

Strong and Stable Structures

This section should fully describe the lesson sequence on how you apply the inquiry-based strategy/approach in your classroom and the steps teachers can follow to adapt for use in their classrooms. Where ever possible, embed teacher tips and hints throughout the lessons/approaches.

Here are some helpful ideas:

- How did you start the process?
- What were the guiding questions? Backwards design process:
 - What is it that you want your students to learn or to be able to do?
 - How will you know that they learned what you wanted them to learn (or do)?
 - How will you get them there?
- How did you scaffold the instruction of required skill sets and knowledge-building? Use sub-headings to describe the sequence of teaching/learning strategies and discussion outlines with suggested timelines.
- What were the Inquiry experiential and hands-on opportunities? Use sub-headings to describe these teaching/learning opportunities with suggested timelines.

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General Safety Guidelines

Instructions:

1. It is very important to co-construct the Safety Guidelines with your students.
2. This document is the 2nd edition from the American Chemical Society, the guidelines are very succinct. However, it is important that you review all of them with students and build them together.
3. Depending on what materials you are using, there are specific safety guidelines to consider. They are listed in this document and also the 3rd edition of this document which if you prefer to use is listed in the references of whole inquiry.

General Safety Rules for Students

Always review the general safety rules with the students before beginning an activity.

1. Never do any experiment without the approval and direct supervision of your teacher.
2. Always wear your safety goggles when your teacher tells you to do so. Never remove your goggles during an activity.
3. Know the location of all safety equipment in or near your classroom. Never play with the safety equipment.
4. Tell your teacher immediately if an accident occurs.
5. Tell your teacher immediately if a spill occurs.
6. Tell your teacher immediately about any broken, chipped, or scratched glassware so that it may be properly cleaned up and disposed of.
7. Tie back long hair and secure loose clothing when working around flames.
8. If instructed to do so, wear your laboratory apron or smock to protect your clothing.
9. Never assume that anything that has been heated is cool. Hot glassware looks just like cool glassware.
10. Never taste anything during a laboratory activity. If an investigation involves tasting, it will be done in the cafeteria.
11. Clean up your work area upon completion of your activity.
12. Wash your hands with soap and water upon completion of an activity.

Curriculum Expectations

Overall Expectations

- Assess the importance of form, function, strength, and stability in structures through time;
- Investigate strong and stable structures to determine how their design and materials enable them to perform their load-bearing function;
- Demonstrate an understanding of the concepts of structure, strength, and stability and the factors that affect them.

Specific Expectations

- Assess effects of strong and stable structures on society and the environment (1.1)
- Assess the environmental impact of structures built by various animals and those built by humans (1.2)
- Investigate, through experimentation, how various materials and construction techniques can be used to add strength to structures (2.3)
- Investigate, through experimentation, the effects of pushing, pulling, and other forces on the shape and the stability of simple structures. (2.3)
- Define a structure as supporting framework with a definite size, shape and purpose, that holds a load. (3.1)
- Identify the strength of a structure as its ability to maintain balance and stay fixed in one spot. (3.4)
- Identify properties of materials that need to be considered when building structures (3.5)
- Describe ways to improve a structure's strength (3.7)
- Describe ways in which different forces can affect the shape, balance, or position of a structure (3.9)
- Identify the role of struts and ties in structures (3.10)

Lesson Plan for Keywords: Strong and Stable Structures

Instructions:

- Using the word list for Strong and Stable Structures have students write the word in the Vocabulary Power graphic organizer.
- Have them fill out each box as the inquiry continues.

- Compression
- Tension
- Strut
- Ties
- Strength
- Stability

 Vocabulary Power 	
Write the Word  <small>www.thisreadingnana.com</small>	
 Read the definition. Write what it means in your own words.	 Draw a picture of what it means.
 Write a sentence with the word.	 Write a word that means the opposite of the word. Optional: Draw a picture, too.

