



YSISTE

ASSESSMENT OF SCIENCE AND TECHNOLOGY ACHIEVEMENT PROJECT (ASAP)

Science and Technology Exemplars

Grade 3: Structures and Mechanisms - Stability

Exemplar Task (3SMPT03/Oct 2000)

Tallest Tower



© York University, Oct 2000

Preface

This task is one of a series developed by the Assessment of Science and Technology Achievement Project (ASAP) which is being used for the ASAP Science and Technology Exemplars Project.

This task is organised in three parts:

- A. Task Overview
- B. Student task sheet – designed to be photocopied for the students
- C. Teacher Information – providing essential information relating specifically to this task

For further information, contact the ASAP office at 416-736-5269 or email: asap@edu.yorku.ca

Task Overview

Description of the Task:



This is a culminating activity designed to assess a cluster of expectations for this grade and strand. Students should have been taught the concepts and skills required to perform this task prior to attempting it.

Students will design and construct the tallest free-standing tower they can from the set of materials they select. They cannot use any materials other than those given



Materials and Equipment Required:

Each group has the choice of **one** of the set of materials below.

- a) 50 toothpicks and half a bar of plasticene
- b) 30 plastic straws and 3m masking tape
- c) 50 popsicle sticks and 3m masking tape
- d) 30 (mini) marshmallows and 30 toothpicks
- e) metre stick/tape measure



Suggested Timeline:

Planning	2 x 30 minutes
Building	full day
Reporting	2 x 30 minutes
Presenting	60 – 120 minutes



Suggested Grouping:

Pair/share



SAFETY ASPECTS IN THE DESIGN PROCESS

It is important that all students follow established safety practices when designing, constructing, and experimenting with structures and mechanisms.

These practices include:

- Using tools safely to cut, join, and shape objects
- Handling molding clay correctly, and washing one's hands after using it
- Following proper procedures when comparing mechanical systems and their operation
- Using care when observing and working with objects in motion (e.g., objects that are spinning, swinging, bouncing, vibrating)
- Using care with gears and pulleys and with elevated objects

The following are minimum safety standards, that all students should know:

- Use all tools **below waist** level. (Ideally, tools should be used while standing instead of sitting)
- Ensure your tools are in **good repair** before you begin. Broken tools must be fixed or discarded
- Store tools in a **safe place**
- Always **walk** when carrying tools
- Wear **safety goggles** for protection
- Ensure **workspaces** are set up in low-traffic areas
- Use the **appropriate tool** for the task
- When **exploring materials**, ensure that students are not exposed to hot, sharp, or easily breakable tools or objects
- Special care should be taken when using materials made of **plastic** (e.g., cellophane bags that could obstruct breathing)

Pulleys and Gears

- Use caution when lifting **heavy objects**
- Be careful not to get **fingers, clothes, and hair** caught when using any mechanical device, such as pulleys or gears
- Make sure that pulley systems are securely attached to a **firm structure** and are tested to be secure before using
- Use materials only for their **intended purpose** (e.g., spring scales are only to be used to measure force)
- Be careful not to get **fingers, clothes, and hair** caught when using any mechanical device or system
- Exercise extreme caution when using the test bicycle – turn the pedal slowly, and be careful not to get anything caught in the spokes, gears, or chain. Use only pedal to spin the wheel; do not use hands or feet.

ASSESSMENT OF SCIENCE AND TECHNOLOGY ACHIEVEMENT PROJECT (ASAP)

Science and Technology Exemplars Project

Grade 3: Structure and Mechanism - Stability

Exemplar Task (3SMPT03/Oct 2000)



Tallest Tower

Student Task Sheets

Tallest Tower

Build the tallest tower you can with the materials you have chosen. The tower should be able to stand up by itself.

You will have to show your tower to the class and tell how you made it tall, stable and strong.

