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# Science in Action at Our Port

**Students make connections between the concept of simple machines and their application in port activities. As students work to create a Dictionary of Simple Machines, they learn about the simple and complex machines that are used every day at the Port of Prince Rupert.<sup>1</sup>**

## CLASSROOM TIME REQUIRED

40 – 50 minutes and a project

## LEARNING OBJECTIVES AND OUTCOMES

Students will:

- Describe applications of simple and compound machines
- Develop definitions of the six types of simple machines with reference to examples of machines used in transportation activities at the Port of Prince Rupert

## MATERIALS REQUIRED

- *Concept Development Organizer* (see *Attachments* below)
- Videos of Ridley Terminal, Fairview Container Terminal and Prince Rupert Grain Terminal (on Learning Gateway)
- Images of machines at the Port Of Prince Rupert (see *Resources*)
- Videos of various complex machines in action (see *Lesson Plan Resources* below)
- *Team Work Self-evaluation* (see *Attachments* below)

## TECHNOLOGY RESOURCES REQUIRED

- Access to a computer lab (or alternatively a set of photocopied images for each group of 6 in the class)
- Computer and projector or Smart Board

## TEACHER PREPARATION

- Students will have prior knowledge of simple and compound machines and be able to demonstrate the mechanical advantage of simple machines, including: inclined plane, lever, pulley, screw, wedge, and wheel and axle.

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<sup>1</sup> The development of this lesson was informed by *Making Sense of Social Studies Concepts*, by Amy von Heyking, PhD.

- Draw a Concept Development Organizer on the board.
- Ensure the class has access to a computer lab. If a computer lab is not available, print out a set of photocopied images for each group of 6 in the class and use the computer and projector to show the videos to the class.

### CRITICAL VOCABULARY (see Glossary for definitions)

C-loader	Lever	Wedge
Capstan	Pulley	Wheel and axle
Hump yard	Screw	Windlass
Inclined plane	Stacker-reclaimer	

### LESSON DEVELOPMENT

#### Activity 1

- Before watching the videos of the Fairview Container Terminal, Prince Rupert Grain Terminal and/or Ridley Terminal, review the concepts of simple and compound machines and the six types of simple machines with the students. Tell students to watch for the six types of simple machines in the videos.
- With the students, develop a definition of simple machines by filling in a *Concept Development Organizer*:
  - Write *Simple machines* in the centre of the organizer.
  - Ask students for examples of simple machines and write their examples in the appropriate box on the organizer.
  - Ask students for the essential characteristics of simple machines or to say what makes them simple machines. (Some suggestions may be the concepts of work, force and distance.) Write their suggestions in the appropriate box on the organizer.
  - Ask students for some non-examples of simple machines (for example, types of compound machines). Ask students to explain why these are not simple machines and write their comments in the appropriate box on the organizer.
  - Provide students with challenging examples of simple machines, for example: a canoe paddle (lever); stairs (inclined plane); and screwdriver (lever). Review the essential and nonessential characteristics of simple machines and change the information on the organizer. Ensure students understand the concepts of work, force and distance.
- Create a definition of simple machines with the class. One example would be: *A simple machine makes work easier to do by providing some trade-off between the force applied and the distance over which the force is applied.* Another example would be: *Simple machines make work easier for us by allowing us to push or pull over increased distances.*

#### Activity 2

- Tell students that they will be studying pictures and videos of machines used at the Port of Prince Rupert to develop definitions for the six types of simple machines (i.e. inclined plane, lever, pulley, screw, wedge, and wheel and axle).
- Divide students into groups of 6. This is the *home* group.
- Assign each student in the home group the task of developing the concept of one of the simple

machines.

