Important Concepts . . .

Preview Review

Science *Grade 7* *TEACHER KEY*

W3 - Lesson 1: Forces on and within Structures

V5-07

Important Concepts of Grade 7 Science

W1 - Lesson 1 ..... Interactions and Interdependencies
W1 - Lesson 2 ..... Nutrient Cycles, Energy Flows, and Changes in Ecosystems
W1 - Lesson 3A ..... Environmental Impacts of Human Activities
W1 - Lesson 3B ..... The Particle Model of Matter, Temperature, Heat, and Change of State
W1 - Lesson 4 ..... Heat Transfer
W1 - Lesson 5 ..... Understanding Heat and Temperature in Nature and Technology
W1- Quiz
W2 - Lesson 1 ..... Life Processes and Structure of Plants
W2 - Lesson 2 ..... Plant Propagation and Reproduction
W2 - Lesson 3 ..... Plant Needs and Growing Conditions
W2 - Lesson 4 ..... Role of Plants and Controlling Plant Growth
W2 - Lesson 5 ..... Review of Plant Management
W2 - Quiz
W3 - Lesson 1 ..... Forces on and within Structures
W3 - Lesson 2 ..... Structural Forms
W3 - Lesson 3A ..... Materials Used in Structures
W3 - Lesson 3B ..... Rocks, Weathering, and Erosion - The Rock Cycle
W3 - Lesson 4 ..... Plate Tectonics and Related Events
W3 - Lesson 5 ..... Fossils
W3 - Quiz.....

Materials Required.

Textbook:
Science in Action 7

Science Grade 7
Version 5
Preview/Review W3 - Lesson 1 TEACHER KEY

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Preview/Review Concepts
for
Grade Seven Science

TEACHER KEY

W3 - Lesson 1:
Forces on and within Structures

OBJECTIVES

By the end of this lesson, you should be able to

- explain force and the units measuring it
- define and identify static and dynamic loads
- define and identify examples of compression, tension, and shear
- discuss the effects of loads on structures

GLOSSARY

complementary forces - forces that act on a structure at the same time

compression - a squeezing force

dynamic load - a load that changes over time

force - a push or pull

shear - side by side parts are pushed in opposite directions

static load - a load that stays the same over time

tension - a pulling force

Introductory Information for Teachers

Preview/Review courses are aimed mainly at students who have complete the regular course but who need to review before beginning the next grade. Other students may find Preview/Review courses useful in preparing for the new materials they will study in their next grade. No Preview/Review course is intended to replace the regular course because all cover only some important concepts from the Program of Studies for each grade.

Preview/Review materials are intended for use by teachers in one-subject and one-grade classrooms.

This Preview/Review course contains fifteen lessons in three sections. Each section has five lessons with homework. A short quiz is provided at the end of each section to test students' knowledge of the material studied. In a classroom, the course will likely be completed in three weeks.

Students may attend one, two, or all three sections. Because Science has five units per grade and does not divide into three sections, Sections 1 and 2 cover two units each and Section 3 covers the final unit.

In Science, textbooks are central to Preview/Review. That is, the textbook must be read and used to complete the activities proficiently.

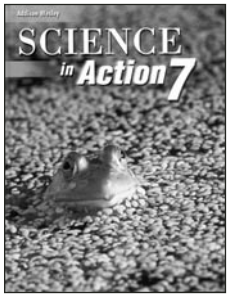
Textbooks required:

- Grade 7: *Science in Action 7*
- Grade 8: *Science in Action 8*
- Grade 9: *Science in Action 9*

W3 - Lesson 1: Forces on and within Structures

Every structure experiences forces. Some forces are external to the structure; some are internal. Regardless of type, each force has an effect on the structure.

Force



A **force** is simply a push or a pull applied to something. The unit of force is the Newton (N). One Newton is the force required to support 100 g on Earth. The material an object is made of and the way it is put together have an important influence on how forces affect it. Also, the size and direction of the force, and where on the object it is applied, affect the object. For more information, read pages 280 to 283 and 286 to 287 of *Science in Action 7*.

