ONTARIO COUNCIL FOR TECHNOLOGY EDUCATION

Grade 4 Pulleys & Gears

ONLINE RESOURCE

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Pulleys and Gears Grade 4

Activity 1: Understanding Structures and Mechanisms - Pulleys and Gears

Development of Curiosity and Wonder - The analysis of daily machines in our lives

Scientific and Technological Concepts:
In this strand of Structures and Mechanisms, students will learn about simple machines in their day-to-day lives and examine their use and functionality by looking closely at the components of pulleys and gears. Pulleys and gears allow motion to be transferred, facilitate force and speed when lifting very heavy objects. Students will learn how machines with pulleys and gears can perform these types of actions. Students will reflect on how machines simplify our daily lives with everyday jobs.

Learning Goal:
Students will

- Investigate the impact of simple machines on their daily lives in their everyday environment

Expectations (Overall & specific):
Overall:

1. Evaluate the impact of pulleys and gears on society and the environment

Specific:

1.1 assess the impact of pulley systems and gear systems on daily life
1.2 assess the environmental impact of using machines with pulleys and gears, taking different perspectives into account, and suggest ways to minimize negative impacts and minimize positive impacts
3.6 identify pulley systems that are used in daily life, and explain the purpose and basic operation of each

Equipment & Materials	Personal Protective Equipment (PPE)
• n/a	• n/a

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Safety Considerations:

- When searching for simple machines in their surrounding area, students should not plug in machines or devices and should not try to operate them without the supervision of an adult.

What does the teacher do?	**What do the students do based on the Technological Problem-Solving Skills Continuum?**
-Appendix A - Visuals of a single pulley system and gears for students to use a reference -See Appendix B - Show images of types of machines.Teachers can screencast themselves explaining the examples of machines and their performance task or function with a pulley or gear. Ex. *This is a gumball machine and when you put money in the gumball machine and turn the knob a gumball rolls out. Which part of the machine has a pulley or gear?* -Appendix C - What simple machines containing a pulley or gear can you find in your home? Draw or take a picture of 4 simple machines. Draw the pulley or gear you think is in this simple machine. -.Appendix D - Pick **one** of your machines and explain what this machine does for you? How does it simplify your life? What would you have to do if you did not have this machine? *Sample accommodations:* - When answering questions students can use speech to text to type answers onto a google doc or voice record answers on a device and send to the teacher.	***Initiating and Planning*** Refer to Appendix A to understand the terms pulley and gear ***Analysing and Interpreting*** - Appendix B. Students will first see samples of various simple machines all around us that have pulleys or gears. They will reflect on the function of the pulley or gear in the simple machine. -Appendix C. Students will analyse simple machines in their household. They will find simple machines that perform tasks. They will draw or take pictures of 4 simple machines (which have a pulley or gear) and draw what they think the pulley or gear in the machine looks like. - Appendix D. Students will answer questions on **one** of the machines of their choice. ***Communicating:*** -Answering 3 thinking questions of the effect of a machine in your life. Students reflect on how machines simplify our lives.

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Sample Troubleshooting: If students cannot write on template (BLM 1) they can create a slideshow with pictures and names of their simple machines. If students cannot answer questions on the google docs (BLM 2), they can type answers on a separate document or simply write answers on a piece of paper and email it to the teacher.	

Opportunities for assessment (Links to assessment pieces, organizers):
Assessment as learning:
-BLM 1-Identifying machines in their surroundings
-BLM 2-Thinking and Communication- the function and performance task of a machine and reflecting on how it simplifies their lives

Success Criteria:

Criteria	Met	Not There Yet
1- I can identify a pulley or gear in a simple machine		
2- I can explain how a pulley or gear simplifies the lift, motion or direction		
3- I can compare the efficiency of a task with a simple machine to complete the job manually		

Cross Curricular Opportunities:
-Writing (Specific Expectations: Sentence Fluency 2.4 use sentences of different lengths and structures (e.g., complex sentences incorporating conjunctions such as because, so, if)
Point of View 2.5 identify their point of view and other possible points of view on the topic, and determine whether their information sufficiently supports their own view

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Social Studies: A1.3 describe some of the ways in which their daily life differs from the lives of young people from different backgrounds (what machines were used in ancient civilizations for farming and household chores compared to students' current lives)

