Structures and Forces Review

How do structures stand up under a load? What forces act on structures, and what materials and design characteristics contribute to their strength and stability?

Key Concepts (Unit At A Glance Science Focus 7 p. 346) Links to Topic Notes provided	**Guiding Questions and Activities to Help you Study**
Topic 1 **Classification of Structures according to their origin (natural or manufactured) and according to how they are built (mass, frame, shell)** **Similarities, in form or function, of manufactured structures to natural structures**	- Describe the differences between natural and manufactured structures. - Can you detail examples of manufactured structures that have their design based on a natural structure? - What modifications need to be made to certain types of frame structures to stabilize them? Give detailed examples, if you can. (p. 275)
Topic 2 **Factors considered by structural designers include: shape, function, appearance, safety, esthetics, cost, materials, and joints**	- What are some of the common functions of structures? - What does 'aesthetically appealing' mean? - What is a 'margin of safety'? - What factors make building a structure more expensive? - How do material properties determine their use? - What are the common different types of materials? - When choosing material for a structure, what considerations do designers need to get information about before making a decision? - What are the two different types of joints? - Describe the various types of fasteners - giving examples of each type.
Topic 3 **Measurement of Mass (How and units)** **Measurement of Weight (How and units)**	- Describe the difference between mass and weight. - What instruments are use to measure mass and weight? - What units are mass and weight calculated in and how were these units developed? - Draw force diagrams that show a balanced force and an unbalanced force.
Topic 4 **External forces including live loads (changing or non-permanent) and dead loads (the weight of the structure itself)** **Internal forces of tension, compression, shearing, buckling and bending**	- What is deformation? - Describe the differences between external and internal forces, giving examples of each. - Draw force diagrams that illustrate the different internal forces that can act on a structure. - Describe tensile strength, compressive strength, shear strength and torsion strength. - Identify the forces acting on different parts of a bicycle and the types of strengths of each of the main parts. - How do materials get their strength?
Topic 5 **Deformation in structures** **Properties of Materials to withstand internal forces.** **Failure of materials under pressure from forces by snapping, buckling, bending, stretching, shearing and twisting**	- Describe how a lever can generate a large force. - Describe the types of forces, which cause shear failure, buckling failure and torsion failure. - How can knowledge about failure of materials and structures be useful? - What is metal fatigue?
Topic 6 **Choices in design and materials to strengthen a structure against specific kinds of forces** **Frictional Forces**	- What are the three key methods used by designers to help structures withstand forces and prevent failure? - What is corrugation? - What are flying buttresses? - How can the way a material is made, lower the cost of making that material, but still be strong? - How can you strengthen a load-bearing horizontal beam that is supported only at the ends? - How can frictional forces be used to stabilize a structure?

Topic 7 **Structural stability (ability not to tip over)**	- How can you locate the center of gravity? - What is 'thrust line'? - What are the key strategies used in making a firm foundation? - What scientific principle does a gyroscope demonstrate and what practical applications can you describe that show a gyroscope in action?

Design a Concept Map linking the ideas introduced and reinforced in this Unit on Heat and Temperature

Try some of the Practice Quizes to see how much you have recalled from this Unit

These Internet links may help you find out more information about the key concepts from this Unit.

- structural forms
- material strength **and** flexibility
- joints
- forces on and within structures
- direction of forces
- deformation **(examples)**
- structural stability
- modes of failure
- performance requirements
- margin of safety monolithic dome