- Distribute the Concept Development Organizer. Direct students to use the lesson plan images, videos about machines at the Port of Prince Rupert and other websites on the Learning Gateway website to fill in their organizer for their simple machine.
- Before forming *expert* groups – one group for each simple machine – remind students about how to use their conversational skills when working in cooperative groups:
  - Listen carefully to what other speakers say
  - When contributing to the discussion, build on what others have said by using phrases such as:
    - *What I think is similar to what ... said*
    - *I disagree with what ... said, because*
  - Use *I* statements such as, *I think* or *It seems*
- In *expert* groups, have students discuss and develop the concept of their simple machine using the organizer. Have them decide what information they will present to their *home* group.
- Have students share their information about their type of simple machine with their home groups. Encourage others in the home group to ask questions for clarification and to fill in a Concept Development Organizer for each one of the simple machines themselves.

### Activity 3

- At the end of the session, show the students examples of machines and equipment used at the Port of Prince Rupert.
- Check for students' understanding by asking them which simple machines are represented in the images of the equipment.
- Let students know they will make a dictionary of the six types of simple machines. (This may be done as a classroom or homework activity.)

### ASSESSMENT

- Explain to students that they develop a Dictionary of Simple Machines. To do this, they will use the information about the six types of simple machines from their *Concept Development Organizers* as well other pertinent sources (e.g. previous classroom work, books, websites).
- Tell the students that they can present their dictionary as a book or a poster.
- Lead the class in the collaborative development of assessment criteria for their Dictionary of Simple Machines. Criteria could include:
  - Clear written definitions of the six simple machines
  - Examples of the six simple machines from those used at the Port of Prince Rupert
  - A description of the essential characteristics of the equipment that make it an example of a simple machine
- Students can complete a *Self-evaluation Rubric* to reflect on their participation/contribution during group work.

### MODIFICATIONS

- During group work, assign a leader to facilitate each group by calling on students in a fair manner and trying to spread participation evenly. This will help ensure that all students have the opportunity to participate rather than having one student dominant the discussions.

- To ensure that all students bring an accurate and complete report back to their home group, have each expert group report their information to the class.

## EXTENSIONS

Have students research how to make simple machines and then make a model of a piece of equipment used the Port of Prince Rupert.