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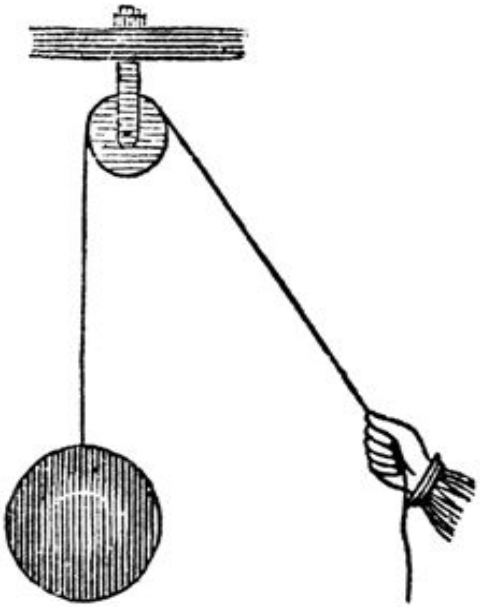
Appendix A - What do pulleys and gears look like?

A single pulley system



An example of 2 gears

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Appendix B: Types of Machines

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Appendix C

Walk around each room in your home (kitchen, bathroom, bedroom). What machines can you find in your home? Take a picture or draw your simple machine and draw the pulley or gear that makes them operate.

Example:

Name of simple machine: a toaster

Name of simple machine: _____	Name of simple machine: _____
Name of simple machine:_____	Name of simple machine: _____

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Appendix D - Pick one of your machines and answer the following questions:

ANALYSING MY MACHINE

Name of machine: _____

1. What does this machine do for you?

2. How does it simplify your life?

3. What would you have to do if you did not have this machine?

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Activity 2: Understanding Structures and Mechanisms - Pulleys and Gears

Structured to develop technological problem solving skills - Assessing the negative impacts of machines on the environment

Scientific and Technological Concepts:
Part 1: In becoming more familiar with machines all around us, students will explore machines used everyday in society (e.g. lawn mowers) and investigate the environmental negative impact. Due to the environmental impact of these machines, students will investigate other methods to perform the same duties without having a negative impact on the environment.

Part 2: This lesson involves investigating the function and use of gears on a bike. What happens when we change the gears on a bike? How does changing the gears on a bike affect force, distance and speed?

Learning Goal:
Students will

- Reflect on the environmental impacts of using machines in society
- Explore the use and function of gears on their bicycles

Expectations (Overall & specific):
Overall:

1. Evaluate the impact of pulleys and gears on society and the environment
2. Investigate ways in which pulleys and gears modify the speed and direction of, and the force exerted on, moving objects

Specific:
1.1 Assess the impact of pulley systems and gear systems on daily life
1.2 Assess the environmental impact of using machines with pulleys and gears taking different perspectives into account
2.1 Follow established safety procedures for working with machinery
2.2 Use scientific inquiry / experimentation skills to investigate changes in force, distance, speed, and direction in pulley and gear systems

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3.1 describe the purposes of pulley systems and gear systems
3.6 Identity pulley systems
3.7 Explain how the gear system on a bicycle works (e.g., by using the largest gear on the front chain ring and the smallest gear on the rear wheel, we can move quickly along a flat surface)
3.8 Identify the input components that drive a mechanism and the output components that are driven by it (e.g., the pedal on a bike are the input component; the rear wheel is the output component)

Equipment & Materials	**Personal Protective Equipment (PPE)**
• A bike • Chalk	• Safety gloves (to protect from the grease of chains

Safety Considerations:

- When placing your bike upside down, turn the pedals very gently
- When hand pedaling the bike (in its upside down position) keep fingers away from the wheels and the gears.
- Tie back hair
- Remove loose jewellery or long earrings
- Only lift light objects in case they fall

What does the teacher do?	**What do the students do based on the Technological Problem-Solving Skills Continuum?**
Part 1 of this lesson is assessing the environmental impacts of machines: Appendix E: Students will explore alternate ways to do the work of machines by caring for the environment and taking an environmentalist stance. Part 2 of this lesson is looking at the gears of our bike. Place your bike upside down. Compare	Part 1 of the lesson- ***Analysing and Interpreting*** -Although we appreciate the use and efficiency of machines, we need to analyse and assess the negative impact they may have on the environment. Students do Appendix E -Explore alternate ways to get the job done while caring for the environment