1. Draw a picture of the tower you built.

2. Build your tower

3. Explain how you made your tower tall

4. Explain how you made your tower stable

5. Explain how you made your tower strong

6. What was a problem that you had in the construction of your tower?

7. How did you solve this problem?

8. Measure the height of your tower in m, cm, and mm.

9. Explain how you could have made your tower taller, stronger or more stable

10. If you had to build a tower with paper, how could you make the paper stronger?

11. Draw the best shapes to use when you build a tower.

12. Explain why some shapes are better than others are.

ASSESSMENT OF SCIENCE AND TECHNOLOGY ACHIEVEMENT PROJECT (ASAP)

Science and Technology Exemplars Project

Grade 3: Structures and Mechanisms - Stability

Exemplar Task (3SMPT01/Oct 2000)



Tallest Tower

Teacher Information Sheets

This task addresses the following cluster of expectations. Expectations assessed by the rubric are highlighted in bold.



Understanding Basic Concepts

- **describe using their observations, ways in which the strength of different materials can be altered (e.g., folding increases the strength of paper)**
- **describe ways in which forces alter the shape or strength of different structures e.g., a load may cause a cardboard box to buckle)**
- **describe ways to improve the strength and stability of frame structure (e.g., use of triangulation or a cross-member)**
- describe, using their observations, the role of struts (e.g., to resist compression) and ties (e.g., to resist tension) in structures under load (e.g., describe the effect of adding a strut to a wooden frame)



Developing Skills of Inquiry, Design and Communication

- ask questions about and identify needs and problems related to structures and mechanism in their immediate environment, and explore possible answers and solutions (e.g., investigate the effects of folding on the shape and strength of materials)
- plan investigation to answer some of these questions or solve some of these problems, and explain the steps involved
- use appropriate vocabulary to describe their investigations, explorations and observations (e.g., use terms such as *fulcrum*, *load*, and *effort* when describing levers)
- **design and make a stable structure that will support a given mass and perform a specific function (e.g., a bridge, a photo frame)**
- **use appropriate materials to strengthen and stabilize structures that they have designed and made and that are intended to support a load (e.g., use gussets, struts, ties, buttresses)**
- use hand tools (e.g., hand saws, scissors) and equipment (e.g., templates, mitre boxes) appropriately to cut a variety of materials (e.g., wood, paper, cardboard, plastic)



Relating Science and Technology to the World Outside the School

- recognize that geometrical pattern in a structure contribute to the strength and stability of the structure (e.g., a climbing frame)
- demonstrate awareness that the strength in structures is due to bulk (or mass), number of layers (e.g., layers in particle board), and shape (e.g., triangulation)



Prior Knowledge Required:

Before attempting this task students should have been taught the following:

- how the strength of material can be altered e.g., folding
- how a load can affect the shape and strength of structures
- a variety of ways that the strength and stability of a frame structure can be improved e.g., triangulation or cross-member
- that struts and ties can be used to improve the strength of structures
- that geometric patterns contribute to the strength and stability of structures
- how bulk and layers improve the strength of structures



Students should be familiar with the following science and technology terminology:

tall, strong, stable, struts, ties, bulk, layers, triangulation



Prior Skills Required:

Before attempting this task students should have experience of the following:

- use of tools
- co-operation in small groups
- planning
- drawing their designs



Suggested Introductory Activities:

The following activities are suggested to introduce this task to the students:

- review the background knowledge for the task
- read the scenario to the students, clarify and answer questions
- brainstorm ways of making the towers as a whole class on chart paper



Cross-strand Links:

Link can be made to *The Ontario Curriculum Grades 1-8 Math Grade 3 – Measurement, Units of Measure*. This activity also provides an opportunity for students to be assessed and evaluated on their ability to work cooperatively as part of a team. Students should be made aware that this will be an integral part of the evaluation and should have prior experience of working with a group before being assessed. This provides a cross-curricular link with *The Ontario Curriculum Grades 1-8 Language, Grade 3: Oral and Visual Communication – Group Skills*.



