

Understanding Structures and Mechanisms

Simple Machine: Pulleys

Specific Expectations:

Grade 2 – Movement: **1.1** assess the impact on society and the environment of simple machines that allow movement; **2.2** investigate and describe different kinds of movement; **2.3** investigate the structure and function of simple machines; **2.4** use technological problem-solving skills (see page 16), and knowledge and skills acquired from previous investigations, to design, build, and test a mechanism that includes one or more simple machines; **3.1** describe different ways in which objects move (*e.g., turning, spinning, swinging, bouncing, vibrating, rolling*); **3.2** identify ways in which the position of an object can be changed (*e.g., by pushing, by pulling, by dropping*); **3.3** identify the six basic types of simple machines – lever; inclined plane; pulley; wheel and axle, including gear; screw; and wedge – and give examples of ways in which each is used in daily life to make tasks easier; **3.4** describe how each type of simple machine allows humans to move objects with less force than otherwise would be needed; **3.5** identify simple machines used in devices that move people

Grade 3 – Strong and Stable Structures: **2.3** investigate, through experimentation, the effects of pushing, pulling, and other forces on the shape and stability of simple structures; **3.1** define a structure as a supporting framework, with a definite size, shape, and purpose, that holds a load

Potential Specific Expectations with minor extensions to the lesson:

Grade 4 – Pulley and Gear Systems: **1.1** assess the impact of pulley systems and gear systems on daily life; **2.3** use technological problem-solving skills (see page 16) to design, build, and test a pulley or gear system that performs a specific task; **2.4** use appropriate science and technology vocabulary, including *pulley, gear, force, and speed*, in oral and written communication; **3.2** describe how rotary motion in one system or its components (*e.g., a system of pulleys of different sizes*) is transferred to another system or component (*e.g., a system of various gears*) in the same structure; **3.3** describe how one type of motion can be transformed into another type of motion using pulleys or gears

Grade 5 – Forces Acting on Structures and Mechanisms: **2.2** measure and compare, quantitatively and/or qualitatively, the force required to move a load (*e.g., to lift a book, to open a drawer*) using different mechanical systems (*e.g., different pulley systems, a lever, a gear system*), and describe the relationship between the force required and the distance over which the force moves; **2.5** use appropriate science and technology vocabulary, including *tension, compression, torque, system, and load*, in oral and written communication; **3.3** explain the advantages and disadvantages of different types of mechanical systems

Grade 8 – Systems in Action: **2.2** investigate the work done in a variety of everyday activities and record the findings quantitatively; **2.3** use scientific inquiry/experimentation skills (see page 12) to investigate mechanical advantage in a variety of mechanisms and simple machines; **2.6** use appropriate science and technology vocabulary, including *mechanical advantage, input, output, friction, gravity, forces, and efficiency*, in oral and written communication; **3.2** Identify the purpose, inputs, and outputs of various systems; **3.3** Identify the various processes and components of a system that allow it to perform its function efficiently and safely; **3.5** understand and use the formula work = force × distance ($W = F \times d$) to establish the relationship between work, force, and distance moved parallel to the force in simple systems; **3.6** calculate the mechanical advantage (MA = force needed without a simple machine divided by force needed with a simple machine) of various mechanical systems

Big Ideas (for lesson):

Students will understand why people create and use simple machines to make tasks easier to perform (*mechanical advantage*)

Students will learn how pulleys function and how they are used to lift heavy objects

Students will see how pulleys are used effectively in everyday life

Other: _____

<p>Accommodations:</p> <ul style="list-style-type: none"> <input checked="" type="checkbox"/> Increase time <input checked="" type="checkbox"/> Visual Aids <input checked="" type="checkbox"/> Manipulatives <input checked="" type="checkbox"/> Chunking <input checked="" type="checkbox"/> Step-by-Step <input checked="" type="checkbox"/> Scaffolding <input checked="" type="checkbox"/> Copy of Notes <input checked="" type="checkbox"/> Student Grouping 	<p>Differentiated Instruction:</p> <ul style="list-style-type: none"> <input checked="" type="checkbox"/> Content: Use demonstrations throughout verbal instruction to help visual learners. <input checked="" type="checkbox"/> Process: Students will work in pairs or groups to support each other if limitations or impediments exist. <input checked="" type="checkbox"/> Product: Students may demonstrate their learning verbally, visually, or by written means. <input type="checkbox"/> Other: _____
<p>Bloom's Taxonomy:</p> <ul style="list-style-type: none"> <input checked="" type="checkbox"/> Knowledge <input checked="" type="checkbox"/> Comprehension <input checked="" type="checkbox"/> Application <input checked="" type="checkbox"/> Analysis <input checked="" type="checkbox"/> Synthesis <input checked="" type="checkbox"/> Evaluation 	<p>Multiple Intelligence:</p> <ul style="list-style-type: none"> <input checked="" type="checkbox"/> Verbal/Linguistic <input checked="" type="checkbox"/> Logical/Mathematical <input checked="" type="checkbox"/> Visual/Spatial <input checked="" type="checkbox"/> Bodily/Kinesthetic <input type="checkbox"/> Naturalist <input type="checkbox"/> Musical/Rhythmic <input checked="" type="checkbox"/> Interpersonal <input checked="" type="checkbox"/> Intrapersonal

