

# Bridges, Bridges, Bridges

© SD60 Peace River North



**Preamble:** This package allows you to decide your goals for your class and what you want to do with your students. If your focus for the Core Competencies is Thinking (Creative or Critical) look for any of the blue items. If your focus is Collaboration or Communication, look for the orange items. If your goal is Personal Awareness or Positive Personal and Cultural Identity, look at the green items. Feel free to choose the focus area or areas and use only those parts of this project.

## GUIDING QUESTIONS

What makes a bridge strong?

How do I get new ideas or build on other people's ideas?

How do I use my observations, experiences and imagination to make judgements?

How did I contribute to my group and share responsibilities?

Did I communicate my ideas in different ways?

How did I take responsibility for my actions and accept feedback?

What personal connections did I make with this project?

## CURRICULUM CONNECTIONS

### UNDERSTAND (Big Ideas)

- Properties of objects and shapes can be described, measured, and compared
- Machines are devices that transfer force and energy.
- Complex tasks require the acquisition of additional skills.

### DO (Curricular Competencies)

- |         |  |
|---------|--|
| Maths   | - use reasoning and logic to explore, analyse and apply mathematical ideas                   |
|         | - Apply multiple strategies to solve problems in both abstract and contextualized situations |
| Science | - make observations in familiar and unfamiliar contexts                                      |
|         | - Demonstrate an openness to new ideas and consideration of alternatives                     |
|         | - Generate and introduce new or refined ideas when problem solving                           |
|         | - Communicate ideas, explanations, and processes in a variety of ways                        |
|         | - Express and reflect on personal, shared, or others experiences of place                    |
| ADST    | - Identify the main objective for the design and any constraints                             |
|         | - Generate potential ideas and add to others' ideas  |
|         | - Screen ideas against the objective and constraints   |
|         | - Choose an idea to pursue   |

# Bridges, Bridges, Bridges

© SD60 Peace River North



- Reflect on their design thinking and process and evaluate their ability to work effectively both as individual and collaboratively in a group, including their ability to share and maintain an efficient cooperative work space

## KNOW (Curricular Content)

- Maths
- regular and irregular polygons
  - angle measurement and classification
- Science
- effects of balanced and unbalanced forces
- ADST
- technical drawing, including sketching techniques and manual drafting techniques
  - elements of plans and drawings

## INSTRUCTIONAL MODEL (5E)

### ENGAGE

Ask students to share what they know about bridges. Have them partner talk and then share out. Teacher records info. Ask them the question: What makes a bridge strong? Again partners talk and then share.

Show the students the film about the collapse of the [Taylor Bridge](#) and the film about the [Tacoma Narrows Bridge](#) collapse.

Revisit the question - What makes a bridge strong?

## Lesson 1

### 1. EXPLORE

Examine types of bridges. (See article) Ask students to look at the polygons that are used to construct the bridges. In their groups or with their partners, have them examine each type of bridge and speculate about what shapes are involved in each bridge type and why those shapes might make a bridge strong.

Provide students with spaghetti and glue guns or tape. Have the groups or partners build regular and irregular polygons and test them for stability and strength. Students will need to determine what makes a fair test for their mini structures.

### 1. EXPLAIN

What makes a bridge strong? Have your ideas changed?

# Bridges, Bridges, Bridges

© SD60 Peace River North



## 1. EXTEND

What happens when shapes are combined? Does it improve strength or stability? If it does, how does it improve them?

## 1. EVALUATE

What makes a bridge strong?

How do I get new ideas or build on other people's ideas?

How do I use my observations, experiences and imagination to make judgements?

How did I contribute to my group and share responsibilities?

Did I communicate my ideas in different ways?

How did I take responsibility for my actions and accept feedback?

What personal connections did I make with this project

## Lesson 2

## 2. Explore

Understand the forces of load, tension and compression. What do these mean in terms of bridge construction?

### Materials

- String
- Paper clip
- Large plastic/paper cup
- Single hole punch
- Object to use as weights (such as coins)
- Rubber bands or tape
- Spaghetti - 20 to 25 strands
- Safety goggles are recommended
- Recording sheet (attached)

### Preparation

- Set up two equal height chairs, tables or boxes so the gap between them is a few centimetres less than the length of a piece of spaghetti.
- Hole punch two holes just below the rim of the cup on either side. Tie the string such that you have made a "handle".
- Bend a paper clip into either a "C" or "S" hook shape. This will allow you to hang the "bucket" from the spaghetti.

### Procedure

- Place a single piece of spaghetti across the gap between your "piers" (chairs, tables or boxes)

# Bridges, Bridges, Bridges

© SD60 Peace River North



- Hang your cup from the strand of spaghetti using the paper clip hook that you made.
- Slowly start adding weight to the cup. *Estimate and predict how much weight do you think the cup will hold before the spaghetti breaks?*
- Continue adding weight slowly. Support the cup as you add the weight and then gently lower the cup until the string pulls on the spaghetti
- Keep adding weight until the strand of spaghetti breaks. If it bends and falls through the gap without breaking, move your “piers” closer together and try again.
- Now, bundle together five pieces of spaghetti. Do this by wrapping their ends in either rubber bands or tape to hold them together. *How much weight do you think the bundled strands of spaghetti will hold? Will it be approximately five times the amount a single strand could hold, or?*
- Try the test again with a bundle of 10 strands of spaghetti.
- Observe carefully where the strands that broke are located. *Are the strands that fracture first at the top or bottom of the bundle?*

## 2. Explain

Complete the attached [worksheet](#)

## 2. Extend

Try the test with bigger bundles of spaghetti. Does how you bundle the spaghetti strand together affect how much load they can hold?

## 2. Evaluate

How does load, tension and compression affect the construction of a bridge? How do you think these forces act on each of the types of bridge?  
What makes a bridge strong?

How do I get new ideas or build on other people’s ideas?

How do I use my observations, experiences and imagination to make judgements?

How did I contribute to my group and share responsibilities?

Did I communicate my ideas in different ways?

How did I take responsibility for my actions and accept feedback?

What personal connections did I make with this project

# Bridges, Bridges, Bridges

© SD60 Peace River North



## Lesson 3

If you wish to continue to explore forces and bridge construction then continue with this [lesson](#).

## Lesson 4

### The Challenge!!

#### Explore

With your group, plan the construction of a spaghetti bridge. The criteria for the bridge is:

- Must span 500 mm, be a minimum width of 50 mm and a minimum height of 100 mm
- Hold the maximum load (1kg for 60 seconds)
- Weigh the least amount possible

The materials you may use for construction are spaghetti and hot glue.

Your plan must include several sketches of the bridge. The sketches must be the top view (birds eye), a side view and a sketch that includes labels identifying the polygons your group will utilize in the construction and what forces will affect your bridge. The plan must also include a written safety plan for your construction site.

#### Explain

Present your finished bridge for testing.

Reflect on how you contributed to your group and the bridge construction.

#### Evaluate

What makes a bridge strong?

How do I get new ideas or build on other people's ideas?

How do I use my observations, experiences and imagination to make judgements?

How did I contribute to my group and share responsibilities?

Did I communicate my ideas in different ways?

How did I take responsibility for my actions and accept feedback?

What personal connections did I make with this project?

# Bridges, Bridges, Bridges

© SD60 Peace River North



## Resources

Videos - [Taylor Bridge](#) and the [Tacoma Narrows Bridge](#)

Worksheet - [Bridge Types](#)  
[Forces on a Bridge](#)

## References

Lesson 2 - [source](#)

Lesson 3 - [source](#)

Information and pictures from the collapse of the [Taylor Bridge](#)