Build a Bridge

3rd Grade

Unit 6 – Fantastic Adventures with Dragons, Gods and Giants

Text Connection: *My Father's Dragon* by Ruth Stiles Gannett

Design Challenge Summary

Challenge: What will the students be required to do?

In *My Father's Dragon*, Elmer Elevator has to cross the river, via a bridge of crocodiles, to rescue the dragon. Your challenge today is to design and build a bridge, within an allotted budget, that will: span a distance of 35 cm between two desks, have a perimeter of at least 32 inches, and support the most weight without collapsing. (see additional information section for more details)

Standards: What standards are addressed?

Science:

NS.1.3.1 Communicate observations orally, in writing, and in graphic organizers

NS.1.3.2 Develop questions that guide scientific inquiry

NS.1.3.3 Conduct scientific investigations individually and in teams

NS.1.3.4 Communicate the results of scientific investigations

NS.1.3.5 Estimate and measure length, mass, temperature, and elapsed time using International System of Units (metric system)

NS.1.3.6 Collect and analyze measurable empirical evidence as a team and/or as individuals

NS.1.3.7 Make and explain predictions based on prior knowledge

NS.1.3.8 Use simple equipment, age appropriate tools, technology, and mathematics in scientific investigations

Math:

Mathematical Practice Standards

3.OA.5 Apply properties of operations as strategies to multiply and divide.

3.OA.7 Fluently multiply and divide within 100, using strategies such as the relationship between multiplication and division or properties of operations.

3.NBT.2 Fluently add and subtract within 1000 using strategies and algorithms based on place value, properties of operations, and/or the relationship between addition and subtraction.

3.NBT.3 Multiply one-digit whole numbers by multiples of 10 in the range 10-90 using strategies based on place value and properties of operations.

3.MD.8 Solve real world and mathematical problems involving perimeters of polygons, including finding the perimeter give the side lengths, finding an unknown side length, and exhibiting rectangles with the same perimeter and different areas or with the same area and different perimeters.

ELA:

W.3.3 Write narratives to develop real or imagined experiences or events using effective technique, descriptive details, and clear event sequences.

W.3.10 Write routinely over extended time frames and short time frames for a range of discipline-specific tasks, purposes, and audiences.

SL.3.1 Engage effectively in a range of collaborative discussions with diverse partners on grade 3 topics and texts, building on others' ideas and expressing their own clearly.

SL.3.3 Ask and answer questions about information from a speaker, offering appropriate elaboration and detail.

SL.3.4 Report on a topic or text, tell a story, or recount an experience with appropriate facts and relevant, descriptive details, speaking clearly at an understandable pace.

SL.3.6 Speak in complete sentences when appropriate to task and situation in order to provide requested detail or clarification.

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

Know and apply the engineering design loop.
Understand how mass affects a structure.
Understand the impact of gravity and force on an object.
Estimate and measure length and/or mass.
Utilize budgets in planning projects – keep running totals of expenditures and amount left to spend (+/-/x/÷)
Write about observations, process, results, etc.

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

Did they build a bridge that met the criteria?
Did they follow their plan/budget?
Did they follow the design loop process?
Did they work collaboratively?

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

Experience with the Engineering Design Loop process
Connections to the Mathematical Practices
Investigations/inquiry in Science
Experiences with weight, mass, and gravity
Experiences in measurement and estimation
PS.6.1.2 Relationship between mass and weight
PS.6.K.3 Effects of the force of gravity on objects
2.MD.1 Measure the length of an object by selecting appropriate tools
2.MD.3 Estimate lengths using units of inches, feet, centimeters, and meters
2.MD.8 Solve problems involving dollar bills, quarters, dimes, nickels and pennies, using $ and ¢ symbols appropriately

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. It will allow students the opportunity to transfer and apply skills from various content areas within one task.

Discuss issues and challenges the students encountered during the challenge. Some examples:

- Do any two bridges look alike? What are some of the differences in design?
- What makes one design better than the other? Strength, Cost, Design (aesthetics)
- Did the final design end up anything like what you planned?

Extension:
Student research building bridges or bridge design. W.3.7
Complete the task again with their new knowledge. What did they do differently? Was it easier this time?
What might happen if the span (distance) of the bridge was longer/shorter?
Are there other materials that would help you to construct a better designed bridge?

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

Straws
Scotch tape
Copy paper/blank paper, etc.
Pennies, washers, counters/manipulatives (something to use as the weights)

Additional Information

Design and build a bridge, within your allotted budget, that will:

- span a distance of 35 cm between two desks
- have a perimeter of at least 32 inches
- support the most weight without collapsing

Students will use two desks to serve as the "sides" of the expanse that needs to be crossed.
That span must be at least 35 cm. It would probably be best for the "equity of the challenge" to have everyone keep their span to 35 cm during the initial challenge. If you perform the challenge again with different constraints that might be something you change.

Students will need to plan their design and use a budget for the expenditures of their supplies. You could use "play money" if you wish, however, it is not necessary. They will need to keep a record of their budget and expenditures. This is where you should see the mathematics recorded for their design. You can adjust the budget or cost of materials to fit your needs, as well as adding different materials to the challenge.

Two separate task cards have been included in the lesson – one that uses this budget and one that doesn't list the supplies or budget, in the case you want to change the materials or cost of items.

Suggested Budget and List of Available Materials:

Budget for Bridge Design: $1000
Available Items & Cost
5 Straws - $50
10 cm tape - $100
1 piece of paper - $200

Students will need to ensure that the perimeter of their bridge is at least 32 inches.

In order to measure the "most weight without collapsing", you could use the following items as your weight:
Pennies, washers, specified manipulative, actual weights (that came with the balance, if available) or other material you may have available.

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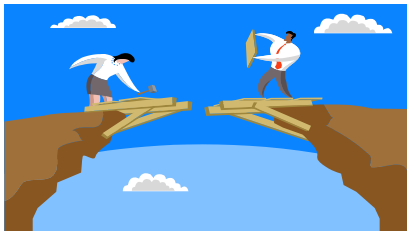

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Group Supplies:
Straws, Tape, Paper, weights

Design Budget: $1000

Available Materials

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10 cm tape	$100
1 piece of paper	$200

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