Definitions for Keywords -Teacher Resource

<u>Keyword</u>	<u>Definition</u>
Compression	is a force that squeezes something together.
Tension	is an interaction that causes an affected object to be pushed or pulled in a certain direction.
Strut	All structures have forces acting on them. You should have an understanding of tensile, compressive and shear forces (see previous sheet). The part of the structure that has a tensile force acting on it is called a TIE and the part that has a compressive force acting on it is called a STRUT .
Ties	All structures have forces acting on them. You should have an understanding of tensile, compressive and shear forces (see previous sheet). The part of the structure that has a tensile force acting on it is called a TIE and the part that has a compressive force acting on it is called a STRUT .
Strength	the quality or state of being physically strong
Stability	the strength to stand or endure

KWHLAQ - Chart - to discuss prior knowledge and key questions

Instructions:

1. Learning Goal for this activity is to discuss prior knowledge and plan an overview of learning for students.
2. You will need chart paper (markers) and also a hardcopy of the KWHLAQ organizer so students have their own copy.
3. See next slides for the guiding questions to ask students and ideas of where the inquiry can lead.

Strategy - KWL Charts National Behaviour Support Service

KWHLAQ	
K What do I Know?	
W What do I Want to know?	
H How do I find out?	
L What have I Learned?	
A What Action will I take?	
Q What Questions do I have?	

Name: _____

Date: _____

Teacher's Guide:

- Whole group or small group
- Materials - Chart Paper and Markers

K - What do I know?	Ask students what they know about strong and stable structures. Write down responses.
W - What do I want to know?	Ask students what they want to know about strong and stable structures. Write down responses.
H - How do I find out?	Discuss how we will use experiments to learn more about strong and stable structures.
L - What have I learned?	Leave this blank, initially and then come back to it during the consolidation portion of the inquiry.
A - What action will I take?	Leave this blank, initially and then come back to it during the consolidation portion of the inquiry.
Q - What questions do I have?	Leave this blank, initially and then come back to it during the consolidation portion of the inquiry.

Name: _____

Date: _____

K - What do I know?	
W - What do I want to know?	
H - How do I find out?	
L - What have I learned?	
A - What action will I take?	
Q - What questions do I have?	

Student Support Resources - A List of Experiments for Strong and Stable Structures

Simple Experiments to define structures, what makes a strong structure, what materials make a strong structure, what is the role of the load, struts and ties in structures. Review the different forces that can affect shape, balance and fixed in one spot, if need be. Finally, make sure students have time to reflect on how structures they create can be improved in various ways. (Formative)

- Define a structure as supporting framework with a definite size, shape and purpose, that holds a load. (3.1)
- Identify the strength of a structure as its ability to maintain balance and stay fixed in one spot. (3.4)
- Identify properties of materials that need to be considered when building structures (3.5)
- Describe ways to improve a structure's strength (3.7)
- Describe ways in which different forces can affect the shape, balance, or position of a structure (3.9)
- Identify the role of struts and ties in structures (3.10)

Can you add a safety feature to your structure? Based on the last unit of inquiry, students are to research, discuss and create a strong structure that can adapt to the effects of movements that are caused by different forces. They need to include a safety feature and device so that people can evacuate safely and effectively if necessary.

(Summative)

- Investigate, through experimentation, how various materials and construction techniques can be used to add strength to structures (2.3)
- Investigate, through experimentation, the effects of pushing, pulling, and other forces on the shape and the stability of simple structures. (2.3)

Simple Experiments (Formative)

1. What makes a strong structure? (Introduction)

- a. Materials: sheets of paper 8.5 by 11, items that can be used to pile on the structure (unit cubes etc.), masking tape, scissors, glue, pencil, straws, wire, string, scissors
- b. Ask students to bring in corrugated cardboard from boxes from packages, and to bring in recycled cereal boxes for their structure,
- c. Instructions: Ask students to make three different structures: one with paper, one with cardboard, and one with recycled cereal boxes. Ask them to use shapes that they know, for example, circle, squares, triangles, hexagons, cylindrical shapes using the materials and see which shape can carry the weight of their load the best. Have students use the chart, Strength of Materials, to make predictions and record their observations. When they are finished have them record which shape and material was the best and explain. Also, have them discuss and write what they would do differently next time.