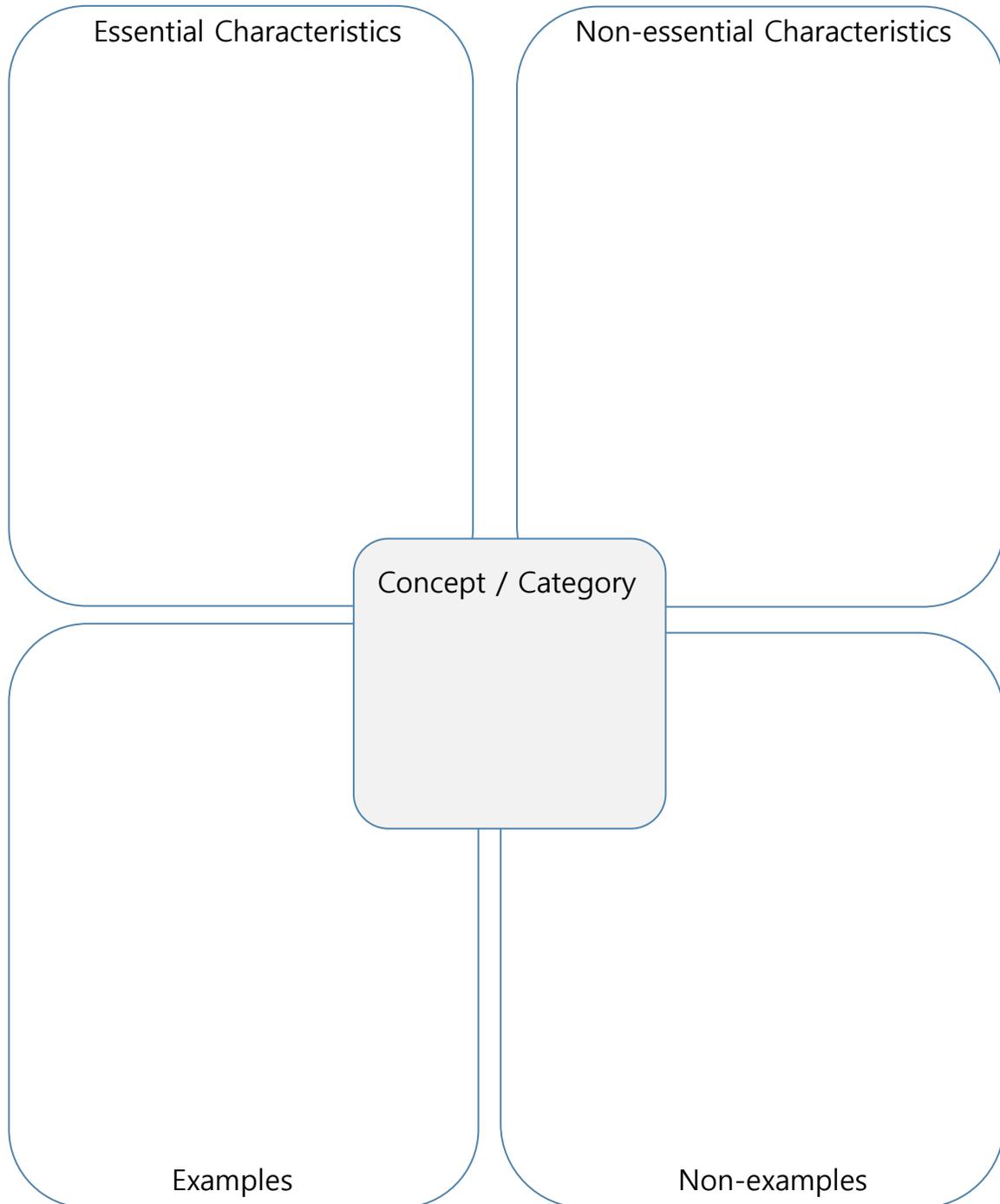
## LESSON PLAN RESOURCES

- Definitions and examples of simple machines:
  - Massachusetts Museum of Science
  - Mikids.com
- Stacker-reclaimer video
- Video of gantry crane in operation
- Drawing of the inside of grain elevator
- Ridley Terminals – video of stacker-reclaimer, tandem rotary dumper and vessel berth and loading
- Images on the Learning Gateway site (see Resources):
  - Hopper car (inclined plane)
  - Hopper car unloading
  - C-loader Quick Load (inclined plane)
  - Forklift (wedge, lever, wheel and axle)
  - Stacker-reclaimer at the Ridley terminals (lever, wheel and axle)
  - CBSA officer bolt cutters (lever)
  - Gantry Crane (pulley, wheel and axle)
  - Dry bulk carrier – bow of the ship (wedge)
  - Rail car (wheel and axle)
  - Grain Elevator
  - Conveyor belt and silo
  - Container rail car (N.B. *Do not hump* refers to a hump yard, an example of an inclined plane. See Glossary for definition.)
  - Chicago rail yard (example of a hump yard)
- For other images do a Google Image search on “ship propeller”, “capstan”, and “windlass”

## ATTACHMENTS (below)

- *Concept Development Organizer*
- *Team Work Self-evaluation*

# Concept Development Organizer



### Team Work Self – Evaluation Rubric

As a team member I:

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Did all of my work	Let my partners do some of my work	Let my partners do all of my work	
Helped my partners and let others help too	Only helped my partners when they asked me	Did not help my partners	
Listened carefully to my team's ideas and use their ideas to help get new ones	Listened carefully to my team's ideas	Did not listen to my team's ideas	
Asked questions of my team to help us figure out what to do and create new ideas	Asked questions of my team to help us figure out what to do	Did not ask questions or asked questions that did not help the team	
Exchanged ideas using 'I' statements and tried to explain my thinking to my team	Exchanged a few ideas with my team	Did not contribute any ideas to my team	
Respected the opinions of my team by offering encouragement and support for new ideas	Respected the opinions of my team and supported new ideas	Did not respect the opinions of my team and did not support new ideas	
Participated in each activity enthusiastically to the best of my ability	Participated in each activity	Did not participate	