WAMC Lab Template

Math Concept(s): Construction
Source / Text: Kevin Ridout
Developed by: Rachelle Ridout E-Mail: rridout@eagles.edu Date: Summer Conference 2022

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):

Students will build a bridge out of spaghetti and hot glue that holds the most weight. This lab takes place after students complete research to choose a type of bridge and complete an accurate to-scale blueprint of the bridge. This lab has multiple entry points and difficulty levels. Therefore, it can take place anytime during a mathematical year. It is most effective after the triangles unit in Geometry or at the end of semester.

Lab Plan

Lab Title: Spaghetti Bridge

Prerequisite skills: Ruler, compass (create/measure angles)

Lab objective: The objective of the lab is for students to build a bridge out of spaghetti and hot glue that holds the most weight. Students gain a better understanding of the pros and cons of different types of bridges and the basics of construction.

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

Mathematics K–12 Learning Standards:

- HS.G.CO.12

Standards for Mathematical Practice:

- 5. Use appropriate tools strategically
- 6. Attend to precision

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

- N/A

K-12 Science Standards

- N/A

Technology

- Prior to Lab: 3.a Students plan and employ effective research strategies to locate information and other resources for their intellectual or creative pursuits.

Engineering

- HS-ETS1-3

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

- glue gun, glue sticks, box, spaghetti, rulers, blueprint, testing area, loading wire/S hook/5cm wood block/weights

Set-Up Required:

- Students should have access to flat tables near outlets. Desks should be covered to protect from hot glue.

Lab Organization Strategies:

Leadership (Connect to 21st Century Skills selected):

-

Cooperative Learning:

- Students work in pairs to research bridge design, create blue print for bridge, construct bridge, and load bridge until failure. Students will need to figure out the best way to glue together spaghetti so that it holds and is strong.

Expectations:

- Students are expected to treat all materials and people with respect and attend to safety.

Timeline:

- up to 250 minutes for construction (5 days)

Post Lab Follow-Up/Conclusions:

Discuss real world application of learning from lab

- Students will gain further knowledge of the components that make a bridge strong including why a truss is important and the importance of beam size.

Career Applications

- Construction and engineering

Optional or Extension Activities

- Students could collect data to model the effectiveness of different bridges.

Spaghetti Bridge Contest

Materials: glue gun, glue sticks, box, spaghetti, rulers, blueprint, testing area, loading wire/S hook/5cm wood block/weights

Prior to building the bridge, each group needs to finish a blueprint of the bridge they intend to build. Each group is to build a bridge made from spaghetti and hot glue. The object is to construct a bridge that will carry the heaviest load while meeting specifications. Bridges will be loaded until they fail.

Rules:

1. The bridge must be built from spaghetti and hot glue.

2. The bridge shall be free standing and must span two level surfaces, which are 30 cm apart.

3. The support for the bridge shall be from the top of the level surfaces. The edges of the level surfaces cannot be used in any way for support.

4. The bridge must include a decking of spaghetti to provide a suitable road surface at least 5 cm wide across the full span of the bridge. Four conditions must be met.

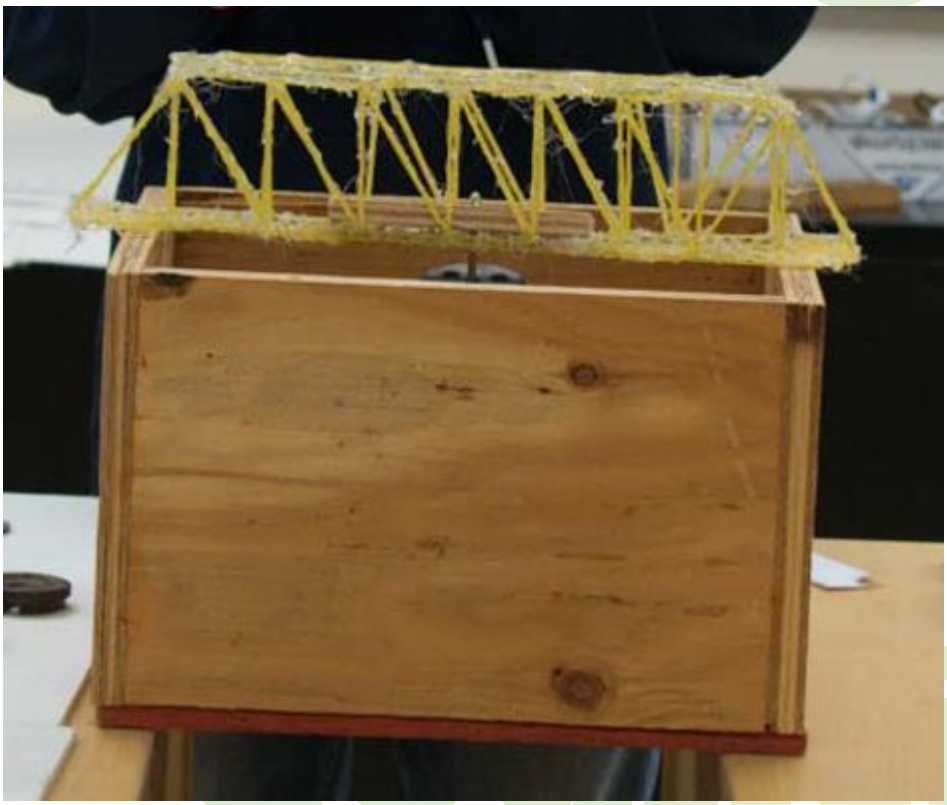
    a. Gaps in the bridge deck are not to exceed 2 cm.
    b. A block of wood (5 cm wide) representing a car must be able to move along the length of the decking unobstructed from end to end.
    c. The deck of the bridge must not be more than 5 cm above or below the ends of the bridge at any point long its length.
    d. A hole must be provided in the center of the bridge to attach a load. This hole is not to exceed 2 cm.