Strength of Materials and Shapes

Name: _____

Date: _____

Write the material you used, the shapes you will try and your prediction in this column. Include a small drawing of your work as well.

What happened? Write your observations in this column.

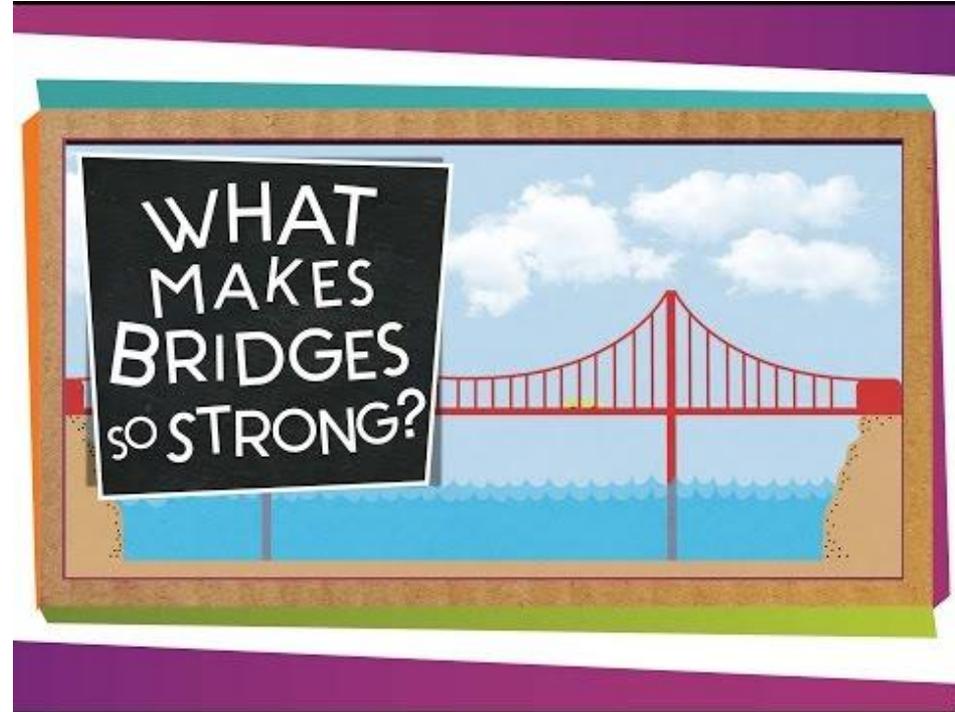
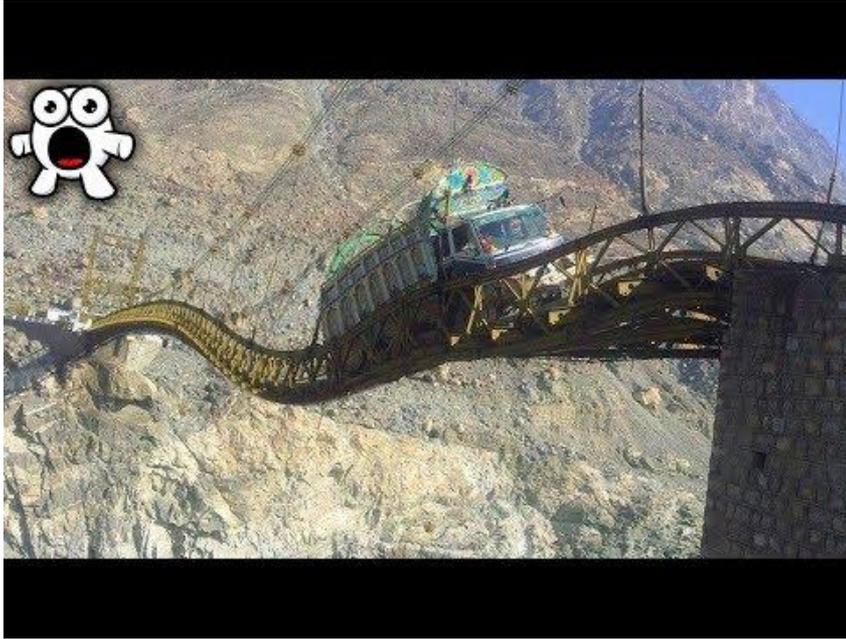
Which one was the best? Why?

