

## Summative 2: The Nature of the Challenge

*Overall Expectation(s): 3. Demonstrate an understanding of the relationship between structural forms and the forces that act on and within them (7s22). 2. Design and construct a variety of structures, and investigate the relationship between the design and function of these structures and the forces that act on them (7s21).*

Nature has the ability to unleash powerful forces that put human structures through extreme tests. Sometimes human structures fail these tests and tragedy occurs. Working in pairs, students will construct models of structures that can withstand the various forces of nature.

The structures must be able to pass the following tests:

1. The Gale Force Wind Test – A powerful fan will create wind to blow on the structure, gradually increasing wind speed
2. The Severe Driving Rain Test - A hose with a gun-type nozzle will create a severe rain storm by spraying the shelter with water with gradually increasing water pressure.
3. The Falling Mass Test – Mass will be dropped on the structure starting at 1Kg and gradually increasing in 1Kg increments until the structure has collapsed.

In their design and construction the students must meet the following criteria:

- Structures must be able to provide shelter for a family of four (8 cm tall figures)
- Structures must be made using only popsicle sticks, toothpicks, Bristol board, paper, glue, and tape
- Structures must be built above ground and have an access way for people to get in and out

Structure Assessment Criteria:

- Submitted detailed plan drawn to scale using the SPICE method. Scale is important when making plans and drawings for this project.
- Used appropriate techniques and construction materials
- Applied the skills addressed in the subtasks
- Conducted tests for structural stability *before* the final design was completed
- Completed structure must pass the wind, water, and mass tests.

As groups construct their structures, they must *continually* investigate the stability of the structure and identify the various forces acting on the structure to ensure that it can pass the tests. Students should be able to identify the forces acting on the structure, and be able to calculate static and dynamic loads.

Students will be expected to demonstrate all of their background knowledge with respect to the types of structures, strong shapes, struts, ties, triangulation, symmetry, balance, and centre of gravity in the construction of their hurricane shelters.

Before final testing of the structures, each group will present their shelter and explain how they created it, what engineering problems they over came, and how their design was modified as a result of load pre-tests. The final part of this subtask will be the testing.

**PART A – The Plan (20 Marks)**

a.	SPICE Model Situation Problem/ Possibilities	<ul style="list-style-type: none"> <li>- Identify the setting of the problem</li> <li>- Defines and states what is going to be built and solved using the phrase “Design and Make a ...”</li> </ul>	1	2	3	4	
b.	Investigation  Drawing of Top & Sides View	<ul style="list-style-type: none"> <li>- All brainstorming, sketches, resources, etc. (Appropriateness of size, Economics of production, Testing, Surroundings/Appearance, Performance, Ergonomics, Safety, Guiding Student Research, List of Materials (quantities given; precise measurements; specific; complete (7s31))</li> <li>- to scale; complexity; straight lines; detailed; pencil (7s31, 7m10)</li> </ul>	1	2	3	4	
c.	Summary	<ul style="list-style-type: none"> <li>- Type of Structure (mass, frame or shell) (7s32)</li> <li>- Describe the type of forces that might act on your structure. Internal/External (7s35)</li> <li>- Draw an arrow on the side or top view to show the direction of these forces (7s34)</li> </ul>	1	2	3	4	
d.	Overall Presentation Vocabulary	<ul style="list-style-type: none"> <li>- name; class; date; title; labels; neatness</li> <li>- appropriate science and technology vocabulary, including truss, beam, ergonomics, shear, and torsion), in oral and written communication (7s30)</li> </ul>	1	2	3	4	
TOTAL							/20

**PART B – Construction of Model (40 Marks)**

SPICE Model Choose & Construction		- The solution is in the form of a model built from real materials.					
e.	Precision Joints	<ul style="list-style-type: none"> <li>- exact measurements, clean cuts</li> <li>- secure; appropriate amount of glue; stable</li> </ul>	1	2	3	4	
f.	Materials	- use of appropriate materials for aesthetics and function	1	2	3	4	
g.	Safety	- follow established safety procedures for using tools and handling materials (7s25)	1	2	3	4	
h.	Symmetry & Balance	- opposite beams parallel to each other; level (7s33, 7s36)	1	2	3	4	
i.	Use of class-time	- preparation for class, materials in class, on task (7s26, 7s27)	1	2	3	4	
TOTAL x2							/40

