

# Grade Four Science

## Aligned to Alberta Curriculum

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The lessons and experiments in this book fall under 5 main topics that relate to the Alberta curriculum for Grade 4 Science – Topic A: Waste and Our World, Topic B: Wheels and Levers, Topic C: Building Devices and Vehicles that Move, Topic D: Light and Shadows and Topic E: Plant Growth and Changes. In each lesson you will find teacher notes designed to provide you guidance with the learning intentions, the success criteria, materials needed, a lesson outline, as well as provide some insight on what results to expect when the experiments are conducted. Suggestions for differentiation or accommodation are also included so that all students can be successful in the learning environment.

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Some material appearing in this book has been used in other published works, such as lessons from Managing Waste and Recycling (OTM 2131), Earth and Space Science Grade 4 (OTM2155), Physical Science Grade 4 (OTM2147) and Life Sciences Grade 4 (OTM2163).

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# AT A GLANCE

## Skills: Science Inquiry

**4.1** Investigate the nature of things, demonstrating purposeful action that leads to inferences supported by observations. Students will ask questions that lead to exploration and investigation and identify possible answers to questions from themselves and others.

**4.2** Identify patterns and order in objects and events studied; and record observations, using pictures, words and charts, with guidance in the construction of charts; and make predictions and generalizations, based on observations. Students will carry out procedures, identify materials and how they are used and access with guidance information and ideas from sources.

**4.3** Investigate a practical problem, and develop a possible solution. Students will identify applications of what has been learned; identify new questions that arise from investigation and development of solutions to problem; identify the purpose of an object to be constructed; use various strategies to complete tasks; build a structure with moving parts; communicate results of construction activities and evaluate the product in terms of accomplishing goals and opportunities for improvements.

## Attitudes

**4.4** Demonstrate positive attitudes for the study of science and to the applications of science in responsible ways. Students will show growth in acquiring and applying curiosity, inventiveness, perseverance, appreciation of the value of experience and observation, a willingness to work with others, a sense of responsibility for actions taken and respect for living things and environments with a commitment for their care.

## Topic A: Waste and Our World

**4.5** Recognize that human activity can lead to the production of wastes, and identify alternatives for the responsible use and disposal of materials. Students will identify plant and animal wastes and describe how they are recycled in nature, identify and classify wastes that result from human activity, describe alternative methods of disposal along with their advantages or disadvantages, distinguish between wastes readily biodegradable and those that are not, compare packaging in regards to advantages and disadvantages to waste and identify methods of waste disposal currently used within the local community. Students will identify wastes toxic to people and the environment, identify materials and processes that may decrease the amount of waste produced, identify ways in which materials can be reused or recycled, develop a flow chart for a consumer product indicating the source materials, final product, use and method of disposal. Students will identify actions that minimize the production of wastes as well as develop and implement a plan to reduce waste and monitor what happens over a period of time.

## Topic B: Wheels and Levers

**4.6** Demonstrate a practical understanding of wheels, gears and levers by constructing devices in which energy is transferred to produce motion. Students will explain and demonstrate how rollers can be used to move an object in a practical situation, compare where wheels and rollers are used, construct devices that use wheels and axles and demonstrate their use model vehicles, pulley systems or gear systems. Students will construct and explain the operation of a drive system that uses wheel-to-wheel contact, belt, chain or elastic or cogs and gears. Students will construct and explain the operation of a drive system that transfers motion from one shaft to another where the second is parallel or perpendicular to the first. Students will demonstrate ways to use a lever that applies a small force or movement to create a large force or movement, predict how changes in the size of a lever or the position of the fulcrum will affect the forces and movements involved and construct models of levers to explain how levers are involved in other devices.

### Topic C: Building Devices and Vehicles That Move

**4.7** Construct a mechanical device for a designated purpose, using materials and design suggestions provided. Students will design and construct devices or vehicles that move or have moving parts, use simple forces to power or propel a device, use energy-storing and energy consuming components to cause motion.

**4.8** Explore and evaluate variations to the design of a mechanical device, demonstrating that control is an important element in the design and construction of that device. Students will apply control mechanisms in the design and use of devices, compare designs to identify relative strengths and weaknesses, identify steps used to construct a device or vehicle, work cooperatively with other students and design and make several models of a device in order to evaluate each model constructively.