What would you do differently? Why?

Simple Experiments (Formative)

1. Let's build bridges - What is the role of the load, struts and ties in structures, and review the different forces that can affect shape, balance and fixed in one spot, if needs be. (Investigation 1)
 - a. Materials: sheets of paper 8.5 by 11, items that can be used to pile on the structure (unit cubes etc.), masking tape, scissors, glue, traws, wire, string, scissors. pencil. Ask students to bring in corrugated cardboard from boxes from packages and to bring in recycled cereal boxes so they can use them for their structures [Bridges around the world file](#). Youtube videos of different bridges.
 - b. Instructions: Show students different kinds of bridges they can build using the pictures from the bridges around the world file, the youtube video and the Bridge building file. Have them use the different materials to use and make bridges. Once they are finished they record their observations in the types of bridges file.
 - c. Instructions: How can we strengthen our structures? More review of load, struts and ties. Watch the video about strengthening materials with struts and ties.

Youtube videos of bridges



Use this file to introduce Bridge Building



BRIDGE BUILDING



Types of Bridges

Name: _____ Date: _____

Write the material you used, the name of the bridge, and what kind of load you think it can take? Include a small drawing of your work as well.

What happened? Write your observations in this column.

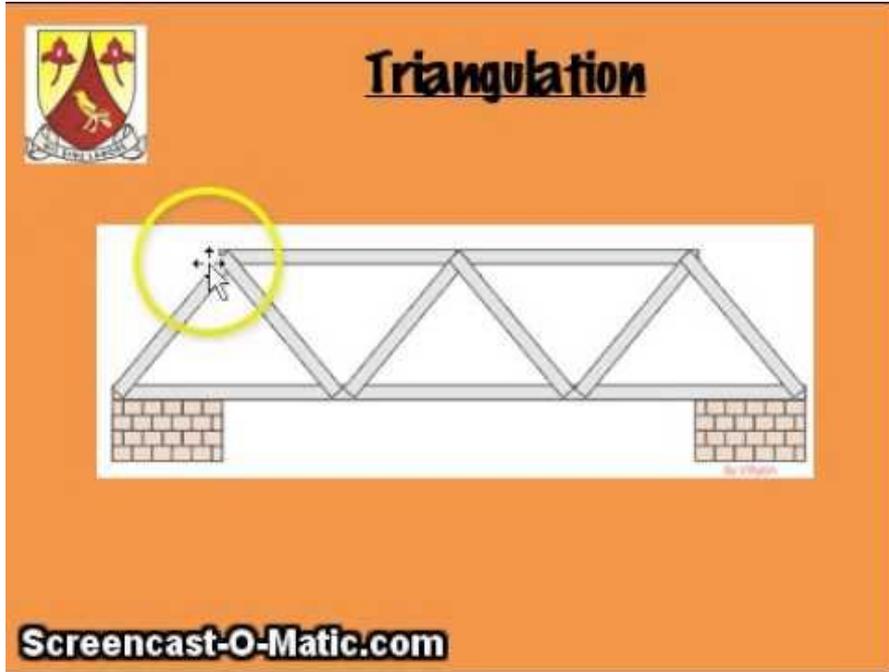
Which one was the best? Why?

What would you do differently? Why?

Simple Experiments (Summative)

1. Let's build bridges - What is the role of the load, struts and ties in structures? (Investigation 2)
 - a. Materials: sheets of paper 8.5 by 11, items that can be used to pile on the structure (unit cubes etc.), masking tape, scissors, glue, pencil, ask students to bring in corrugated cardboard from boxes from packages, ask students to bring in recycled cereal boxes so they can use as material for their structure, straws, wire, string, scissors. [Bridges around the world file](#). Youtube videos of different bridges.
 - b. Instructions: How do we strengthen our structures? What is the role of load struts and ties in structures? Watch the videos about strengthening materials with struts and ties. Have students use different materials to make their bridges stronger.

