

a WOW Lab

**BLUEPRINT**

Pulleys and Mechanical Advantage

## Quebec - Achievements and Competencies

### Learning Outcomes

Cycle 2 (Gr. 3-4)	Cycle 3 (Gr. 5-6)
Characteristics of motion	Gravitational attraction
Effects of a force	Characteristics of motion
Simple machines	Effects of a force
Use of simple machines	Simple machines
	Use of simple machines

The Quebec Achievements and Competencies are based on the Progression of Learning Outcomes derived from the Quebec Education Plan set by the Ministère de l'Éducation, du Loisir et du Sport.

### Specific Expectations

#### **CYCLE 2 (Gr. 3-4)**

#### MATERIAL WORLD

#### C. Forces and motion

##### 5. Characteristics of motion

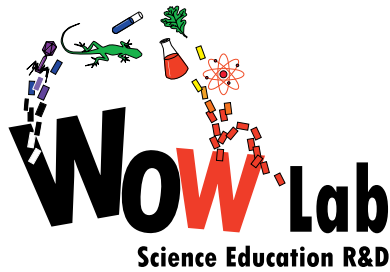
- a. Describes the characteristics of motion (e.g. direction, speed)

In this activity, students should describe the characteristics of motion as they lift their teacher and classmate using the pulley system. They may explain that the characteristics of motion changes when the compound pulley system is used, since it makes it easier to lift an individual (e.g. the speed of motion may change).

##### 6. Effects of a force on the direction of an object

- a. Identifies situations involving the force of friction (pushing on an object, sliding an object, rolling an object)
- b. Identifies examples of a force (e.g. pulling, pushing, throwing, squeezing, stretching)
- c. Describes the effects of a force on an object (e.g. Sets it in motion, changes its motion, stops it)
- d. Describes the effects of a force on a material or structure

Students should be able to define what a force is and identify different types of forces. In this activity, a rope is being pulled down through a pulley to lift someone up. Students should recognize that the direction of the input forces (pulling down) causes the object to move in the opposite direction (the person is lifted up). Students should identify the other forces acting on the pulley systems, such as forces of friction and gravity. Students will learn that the compound pulley system has a higher mechanical advantage than the simple pulley system, making lifting easier.



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## Pulleys and Mechanical Advantage - Quebec - Achievements and Competencies

### D. Systems and interactions

#### 2. Simple machines

- a. Recognizes simple machines (lever, inclined plane, screw, pulley, winch, wheel) used in an object (e.g. lever in seesaw, inclined plane for an access ramp)
- b. Describes the uses of certain simple machines (to adjust the force required)

In this activity, students should identify that the simple machine designed to lift their teacher and one another is made up of pulleys. They can identify the components of a pulley, describing that it has a grooved wheel that fits either a belt or rope inside of the groove. Students should describe the differences between the two pulley systems presented, expressing if they believe that the force required to use them would be different.

### E. Techniques and instrumentation

#### 2. Use of simple machines

- a. Appropriately uses simple machines (lever, inclined plane, screw, pulley, winch, wheel)

As students lift one another using the pulley systems, they should demonstrate how to use the system in a safe and appropriate manner.

### F. Appropriate Language

1. Appropriately uses terminology related to an understanding of the material world

Students are required to use the appropriate terminology throughout the activity (e.g. pulley, simple pulley system, compound pulley system, fixed pulley, moveable pulley, input, output, force, friction, gravity).

## **CYCLE 3 (Gr. 5-6)**

### MATERIAL WORLD

#### C. Forces and motion

##### 3. Gravitational attraction on an object

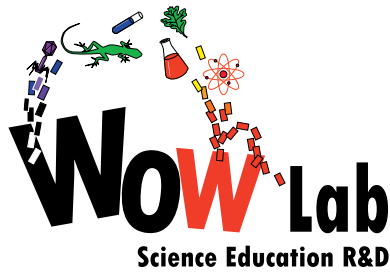
- a. Describes the effect of gravitational attraction on an object (e.g. free fall)

Students should identify gravity as one of the forces that is acting on the pulley systems. They should describe how the object being lifted is affected by the force of gravity. Once the individual is lifted upwards, if no one is holding on to the rope, the person will fall back to the ground due to gravity.