### Topic D: Light and Shadows

**4.9** Identify sources of light, describe the interaction of light with different materials, and infer the pathway of a light beam. Students will recognize that eyes can be damaged by bright lights and eyes should be properly protected, identify a wide range of sources of light including the sun, electric lights, flames and materials that glow and distinguish between objects that emit their own light from those that require external source of light to be seen. Students will demonstrate that light travels outward from a source and continues unless blocked by an opaque material, describe changes in the size and location of Sun shadows during different times of the day, distinguish and classify between material that is transparent, partly transparent and opaque and recognize that light can be reflected using reflecting surfaces. Students will recognize and show that light can be bent (refracted) through certain objects and recognize that light can be broken into colours and that different colours of light can be combined for a new colour. Students will describe and use a variety of optical devices.

### Topic E: Plant Growth and Changes

**4.10** Demonstrate knowledge and skills for the study, interpretation, propagation and enhancement of plant growth. Students will describe the importance of plants to humans and their environment as sources of food, shelter and maintaining the environment, identify and describe the general purpose of plant roots, stems, leaves and flowers and describe common plants on the basis of their characteristics and uses. Students will recognize that plant requirements for growth, including water, space, light, energy, and air vary from plant to plant and conditions such as temperature, humidity and nutrients may also be important to particular plants. Students will identify plants with special needs, recognize the variety of plant communities found in the local area, recognize that differences in plant communities relate to variations in the amount of light, water and other conditions and recognize that plants of the same kind have a common life cycle producing new plants similar but not identical to parent plants. Students will describe ways that various flowering plants can be propagated from seed, cuttings, bulbs and by runners; nurture a plant through one complete life cycle – from seed to seed; describe the care and growth of a plant nurtured identifying the life stages of the plant, conditions and requirements of the plant and reproductive structures of the plant. Students will describe different ways that seeds are distributed and recognize adaptations for different methods of distribution.

*Taken from the Alberta Education Grade 4 Science Curriculum.*

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# TOPIC A: WASTE AND OUR WORLD: WASTE

## LEARNING INTENTIONS:

Students will identify waste that is a result of human activity versus plant and animal waste, and the ways waste is recycled and managed in nature. Students will classify wastes that result from human activity.

## SUCCESS CRITERIA:

- define the meaning of waste and provide examples of it on our planet
- determine which waste is due to human activity vs. plant and animal waste
- describe how waste is managed in the natural world
- create an earthworm farm
- record observations about earthworm activity
- make a conclusion about the earthworm's role in waste management

## MATERIALS NEEDED:

- ask each student to bring in a large wide-mouthed glass jar with a lid
- a copy of *What is Waste?* Worksheet 1 for each student
- a copy of *Human Activity vs Nature* Worksheets 2 and 3 for each student
- a copy of *A Tree in a Forest* Worksheet 4 for each student
- a copy of *The Earthworms Clean Up!* Worksheets 5 and 6 for each student
- dictionaries or access to the internet
- read aloud about plant and animal waste management (see suggestion in #4 of procedure section)
- soil such as sand and loam or topsoil (enough to fill large jars for each student)
- a hammer and a nail, masking tape, a jug of water, a few small cups
- earthworms (2 or 3 per student)
- vegetable or fruit scraps

## PROCEDURE:

**\*This lesson can be done as one long lesson, or divided into shorter lessons.**

1. Explain to students that they will learn about waste. Give them Worksheet 1 and a dictionary, or allow them access to the internet. They will research the meaning of waste, then engage in a Think, Pair, Share activity with a partner to brainstorm some examples of waste they have seen in our world. A follow-up option is to come back as a large group and record their ideas on chart paper that could be used for a later activity.
2. Give students Worksheet 2 to sort their ideas of waste into two categories, these being waste caused by human activity and waste caused by plants and animals. Give students a clipboard to put Worksheet 2 on, and a pencil. Take them on a walk through the neighbourhood to look for signs of waste. They will add these to Worksheet 2.
3. Give students Worksheet 3 to complete. Once again they will engage in a Think, Pair, Share activity with a partner to brainstorm some examples of how the natural world manages its own waste. A follow up option is to come back as a large group and record their ideas on chart paper that could be used for a later activity.
4. Read *A Tree in a Forest* (Author: Jan Thornhill) to the students. Ask students to listen for examples of how nature manages its own waste. Record students' ideas on chart paper as you read through the story. Give students Worksheet 4 to complete.
5. Students will have an opportunity to create their own earthworm farms. Give them Worksheets 5 and 6, and the materials to create the farms. Read through the question, materials needed, and what to do sections on Worksheet 5 with the students to ensure their understanding of the task. Students will make and record observations of the earthworm farms as they are created and again 24 hours later. They will make a conclusion about the purpose earthworms have in nature's waste management system.

