

Understanding Structures and Mechanisms

Simple Machine: Wheel and axles

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 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 ($MA = \text{force needed without a simple machine} \div \text{force needed with a simple machine}$) 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 wheel and axles function are how they are used to move heavy objects

Students will see how wheel and axles are used effectively in everyday life

Accommodations:

- Increase time
- Visual Aids
- Manipulatives
- Chunking
- Step-by-Step
- Scaffolding
- Copy of Notes
- Student Grouping

Differentiated Instruction:

- Content: Use demonstrations throughout verbal instruction to help visual learners.
- Process: Students will work in pairs or groups to support each other if limitations or impediments exist.
- Product: Students may demonstrate their learning verbally, visually, or by written means.
- Other: _____

Multiple Intelligence:

Bloom's Taxonomy:	
<input checked="" type="checkbox"/> Knowledge	<input checked="" type="checkbox"/> Verbal/Linguistic
<input checked="" type="checkbox"/> Comprehension	<input checked="" type="checkbox"/> Logical/Mathematical
<input checked="" type="checkbox"/> Application	<input checked="" type="checkbox"/> Visual/Spatial
<input checked="" type="checkbox"/> Analysis	<input checked="" type="checkbox"/> Bodily/Kinesthetic
<input checked="" type="checkbox"/> Synthesis	<input type="checkbox"/> Naturalist
<input checked="" type="checkbox"/> Evaluation	<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, "*Wheel and Axles (powerpoint)*", and a worksheet, "*Wheel and Axles (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 wheel and axles 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 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:
 - 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 wheel and axles to students - (ppt slides 1-3) Perform demonstration for class by moving various weights; Gizmos simulation can be used as well - Discuss the Mocomi video	- Wheel and axle 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>Wheel and axles (powerpoint)</i> " - " <i>Wheel and axles (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 wheel and axle systems (different sizes) - Have them record their observations by drawing and labelling diagrams of all the different wheel and axles they can create - See which group can create the most efficient and effective wheel and axles (can move the most weight easily)	- Wheel and axle sets to allow students to explore the use and function of wheel and axles
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 wheel and axles	

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.explorelearning.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