

Design Technology: Mastering Structures

Learning objective: To evaluate the structural integrity, stability, and aesthetic design of various frame and shell structures.

Read each question carefully. Use your knowledge of materials and structural shapes to provide detailed answers. Remember to use technical vocabulary where appropriate.

Max the monkey is helping his friends design a new adventure playground. He needs to build a sturdy frame for a climbing tower and a lightweight shell structure for a shaded reading nook. Pip the caterpillar is worried about the structure collapsing under the weight of books, while Nova the owl is observing how the shapes affect the strength of the designs.

Word bank: Reinforce · Compression · Tension · Stability · Triangulation · Struts · Aesthetics · Load-bearing

1. Max wants to use triangles in his climbing tower design. Explain why adding triangular shapes helps to prevent a frame from collapsing. (2 marks)

2. Define the terms 'compression' and 'tension' in the context of building a structure. (2 marks)

3. If Pip the caterpillar wants to build a bridge using only card, suggest two ways she could reinforce the material to make it stronger. (2 marks)

4. Compare and contrast a 'frame structure' (like a tent frame) and a 'shell structure' (like a hollow plastic ball). Which is better for carrying a heavy load and why? (4 marks)

5. Nova notices that the playground tower wobbles when the wind blows. Justify why adding diagonal struts is a more effective solution than simply making the vertical posts thicker. (4 marks)

6. Design a small structure for an animal friend. You have a budget of £10.00. Wood costs £4.00, fabric costs £2.50, and recycled plastic costs £3.00. List your materials and explain why your chosen structure is stable. (3 marks)

7. Extended Writing: Imagine you are an engineer. A local park needs a new shelter that must be both beautiful (aesthetics) and strong (structural integrity). Write a proposal explaining the materials you would choose, the shapes you would incorporate, and how you would ensure the structure remains stable during a storm. Refer to the concepts of load-bearing and triangulation. (5 marks)

Draw: Draw a labelled diagram of a tower structure that uses triangulation to remain stable. Clearly label the 'struts' and the 'joints'.



Extension challenge: What might happen to the stability of a structure if the joints were made of a flexible material instead of a rigid one? Justify your prediction using scientific reasoning. Total: /25