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changing gears and how fast the back tire turns depending on the different gears you select. Mark the tire with chalk and count the rotations. How many times does the back tire turn on the lowest gear? How many times does the back tire turn on the highest gear? Appendix F: Performing and Recording -Mark the tire with chalk. Turn the pedal to allow the back tire to spin slowly. Students will count how many tire rotations in comparison to the pedal rotation by increasing the gear and decreasing the gear, learning to determine which gear allows for more or less force, distance and speed. Teachers view: Grade 4 Pulleys and Gears- https://safeYouTube.net/w/BDkL Sample accommodations: -If you cannot place the bike upside down, then ask an adult to assist by raising the back of the bike when you turn the pedals. -Teacher can take a picture or create a screencast the bike upside down and turning the pedals -If student does not have a bike they can watch the safe youtube video https://safeYouTube.net/w/BDkL <u>Sample Troubleshooting:</u> If students cannot write on hand outs they can record answer on paper or on a google docs to share with their teacher	Part 2 of the lesson- ***Performing and Recording*** -Appendix B: Understanding the function and use of the gears of our bikes -Applying scientific experimental skills by marking the tire with chalk, then changing the gears of the bike and recording tire rotations to determine which gears you would use to ride uphill or on a flat surface ***Communicating*** Appendix F-Questions 4 and 5. Assessing the results of tire rotations on the different gears.

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Opportunities for assessment (Links to assessment pieces, organizers):

Success Criteria:

Criteria:	Met	Not There Yet
1- I can assess the environmental impact of using machines.		
2- I can problem solve ways to help the environment using alternative methods of doing machine jobs.		
3- I use scientific inquiry skills to investigate the change in force, distance and speed with the gears of my bike.		
4- I follow safety procedures when turning the wheels of my bike.		

Assessment as learning:

- Appendix E- Assessing the environmental impact of machines and finding alternate ways to perform jobs
- Appendix F: Understanding the function and use of the gears of our bikes
- Appendix F-Communication and Application-Questions 4 and 5

Cross Curricular Opportunities:

-Language, Writing-Create a persuasive text on ways we can be environmentalists and care for the environment

-Social Studies: Why have bikes been around since approximately 1817? Create a slideshow showing the evolution of bikes through several civilizations.

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Appendix E: Thinking of the Environmental Impact

Interesting Fact: Did you know that a lawn mower running for one hour exhibits the same amount of carbon monoxide as **11 cars travelling for one hour?**

What are other ways we can get the job done without negatively impacting the environment?

1- Instead of putting your clothes in a dryer,  you can...

2. Instead of getting a ride to school,  you can…

3.Instead of mowing the lawn with a gas mower,  you can…

4. Instead of... write your example

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Appendix F:

Performing and Recording The Gears on your Bike

Make the following observations as you turn the pedals on your bike.

1. Mark your back tire with chalk, only one little line. Put the gear on the lowest. How many times does your tire turn with the pedals? Record your results. _____

2. Change the gears of your bike. Go to the middle gear. How many times does your tire turn with the pedals? Record your results. _____

3. Change the gears of your bike. Go to the highest gear. How many times does your tire turn with the pedals? Record your results. _____

4. If you were to ride your bike up a hill, which gear would you put your bike in? Explain your answer.

   _____

   _____

   _____

5. If you were to ride your bike on a flat trail, which gear would you put your bike in? Explain your answer.

   _____

   _____

   _____

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Activity 3: Understanding Structures and Mechanisms - Pulleys and Gears

Guided development of technological problem solving skills - Building a machine

Scientific and Technological Concepts:
As a culminating task in this unit of Pulleys and Gears, students will create a functional machine that will change one or more of the following: force, speed, direction or motion. Students will assess the function of their human-made machine to determine if it can operate and how it simplifies life.

