and quantitatively.
- Construct viable arguments and critique the reasoning of others.
- Model with mathematics.
- Use appropriate tools strategically

K-12 Learning Standards-ELA (Reading, Writing, Speaking & Listening):

- CCSS.ELA-LITERACY.SL 9-10.1.B (working with peers to set rules for collegial discussion and decision making.

K-12 Science Standards

- HS ETS1-2: Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering

Technology

- 3.a Students plan and employ effective research strategies to locate information and other resources for their intellectual or creative pursuits.
- 3.b Students evaluate the accuracy, credibility, and relevance of information, media, data or other resources.

Engineering

- Using the engineering design process to address real world problems and construct models

Leadership/21st Century Skills:

21st Century Interdisciplinary themes (Check those that apply to the above activity.)

☐ Global Awareness ☐ Financial/Economic/Business/Entrepreneurial Literacy ☐ Civic Literacy
☐ Health/Safety Literacy ☐ Environmental Literacy

21st Century Skills (Check those that students will demonstrate in the above activity.)

LEARNING AND INNOVATION
Creativity and Innovation
☒ Think Creatively
☒ Work Creatively with Others
☒ Implement Innovations
Critical Thinking and Problem Solving
☒ Reason Effectively
☐ Use Systems Thinking
☐ Make Judgments and Decisions
☒ Solve Problems
Communication and Collaboration
☐ Communicate Clearly
☒ Collaborate with Others

INFORMATION, MEDIA & TECHNOLOGY SKILLS
Information Literacy
☒ Access and Evaluate Information
☒ Use and manage Information
Media Literacy
☐ Analyze Media
☐ Create Media Products
Information, Communications and Technology (ICT Literacy)
☒ Apply Technology Effectively

LIFE & CAREER SKILLS
Flexibility and Adaptability
☐ Adapt to Change
☐ Be Flexible
Initiative and Self-Direction
☒ Manage Goals and Time
☐ Work Independently
☐ Be Self-Directed Learners
Social and Cross-Cultural
☒ Interact Effectively with Others
☒ Work Effectively in Diverse Teams

Productivity and Accountability
☒ Manage Projects
☒ Produce Results
Leadership and Responsibility
☒ Guide and Lead Others
☒ Be Responsible to Others

Teacher Preparation: (What materials and set-up are required for this lab?)

Materials for paper span bridges: 8 ½" x 11" printer paper, tape, rulers, scale for weighing the book(s).

Set-Up Required:

- No special set up required. Students will construct their model bridges at their tables with their table groups or smaller groups from the table.

Lab Organization Strategies:

Leadership (Connect to 21st Century Skills selected):

Cooperative Learning:

- Students will do the lab in groups of 2, 3 or 4 with students all helping to construct elements of the bridge, as well as measuring and/or testing and data testing/collection.

Expectations:

- Students will describe how each contributed to the project on the lab sheet for each group

Timeline:

- The lab is expected to take approximately 50 minutes as described in the lab instructions: 5 min- intro/lab instructions; 30 min -construction; 5 min-testing; 10 min-lab sheet /photo completion and submission

Post Lab Follow-Up/Conclusions:

Discuss real world application of learning from making concrete representations from lab, measuring, recording, collecting different types of data.

In this lab students will also gain further skill using concrete representations, mathematical modeling, measurements Engineering design process, organizing data and predicting future outcomes.

Career Applications

- Structural/Mechanical Engineering, Public Works industries.

Optional or Extension Activities

- This lab can be adapted/extended to cover many math and science concepts such as forces, systems, and using/understanding vector quantities

Copy of Lab Instructions:

First STEM Bridge Challenge: Paper Span Bridge

You can do this in groups of 2, 3, or 4 with folks from your table

Materials:

4 pieces of printer paper

6 inches of tape

Scissors

Ruler

Classroom Book(s): Habby will provide when ready

Chromebook or phone to take photos

Goal: Design a paper span bridge using the engineering design process, resources listed above inspired by any ideas or resources you develop or find within the allotted time that is capable of supporting one math textbook provided by Habby. Each person will also document the group design, dimensions/description, capabilities, individual contributions to the work and reflections on a lab sheet that will be turned in with photos on Canvas by the end of our 55 minute periods.

Rules:

1. Book(s) must be suspended at least 5 inches off the table

2. The bridge must span at least 15 inches wide

3. (2) pieces of paper must be dedicated to the construction of the top of the bridge

(a bridge is not just a collection of pillars)

4. You can only use the materials listed above

5. You have no more than 30 minutes to build your bridge(s), By the time I indicate that 30 minutes have passed, you must move on to testing/lab submission. You might want to take turns constructing/filling in your lab sheet while building your model.

6. You have about 5 minutes to test your bridge(s)

7. You have about 10 minutes to complete and submit your photos/completed lab sheets on Canvas

7. You must take two pictures of your bridge(s)- one picture before you apply the load and one picture after you apply the load. Please submit them both from each bridge your group makes.

8. If you have time, try again!

8. Please submit completed individual lab sheet and photos from your group's strongest bridge model on Canvas for credit.

Rubric for Lab Participation- 4 pt scale

1- Attended class, participated in activity-as noted by teacher- submitted nothing-Emerging

2-Attended class, participated in activity, submitted incomplete lab sheet/photos-Basic

3-Attended class, participated in activity, submitted complete lab sheet/photos-Proficient

4- Attended class, participated in activity, submitted complete lab sheet/photos that either were very detailed, demonstrated interesting/innovative connections to learning OR submitted completed set of lab sheets/photos for two different designs-Distinguished

Student Lab Collection and Reflection Sheet

Name_____

Period_____

Paper Span Bridge Project Day 1

1. After your download and submit your photos then please write down the names of the members of your group and describe one thing each person did to help the group:

2. Please either write a description of your bridge or make a sketch in the space below. Please make sure your description or sketch includes details like: "We used five 6" columns arranged in a pattern that looked like an "x" with two columns in the back, two in the front, and one in the middle of the span," or clearly shows details like measurements on the sketch.

3a. Was your bridge able to support a book/books? Yes No

b. If your bridge supported a book or books, how many? _____

4. Please reflect on your design and your group's process. What worked and why do you think it worked? What did not work so well and why? What will you change next time and why?