##### 5. Characteristics of motion

- a. Describes the characteristics of motion (e.g. direction, speed)

In this activity, students should describe the characteristics of motion as they lift their teacher and classmate using the pulley system. They may explain that the characteristics of motion changes when the compound pulley system is used, since it makes it easier to lift an individual (e.g. the speed of motion may change).



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## Pulleys and Mechanical Advantage - Quebec - Achievements and Competencies

6. Effects of a force on the direction of an object
  - a. Identifies situations involving the force of friction (pushing on an object, sliding an object, rolling an object)
  - b. Identifies examples of a force (e.g. pulling, pushing, throwing, squeezing, stretching)
  - c. Describes the effects of a force on an object (e.g. Sets it in motion, changes its motion, stops it)
  - d. Describes the effects of a force on a material or structure

Students should be able to define what a force is and identify different types of forces. In this activity, a rope is being pulled down through a pulley to lift someone up. Students should recognize that the direction of the input forces (pulling down) causes the object to move in the opposite direction (the person is lifted up). Students should identify the other forces acting on the pulley systems, such as forces of friction and gravity. Students will learn that the compound pulley system has a higher mechanical advantage than the simple pulley system, making lifting easier.

### D. Systems and interactions

#### 2. Simple machines

- a. Recognizes simple machines (lever, inclined plane, screw, pulley, winch, wheel) used in an object (e.g. lever in seesaw, inclined plane for an access ramp)
- b. Describes the uses of certain simple machines (to adjust the force required)

In this activity, students should identify that the simple machine designed to lift their teacher and one another is made up of pulleys. They can identify the components of a pulley, describing that it has a grooved wheel that fits either a belt or rope inside of the groove. Students should describe the differences between the two pulley systems presented, expressing if they believe that the force required to use them would be different.

### E. Techniques and instrumentation

#### 2. Use of simple machines

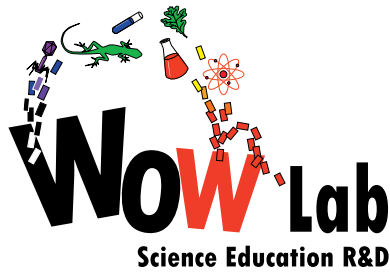
- a. Appropriately uses simple machines (lever, inclined plane, screw, pulley, winch, wheel)

As students lift one another using the pulley systems, they should demonstrate how to use the system in a safe and appropriate manner.

### F. Appropriate Language

1. Appropriately uses terminology related to an understanding of the material world

Students are required to use the appropriate terminology throughout the activity (e.g. pulley, simple pulley system, compound pulley system, fixed pulley, moveable pulley, input, output, force, friction, gravity, ratio, mechanical advantage).



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### Strategies

#### EXPLORATION STRATEGIES

- Drawing a diagram for the problem or illustrating it
- Formulating questions
- Putting forward hypotheses (e.g. individually, as a team, as a class)
- Anticipating the results of his or her approach
- Imagining solutions to a problem in light of his or her explanations
- Taking into account the constraints involved in solving a problem or making an object (e.g. specifications, available resources, time allotted)
- Using different types of reasoning (e.g. induction, deduction, inference, comparison, classification)
- Using empirical approaches (e.g. trial and error, analysis, exploration using one's senses)

#### STRATEGIES FOR RECORDING, USING AND INTERPRETING INFORMATION

- Using a variety of observational techniques and tools
- Using technical design to illustrate a solution (e.g. diagrams, sketches, technical drawings)
- Using different tools for recording information (e.g. diagrams, graphs, procedures, notebooks, logbook)

#### COMMUNICATION STRATEGIES

- Using tools to display information in tables and graphs or to draw a diagram
- Exchanging information
- Comparing different possible explanations for or solutions to a problem in order to assess them (e.g. full-group discussion)