Youtube video for Ties, Struts



powered by Screencastify Lite

Strengtheners

Strut

A member that helps to hold a structure up from below.

A strut forms a triangle below a structure. The strut is in **compression**.

The image shows a purple food truck with a sign that reads "WERKEN DOE JE MET GO-TAM." A red circle highlights a red metal strut that supports the truck's counter from below.

A small inset video shows a woman with long dark hair speaking.

Assessment opportunities

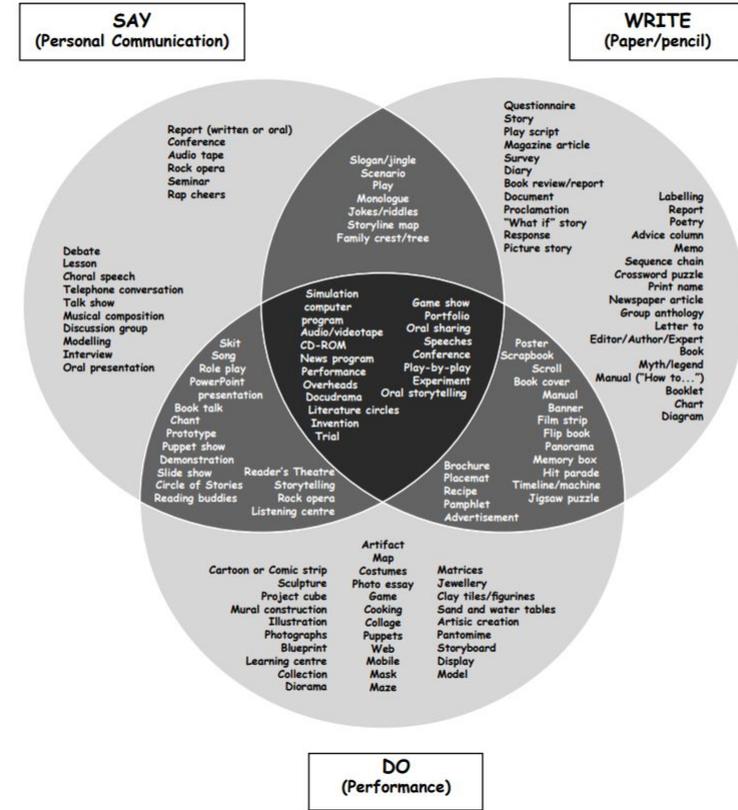
In the graphic in this slide shows teachers different assessment strategies and tools.

You can choose from Say, Write, Do. With these investigations they have a lot of opportunity to do, say and write. If you have students that are having difficulty filling out the forms you can have them communicate their findings by filming their structures using an iPad and describing through video their findings or you can simple record your observations.

In the next slides, you will find different rubrics that you can use for any of the investigations throughout this inquiry.

Introduction

Sample Assessment Strategies and Tasks



Rubric for Self-Assessment Name: _____ Date: _____

	I will do this next time.	I can do better.	I was good at this.	I did very well.
Followed Instructions	1	2	3	4
I asked questions when I didn't understand	1	2	3	4
I worked well on my own	1	2	3	4
I worked well with others	1	2	3	4
I have a good understanding of what I learned.	1	2	3	4

What did you learn?

Can you use this information in real life?
Why? Why not?

If you could learn about something else,
what would it be?

Summative Assignment

1. Create a strong and stable structure using different materials.
 - a. Materials: Any material that will help to create a strong and stable structure
 - b. Instructions: Students will work in pairs and during a period of 1 week they will create a structure that will be strong and stable and can withstand the force of a nature disaster.. Students present to their classmates their findings.

Use the [Design Thinking Process Final Summative Template](#) to help students through this guided inquiry.