1. What does it mean if something has symmetry of mass?

   Mass is equally divided around/on either side of the centre of gravity. The force of gravity will also be equally spaced.

2. At an object's centre of gravity, force can be

   balanced

3. What can you do to a structure's center of gravity to make the structure more stable?

   lower the centre of gravity

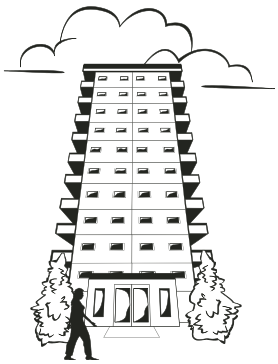
4. What is a centre of gravity?

The imaginary point in an object where the force of gravity acts downward.

5. Why are symmetrical structures stable?

the mass is uniformly positioned on it so the gravity acting on it is also uniform

6. If you were trying to move a large box from one side of a room to the other, how much force would be needed, in what direction would you apply it, and where on the box should it be applied?



a large enough force to overcome friction and gravity acting on it, in direction object is to move, low down on the box (A push would be on the side opposite to the direction I wanted the box to go. A pull would be on the side nearest to the direction I wanted the box to go.)

External Forces

External forces are called the **load** of the structure. A box on a trailer is a load on the trailer. There are two types of loads – static and dynamic. **Dynamic loads** change in size, location, or direction. For example, wind is a dynamic load. **Static loads** are constant. The roof on a building is a static load. How the roof is made influences the amount of gravity that will act on the entire building for the life of the building. Read pages 288 and 289 of *Science in Action 7*.

7. Identify the following as either static or dynamic loads.

   a. Water on a wreck at the bottom of the ocean.

   static

   b. Dishes on a storage shelf

   Answers can vary depending on how long they are left on the shelf. Are they put on and/or taken off occasionally (dynamic) or left longterm (static)?

   c. People walking across a foot bridge

   dynamic

It is important to know how well a structure can support a load. In other words, we want to know its **load performance**. Sometimes, what a structure will support and what it should support are different. Read page 294 in your textbook.

8. When we ask an architect to design a foot-bridge that must be able to support 50 adults at one time in windy conditions, what are we telling the architect about the bridge?

   its structural performance requirements

9. Why should we be just as concerned about a structure's performance requirements as its load performance?

   Without its structural performance requirements, the structure can't be properly designed to carry out its intended function.

10. How could you compare the performance of two different structures of the same type?

Divide the mass of each structure by the mass of its performance requirement.

Internal Forces

Forces from inside the structure are called internal forces. In other words, a force from one part of the structure acts on another part of it. In this section, you will learn about three different internal forces – **compression**, **tension**, and **shear**. Read pages 296 to 298 of the textbook.

- Compression is a squeezing force.
- Tension is a pulling force.
- Shear is a force that pushes side-by-side parts in opposite directions.

Sometimes more than one force acts on a structure. In this case, they are called **complementary forces**.

11. Tell whether each of the following is an example of compression, tension, or shear.

    a. The force exerted on the ropes when a person sits on a swing.

    tension

    b. Paper being cut.

    shear

    c. The force exerted on a chair cushion when someone sits on the chair.

    compression

12. Give an example of a structure with complementary forces acting on it.

Answers will vary. An example is a beam with a load on it. The top experiences compression; the bottom tension.

Effects of Loads on Structures

Sometimes the load on a structure can be too great for its design or materials. That can lead to structural stress. Over time, the result could be structural fatigue, and possibly even structural failure. Read page 303 of the textbook.

13. Give an example of structural failure that you have heard of.

Answers will vary.

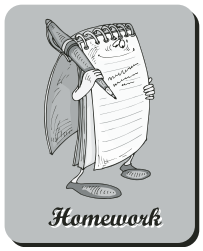
14. Name four types of structural failure.

buckling, shearing, separating of components, deformation.

15. Name and define the two things that a structure needs in order to avoid structural failure.

a. ***strength - the load at which a structure fails***

b. ***stiffness - the ability to withstand shape-change in response to a load***



Homework

16. Look for and record details of three structures with structural stress and failure.

Answers will vary. An example is a building with a collapsing roof.