Cross-curricular Links:

Every strand in the Science and Technology document has common set of expectations clustered under the title ***Developing Skills of Inquiry, Design and Communication***. This task is therefore appropriate to assess and evaluate these skills for every Grade 3 strand.



Reading and Writing Skills:

This task has been constructed to take into account the possible limited reading and writing skills of some students at this grade level. At the end of Grade Three students are expected to be able to write a sentence (see MET Writing Exemplars 1999). Depending on the achievement level of the children in the class and the time in the school year that this task is administered, teachers will need to take into account the diverse abilities in their classes. The task can be presented orally and evaluated through teacher/student conference. Teachers could use the questions on the student task sheet to guide their conference. Students could make an oral presentation about their investigation to the class in their groups. Their presentation could be based upon the questions outlined in the student task sheet. Grade 5/6 students could act as reading/writing buddies to read out questions and transcribe answers. A peer buddy system could be utilised.



Considerations for Combined Grade Classes:

Appropriate strategies are as follows:

- Teach one grade while the other grade completes the task which does not require active teacher guidance
- Create separate learning centers for student investigation specific to each grade topic and strand. The methods of science and technology (inquiry and communication) would provide the whole class focus
- Make thematic connections by clustering the overall expectations around a unifying organizer such as “Form and Function:



TALLEST TOWER

TEACHER OBSERVATION RATING SCALE

Student Name: _____

Please number student work to correspond with the rating scale

Criterion	Score			
	1	2	3	4
Works collaboratively with other students in the completion of task				
The completed picture effectively demonstrates the design features of the tower device				
Explains clearly how the structure is made to be stable				
Explains clearly how the structure is made to be strong				
Describe problems in the design and construction of the tower and possible solutions				

Student Name: _____

Date: _____

Tallest Tower
for use with Subtask 1: Tallest Tower
 from the Grade 3 Unit:

Expectations for this Subtask to Assess with this Rubric:

- 3s71 - describe, using their observations, ways in which the strength of different materials can be altered (e.g., folding increases the strength of paper);
- 3s72 - describe ways in which forces alter the shape or strength of different structures (e.g., a load may cause a cardboard box to buckle);
- 3s73 - describe ways to improve the strength and stability of a frame structure (e.g., use of triangulation or a cross-member);
- 3s83 design and make a stable structure that will support a given mass and perform a specific function (e.g., a bridge, a photo frame);
- 3s84 use appropriate materials to strengthen and stabilize structures that they have designed and made and that are intended to support a load (e.g., use gussets, struts, ties, buttresses);

Category/Criteria	Level 1	Level 2	Level 3	Level 4
Understanding of Basic Concepts	<ul style="list-style-type: none"> • shows limited understanding of how the shape of the materials used in building the tower affect the strength and stability of the structure 	<ul style="list-style-type: none"> • shows some understanding of how the shape of the materials used in building the tower affect the strength and stability of the structure • gives partial explanations 	<ul style="list-style-type: none"> • shows thorough understanding of how the shape of the materials used in building the tower affect the strength and stability of the structure • demonstrates no significant misconceptions • usually gives complete or nearly complete explanations 	<ul style="list-style-type: none"> • shows understanding of all of the basic concepts • demonstrates no misconceptions • always gives complete explanations
Inquiry and design skills	<ul style="list-style-type: none"> • applies limited use of the required skills and strategies in the design and construction of the structure • demonstrates limited use of shapes in the design and construction of the structure 	<ul style="list-style-type: none"> • applies some of the required skills and strategies in the design and construction of the tower • demonstrates some use of shapes in the design and construction of the structure 	<ul style="list-style-type: none"> • applies most of the required skills and strategies in the design and construction of the tower • demonstrates frequent use of shapes in the design and construction of the structure 	<ul style="list-style-type: none"> • applies all (or almost all) of the required skills and strategies in the design and construction of the tower • demonstrates extensive use of a variety of shapes in the design and construction of the structure