5. The maximum vertical depth of the bridge, from the highest point in it structure to the lowest cannot exceed 18 cm.

6. The maximum weight of the bridge must not exceed 200 grams or 7 ounces.

Assessment/Rubric

- Approved Research: 5 points
    - Can identify the type of bridge chosen and explain why this type works for the specifications set out by the project. Can explain what makes this type of bridge affective.
- Approved Blueprint: 5 points
    - Front view, side view, top view
    - To scale
    - Accurate
- Holds minimum weight: 5 points



WAMC Lesson Plan

Name(s): Rachelle Ridout
Email Address: rridout@eagles.edu
Lesson Title: Spaghetti Bridge
Date: 6/21/22
Text: N/A STEM Correlation: Technology/Engineering Lesson Length: 50 minutes

Big Idea (Cluster): Measurement and Construction	
Mathematics K–12 Learning Standards: HS.G.CO.12	
Mathematical Practice(s): 3. Construct viable arguments and critique reasoning of others. 5. Use appropriate tools strategically	
Content Objectives: Students will be able explain why they choose a certain type of bridge to complete the lab objective.	**Language Objectives (ELL):** Students will be able to comprehend bridge related vocabulary during research and look up definitions for unfamiliar words.
Vocabulary: • Truss • Beam • Suspension • Arch • Deck • Angle	Connections to Prior Learning • Plotting Points • Creating Scatterplot • Create linear equation between two points • Create quadratic equation from a graph • Triangles
Questions to Develop Mathematical Thinking: • Why did you choose that type of bridge? • How does this bridge type meet the requirements of the project? • What makes this bridge strong? • Why are triangles a strong shape? • What are the bridge's weaknesses?	Common Misconceptions: • Building a bridge is easy • Beam bridge is the strongest bridge • Each bridge is the same • Truss is just decorative

Assessment (Formative and Summative):

- Formative Assessment: Students verbally address the following questions: 1) What type of bridge did you choose? Why? 2) What are the strengths of this bridge? 3) What are the weaknesses of the bridge? 3) How does this bridge meet the project guidelines?
- Summative Assessment: Students will ultimately build their chosen bridge and load it until failure.

Materials:

- Computers, research materials (websites, documents, etc.)

Instruction Plan:

Introduction: The learning target will be projected on a PowerPoint slide. I open the lesson by showing a video of the Tacoma Narrows Bridge Collapse. We discuss the event and the importance of choosing the right type of bridge for various elements. I give students the project handout that outlines the project constraints.

Explore: In pairs students use technology to conduct research on the different types of bridges. I provide a couple websites, articles and videos for the students to use. Students may use other resources.

When I observe students: Students should be working collaboratively with their partners. I will be monitoring students and listening to discussion. I hold a meeting with students when they decide on a type of bridge. During to this meeting I listen to explanations and ask clarifying questions.

Questions to Develop Mathematical Thinking as you observe:

- Why did you choose that type of bridge?
- How does this bridge type meet the requirements of the project?
- What makes this bridge strong?
- Why are triangles a strong shape?
- What are the bridges weaknesses?

Answers:

The answers to the questions vary from group to group. Below you will find samples of possible answers if students choose a truss bridge.

- We chose a Truss because it is the strongest bridge.
- The truss bridge can be strong and light weight, which is important since we have a weight limit.
- The triangles created in the Truss make this bridge strong.
- Triangles evenly distribute weight when the weight is placed on a vertex.
- This bridge requires expert design. This may be difficult since we are amateurs.

Summarize:

- Students can choose a type of bridge to create and explain why that is an appropriate choice.

Career Application(s):

- Engineering and construction

Leadership/21st Century Skills:

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