

Escape through the Underground Railroad

5th Grade

Unit 4 - America in Conflict

Literature Connection: *If You Lived When There Was Slavery in America* by Anne Kamma

Design Challenge Summary

Standards: What standards are addressed?

Science:

PS.5.5.3 Identify common examples of *physical properties: length, mass, area, perimeter, texture, taste, odor, color, elasticity*

PS.6.5.4 Compare and contrast *potential energy* and *kinetic energy* as applied to motion

Math:

5.NBT.1 Recognize that in a multi-digit number, a digit in one place represents 10 times as much as it represents in the place to its right and 1/10 of what it represents in the place to its left.

5.NBT.3 Read, write, and compare decimals to thousandths.

5.MD.1 Convert among different-sized standard measurement units within a given measurement system (e.g., convert 5 cm to 0.05 m), and use these conversions in solving multi-step, real world problems.

5.NF.5 b Explain why multiplying a given number by a fraction greater than 1 results in a product greater than the given number (recognizing multiplication by whole numbers greater than 1 as a familiar case); explaining why multiplying a given number by a fraction less than 1 results in a product smaller than the given number; and relating the principle of fraction equivalence $a/b = (n \times a)/(n \times b)$ to the effect of multiplying a/b by 1.

5.NF.6 Solve real world problems involving multiplication of fractions and mixed numbers, e.g., by using visual fraction models or equations to represent the problem.

Challenge: What will the students be required to do?

You are a member of the Underground Railroad who is leading a group of slaves trying to escape to a free state. You come upon a gorge that once had a 15 foot bridge crossing it, but the bridge is no longer there. You have to build something that will get as many of your group as possible across the river at one time using only the given materials. Your design has to be a scale model that is 1/10 the actual length of the original 15 foot bridge. Each individual will be given 10 minutes to brainstorm/draw your design and determine the length your structure will have to be. Your group will be given 5 minutes to collaborate and choose one design or a combination of designs. You will then 10 minutes to build your design.

Result: What will students know, value, and be able to do as a result of the lesson? What's the big idea?

Student will be able use the engineering design loop to plan/design/construct a structure that will hold the most weight.

Assessment: What evidence will be used to determine student learning?

Teacher will test each design by hooking a paper clip holding a ziplock bag to the center of the bridge and add one penny (escaped slave) at a time until the bridge breaks.

Prior Knowledge/Experiences: What prior content knowledge and skills will the students need?

- Connection to the mathematical practices
- Finding fraction of a whole
- Base 10 knowledge (10 times; 1/10 of)
- Communication/Cooperation

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Summary/Connections: How will this design challenge connect with new/future learning, other content areas, real world experiences, etc.?

This lesson will help students develop problem solving skills and collaboration skills that are essential in succeeding in the 21st century.

Materials/Equipment/Preparation: What materials and equipment will students need to successfully complete this design challenge?

Spaghetti noodles (10 each group)

4 inches of scotch tape

Ruler

Ziplock bag, paper clip, and pennies for the teacher to test design (each penny is a slave)

String (24 inches for each group)

Pair of Scissors for each group

Design Challenge- Escape through the Underground Railroad**1. State the Problem**

You are a member of the Underground Railroad who is leading a group of slaves trying to escape to a free state. You come upon a gorge that once had a 15 foot bridge crossing it, but the bridge is no longer there. You have to build something that will get as many of your group as possible across the river at one time using only the given materials.

Supplies: 10 Spaghetti Noodles, 4" of scotch tape, rule, 24" of string, scissors

Your design has to be a scale model that is 1/10 the actual length of the original 15 foot bridge.

2. Generate Ideas (2 minutes)

You are not allowed to start building yet; first you must brainstorm some design solutions. You can look at the supplies and use them as inspiration. In the boxes below, draw one or two ideas for your bridge.

Idea 1:

Idea 2:

3. Select a Solution (5 minutes)

Now that everyone has had a chance to think and design, you have the next 5 minutes for each person in the group to present their idea. Once everyone has presented their ideas you can choose one idea to build or you can combine elements of several ideas into a new design. In the box below draw the design your team decided on building.

4. Build Your Design (10 minutes)

Now you get to build! Remember, you only have 10 minutes and a set amount of supplies.

5. Evaluate (5 minutes)

It's time to test your bridge. Let's see how it works! After testing your bridge, answer the following questions:

1. Was your bridge successful? ____
2. How many people could your bridge hold? ____
3. What problems did you experience during the building step?

4. If you could redesign, what changes would you make? How would these changes make your bridge more successful?

6. Present Results (2-5 minutes)

Now it's time to show the class your design. During your presentation we would like to hear about your design, struggles and successes you experienced while building your bridge, and your evaluations from step 5.

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