\*As an activity to enhance the learning about the necessity of decomposition in the natural world, show students The Magic School Bus episode called “Meets the Rot Squad”. Episodes can be accessed at [www.youtube.com](http://www.youtube.com).

## DIFFERENTIATION

Slower learners may benefit by partnering up with a faster learner to complete the Think-Pair-Share activities. Also, this type of pairing could be of benefit while these learners complete Worksheet 2.

**For enrichment**, faster learners could choose one of their illustrations on Worksheet 4 and re-create it on a larger paper. They can paint and display it on a bulletin board.

# What is Waste?

What exactly is **waste**? Use a dictionary to find the definition of this word, or use the internet to research its meaning. Record your answer below.

**Waste is** \_\_\_\_\_

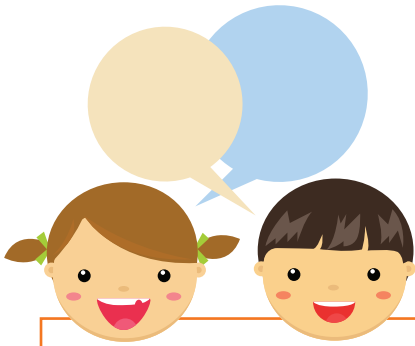
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## Think, Pair, Share

With a partner, do some thinking and sharing of ideas about waste you have seen or heard about happening on our planet.

In the box below, record your ideas of waste.

## Human Activity vs Nature

Look at the ideas of waste that you recorded on Worksheet 1. Which ones are caused by human activity? Which ones are caused by plants and animals in the natural world?

### Sort It Out!

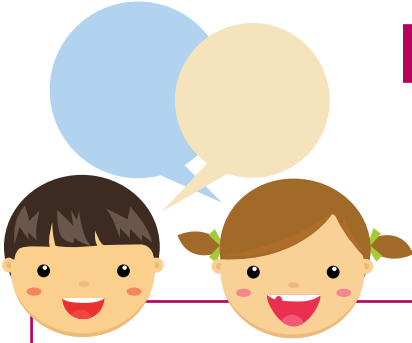
Using point form, sort your ideas in the chart below.

Waste Caused By Human Activity	Waste Caused By Plants and Animals



**What To Do:**

1. Take a walk in your neighbourhood. Look for signs of waste. Add them to your sorting chart on Worksheet 2.
2. Look back at your sorting chart. What produces more waste, human activity or plant and animals? Justify your answer.

**Think, Pair, Share**

With a partner do some thinking and sharing of ideas of how the plant and animal world manages its waste. Record your ideas in the box below.

# GEARS IN MOTION

## LEARNING INTENTION:

Students will explain the operation of a drive system that uses a belt, chain and gears. Students will explain the operation of a drive system that transfers motion from one shaft to a second shaft either parallel or perpendicular (90 degrees) to the first.

## SUCCESS CRITERIA:

- identify bevel gears and worm drive gears as facilitators to make motion happen
- conduct experiments to observe how gears create motion in everyday objects
- make and record observations using drawings and written descriptions
- make conclusions about how gears operate in order to change direction and speed

## MATERIALS NEEDED:

- bevel gears and worm drive gears (to use as manipulatives)
- hand held egg beater/mixer (one or more if students do experiment in small groups)
- an electric mixer (opened to allow mechanical parts to be seen)
- a bicycle with multiple gear settings
- a piece of chalk
- clipboards (one per student)
- a copy of *Gears In Motion* Worksheets 1 and 2 for each student
- a copy of *Exploring the Bevel Gear* Worksheet 3 for each student
- a copy of *Exploring the Worm Gear Drive* Worksheet 4 for each student
- a copy of *How Bicycles Work* Worksheets 5, 6, and 7 for each student
- pencils, markers

## PROCEDURE:

**\*This lesson could be done as one long lesson or divided into shorter lessons.**

1. Give students Worksheets 1 and 2, in order to read through the information about bevel gears and worm gear drives. Some teacher led discussion about key concepts may be beneficial to help students understand the function of these gears, partnered with using actual bevel gears and worm gear drives as manipulatives.

2. Explain to students that they are going to explore how bevel gears work to transmit power and work to make motion happen. For the bevel gear exploration, students could work in a large teacher directed group, or in small groups. Give students Worksheet 3, and the materials they need. Read through with them the section on what to do, to ensure understanding. Students will conduct the exploration and record their observations through drawings and written description.