**Part C - Test of Structural Stability (40 Marks)**

j.	Plan to investigate the stability of the structure	<ul style="list-style-type: none"> <li>- identify variables</li> <li>- identify criteria for assessing results</li> </ul>	1	2	3	4	
k.	Forces Table	<ul style="list-style-type: none"> <li>- Table showing the magnitude, direction and point and plane of application of forces that they tested (7s34)</li> <li>- proper identification of forces</li> <li>- precise measurement of forces acting</li> </ul>	1	2	3	4	
l.	Forces affect Stability	- Description of how different forces affected the stability of their structure (qualitative observations; detailed and specific)	1	2	3	4	
m.	Static & Dynamic loads	- Comparison of static load of structure with dynamic load that it supports. (accurate measurements, units given; ratio calculated)	1	2	3	4	
n.	Function	<ul style="list-style-type: none"> <li>- mechanisms run smoothly</li> <li>- structure performs its function</li> </ul>	1	2	3	4	
o.	SPICE Model Evaluation	<ul style="list-style-type: none"> <li>- Testing and inspection of the model to see if it works to solve the problem. Look back at the problem and reflect on the achievements. Consider any improvement.</li> <li>- modifications they would make to their model to improve stability - factors that caused the structure to fail (7s37)</li> </ul>	1	2	3	4	
TOTAL							/40

**Feedback**

**Assessment Criteria - Summative Evaluation**

	Level 4	Level 3	Level 2	Level 1
<p><b>The Plan</b>                      Summary                      .classify structure (7s32)                      .describe the type of forces that might act on the structure. Internal/External (7s35)                      .draw an arrow on the side or top view to show the direction of these forces (7s34)</p>	<p>.Student demonstrates a high degree of understanding of the relationship between structural forms and the forces that act on and within them.</p>	<p>.Student demonstrates considerable understanding of the relationship between structural forms and the forces that act on and within them.</p>	<p>.Student demonstrates some understanding of the relationship between structural forms and the forces that act on and within them.</p>	<p>Student demonstrates limited understanding of the relationship between structural forms and the forces that act on and within them.</p>
<p><b>.Construction of Model</b>                      .follow established safety procedures (7s25)                      .design, construct, and use physical models to investigate the effects of various forces on structures (7s26)                      .investigate the factors that determine the ability of a structure to support a load (7s27)                      .use technological problem-solving skills to determine the most efficient way for a structure to support a load (7s28)                      .use appropriate science and technology vocabulary (7s30)                      .describe ways in which the centre of gravity of a structure affects the structure’s stability (7s33)                      .describe the role of symmetry in structures (7s36)</p>	<p>.With a high degree of accuracy, student can design and construct a variety of structures, and investigate the relationship between the design and function of these structures and the forces that act on them;</p>	<p>.With a considerable accuracy, student can design and construct a variety of structures, and investigate the relationship between the design and function of these structures and the forces that act on them;</p>	<p>.With a some accuracy, student can design and construct a variety of structures, and investigate the relationship between the design and function of these structures and the forces that act on them;</p>	<p>.With limited accuracy, student can design and construct a variety of structures, and investigate the relationship between the design and function of these structures and the forces that act on them;</p>
<p><b>.Test of Structural Stability</b>                      .identify the magnitude, direction, point of application, and plane of application of the forces applied to a structure (7s34)                      .identify and describe factors that can cause a structure to fail (7s37)</p>	<p>.With a high degree of accuracy, student can design and construct a variety of structures, and investigate the relationship between the design and function of these structures and the forces that act on them;</p>	<p>.With a considerable accuracy, student can design and construct a variety of structures, and investigate the relationship between the design and function of these structures and the forces that act on them;</p>	<p>.With a some accuracy, student can design and construct a variety of structures, and investigate the relationship between the design and function of these structures and the forces that act on them;</p>	<p>.With limited accuracy, student can design and construct a variety of structures, and investigate the relationship between the design and function of these structures and the forces that act on them;</p>