Learning Goal:
Students will

- Learn the necessary components (pulley system or gear system or both) to have in a machine depending on its purpose
- Create a machine that is functional in its use of force or direction or speed or distance or motion
- Assess if their machine is operable and efficient for its purpose

Expectations (Overall & Specific):
Overall:
2. Investigate ways in which pulleys and gears modify the speed and direction of, and the force exerted on, moving objects;
3. Demonstrate an understanding of the basic principles and functions of pulley systems and gear systems.

Specific:
1.1 assess the impact of pulley systems and gear systems on daily life
2.1 follow established safety procedures for working with machinery
2.2 use scientific inquiry/experimentation skills to investigate changes in force, distance, speed, and direction in pulley and gear systems
2.3 use technological problem-solving skills 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

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2.5 use a variety of forms (e.g., oral, written, graphic,multimedia) to communicate with different audiences and for a variety of purposes (e.g., write a set of instructions for setting up a pulley system)
3.1 describe the purposes of pulley systems and gear systems (e.g., to facilitate changes in direction, speed, or force)

Equipment & Materials	Personal Protective Equipment (PPE)
• Recyclable materials (juice cartons, yogurt containers etc.) • Hot glue gun • Regular glue • Scissors • String • Cardboard • Duct tape • Dominoes etc.	• Safety goggles

Safety Considerations:

- Tie hair back
- Remove loose jewellery or long earrings
- Only lift light objects
- Glue gun use should be supervised and goggles need to be worn

What does the teacher do?	What do the students do based on the Technological Problem-Solving Skills Continuum?
-Teacher can view this video on samples of student-made simple machines to prompt students with some direction if they have any questions https://safeYouTube.net/w/V3nL https://safeYouTube.net/w/D6nL	***Initiating and Planning:*** -Students will reflect on what machine would be useful for their needs -Students will brainstorm a list of materials they will need for their machine -Appendix G - Students will sketch their machine, list materials, draw the function of the pulley/gear

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-Teacher will give students instructions to create their own machine using recyclable materials and other objects they may find useful around the house. Sample accommodations: -Complexity level can vary based on students' individual abilities in creating a machine Sample Troubleshooting: -Students can take pictures of their machine if they cannot or do not want to video record	***Performing and Recording:*** -Students will test out their machine to determine that it has a useful function -Students will make modifications to ensure machine is sturdy and works efficiently -Students are encouraged to use entrepreneurial skills and create a machine that does not exist ***Communicating:*** Students can record themselves explaining the parts to their machine and the function of the machine -Students can take a picture and post on google slides. Picture must include a description of its use and the components of the machine,

Opportunities for assessment (Links to assessment pieces, organizers):
Assessment of Learning;
-Presentation of your personal student-made machine
-Application of correct science terms e.g., gears, pulley, force, direction etc.
-Communicate clearly the function, components, and purpose of the machine

Cross Curricular Opportunities:
-Oral Communication -Presentation skills

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Appendix G: Brainstorming My Planning

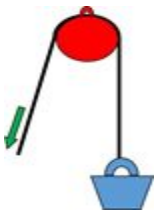
Materials Needed:

_____

_____

Sketch of my machine:

Function of pulleys and or gears: (Draw how your pulley and gear operates your machine

	For example:  

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Science Rubric: Building a Simple machine

Students will create their own machine and test if it is operable and efficient.

Categories of the Achievement Chard	**Level 1**	**Level 2**	**Level 3**	**Niveau 4**
Knowledge of Content E.g., (facts, terminology, safe use of tools and equipment)	Demonstrates limited knowledge of content	Demonstrates some knowledge of content	Demonstrates considerable knowledge of content	Demonstrates thorough knowledge of content
Thinking Use technological problem-solving skills to design, build, and test a pulley or gear system that performs a specific task	Uses processing skills and strategies with limited effectiveness	Uses processing skills and strategies with some effectiveness	Uses processing skills and strategies with considerable effectiveness	Uses processing skills and strategies with a high degree of effectiveness
Communication Use a variety of forms (i.e. oral, visual, google slides) to communicate and explain the function of their machine and relevant vocabulary and science words	Communicates for different audiences and purposes with limited effectiveness	Communicates for different audiences and purposes with some effectiveness	Communicates for different audiences and purposes with considerable effectiveness	Communicates for different audiences and purposes with a high degree of effectiveness