**Optional:** the Alberta Distance Learning Centre created a video to show an egg beater bevel gear turning: <https://youtu.be/iVJcRTqxtg>

3. This is a teacher directed exploration. Come together as a large group. Explain to students that they are going to explore how a worm gear drive works to transmit power and works to make motion happen. Give students Worksheet 4 and a clipboard. Read through with them the section on what to do, to ensure understanding. The electric mixer must be opened up so that its mechanical parts are visible. The teacher will operate the mixer to demonstrate how the worm gear drive works to transmit power to make the paddles turn. (Having students approach in small numbers is recommended so that they can get a closer look at the demonstration). Students record their observations through drawings and written description.

4. Explain to students that they are going to explore the gears on a bicycle to see how they work to make the bike move. Place the bicycle upside

down so that it is resting on its seat and handle bars. Give students Worksheets 5, 6, and 7, and a clipboard to use as they record their observations during this large group exploration. Read through the information and what to do sections on the worksheets, as the students complete each step. They will record their observations in the chart on Worksheet 7, and make conclusions based on their observations.

## **DIFFERENTIATION:**

Slower learners may benefit by working with a peer to discuss ideas about their conclusions on how bicycles work. Scribing of responses to conclusions may also be beneficial.

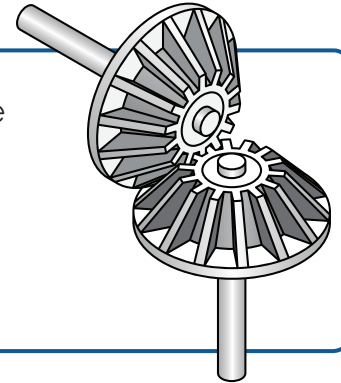
**For enrichment**, faster learners could research other parts on a bicycle (i.e., brake system), in order to learn how all the parts work together to make the bicycle operate.

# Gears In Motion

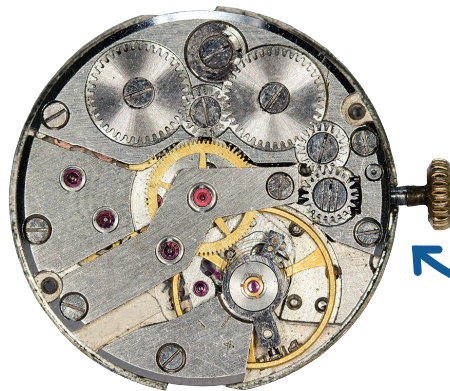
There are many types of gears that work to change speed and direction of motion. Some are designed to keep the speed steady, and some are designed to reduce speed. Gears can be connected in many ways in order to work to make motion happen.

## Bevel Gears

Bevel gears are most often attached to shafts that are 90 degrees apart. Bevel gears are found where the axes of the two shafts meet. The tooth-bearing faces of the gears are shaped like a cone. This allows the gears to go around corners.



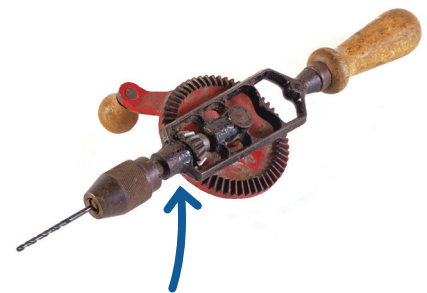
## Where could bevel gears be found?



Bevel gear on the inside of a watch.



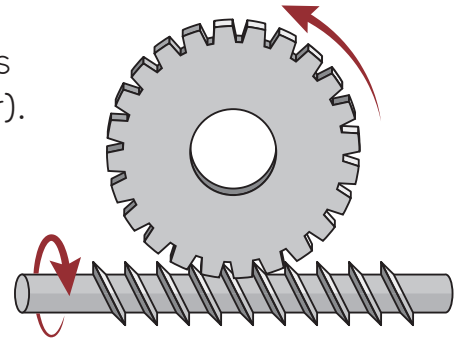
Bevel gear lifts a floodgate by means of a central screw.