Teachers Notes:

- This lesson is accompanied by a supplementary PowerPoint, "*Pulleys (powerpoint)*", and a worksheet, "*Pulleys (worksheet)*"
- The use of simple machine kits can be found throughout the lesson – it is recommended that these manipulatives be used to increase the experience and understanding of the students
 - your school might have access to a set of pulleys you can use for this lesson
 - if this is not available, you can purchase simple machines sets here:
 - http://www.pitsco.com/Grades_3-5/Kits/Simple_Machines_Set
 - <http://www.learningresources.com/product/simple+machines+set.do>
 - if this is still not an option, you can build your own simple machines
 - see below for examples:
 - http://www.ehow.com/info_7969543_homemade-simple-machines-kids.html
- Extensions to the lesson should be done if it is to be used at the grade 4, 5, or 8 levels
 - The material covered by these lessons is strongly emphasized at the Grade 2 level – the more complex concepts that arise at later grade levels can be situated within the lesson
 - **i.e.** calculating force and mechanical advantage can be added into the lesson
- Resources for teaching and learning about simple machines can be found here:
 - Queen's Faculty of Education, Pulleys and Gears, https://www.youtube.com/watch?v=YcqY_jEcHg&list=PLb6AhYEN0qssuPV9wtgrSjEQ_KYEuSa6G&index=2
 - Brainpop, <http://educators.brainpop.com/bp-jr-topic/simple-machines/>
 - Bill Nye The Science Guy: Simple Machines https://www.youtube.com/watch?v=rRjCQGa_HCE
- The font used for the handout is called [Dyslexie](#). It is designed to help dyslexics read, but it is a very easy to comprehend font which will aid all readers.

Delivering the Lesson

Portion & Timing	Grouping:			Introduction:	Materials
Minds On: 5 minutes	W <input checked="" type="checkbox"/>	S <input type="checkbox"/>	I <input type="checkbox"/>	Teacher introduces pulleys to students - (ppt slides 1-3) Perform demonstration for class by lifting various weights; Gizmos simulation can be used as well - Discuss the Mocomi video	- Pulley set to provide example to students - projector technology
Action: 30 minutes	W <input checked="" type="checkbox"/>	S <input checked="" type="checkbox"/>	I <input checked="" type="checkbox"/>	Proceed through " <i>Pulleys (powerpoint)</i> " - " <i>Pulleys (worksheet)</i> " can be followed along and filled in by students - Answer questions about the simple machine as the lesson proceeds - Students should highlight/underline important vocabulary words Activity: - Separate students into groups or pairs - Allow students to build and operate different pulley systems - Have them record their observations by drawing and labelling diagrams of all the different pulleys they can create (fixed and movable) - See which group can create the most efficient and effective pulley system (can lift the most weight easily)	- Pulley sets to allow students to explore the use and function of pulley systems
Consolidate: 5 minutes	W <input checked="" type="checkbox"/>	S <input checked="" type="checkbox"/>	I <input type="checkbox"/>	Conclude lesson by taking up worksheet – ensure each student has filled in all the appropriate information - Answer any remaining questions on pulleys	

References:

Mocomi; <http://mocomi.com/>

Teach Engineering;

https://www.teachengineering.org/view_lesson.php?url=collection/cub_/lessons/cub_simple/cub_simple_lesson01.xml

ExploreLearning Gizmos;

<https://www.explorelarning.com/index.cfm?method=cResource.dspResourcesForCourse&CourseID=361>

Wikipedia; https://en.wikipedia.org/?title=Simple_machine

All images from Google image search, Educational websites, and stock photos

All videos found on YouTube for educational purposes