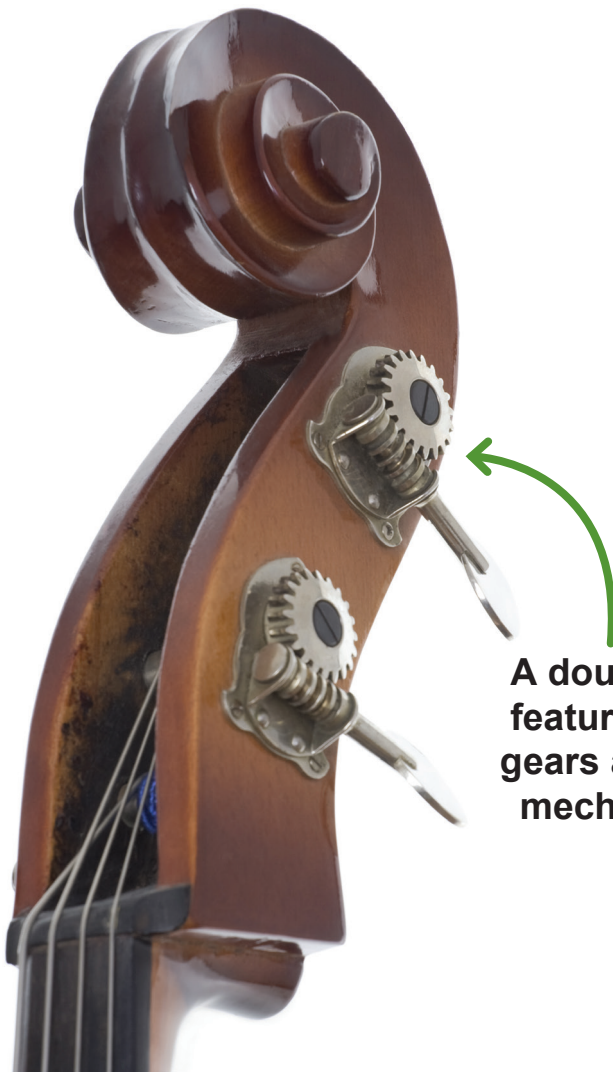
Bevel gear on an antique hand drill.

## Worm Drive

A worm drive is a gear system where a worm (which is a gear in the form of a screw) meshes with a worm gear (which looks like a spur gear). A worm gear system transmits power from the worm to the gear wheel. The worm acts like a brake. The worm gear needs to rotate many times for each complete turn of the gear wheel.



Where could worm drives be found?



**A double base features worm gears as tuning mechanisms.**



**This is a worm drive controlling a gate.**



## Exploring the Bevel Gear

Let's explore how bevel gears work to transmit power and work to make motion happen!

### Materials Needed:

- a hand held egg beater



### What To Do:

1. Turn the egg beater handle. Carefully observe how the bevel gears connect in order to make the beater paddles turn.
2. Record your observations by drawing what you see happening. Write a sentence to describe how the gears in the egg beater work to create motion of the paddles.

Example of bevel gears operating:

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You turned the handle up and down but the beaters turned around and around. Are the gears operating at 90 degrees apart from each other? Or do they operate parallel to each other?

## Exploring the Worm Gear Drive

Let's explore how a worm gear drive works to transmit power and works to make motion happen!



### Materials Needed:

- an electric mixer (opened to allow the inside to be seen)

### What To Do:

1. Your teacher will open up the electric mixer so that the parts on the inside are visible. Your teacher will plug in the mixer and operate it so that you are able to view and carefully observe how the worm gear drive works to create motion of the paddles.
2. Record your observations by drawing what you see happening. Write a sentence to describe how the gears in the electric mixer work to create motion of the paddles.

Example of a worm drive operating:

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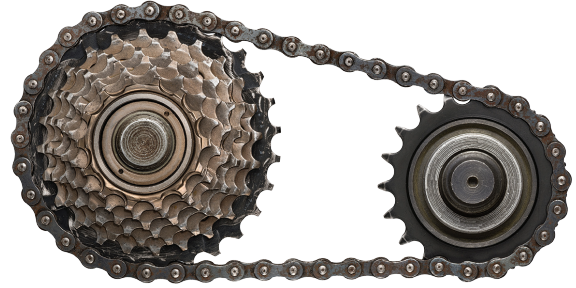
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# How Bicycles Work

We have learned a lot about how gear trains and pulleys systems work to make things move. Let's explore the parts of a bicycle to see them in motion!

The chain of a bicycle is like a belt drive pulley system. The pedals are like an input wheel and the back gears are like an output wheel, always turning in the same direction around the sprockets, as the gears are changed. The idea behind multiple gears on a bicycle is to let you change the distance that the bike moves forward with each pedal stroke. The chain naturally slips from one gear to the next as you turn the pedals.



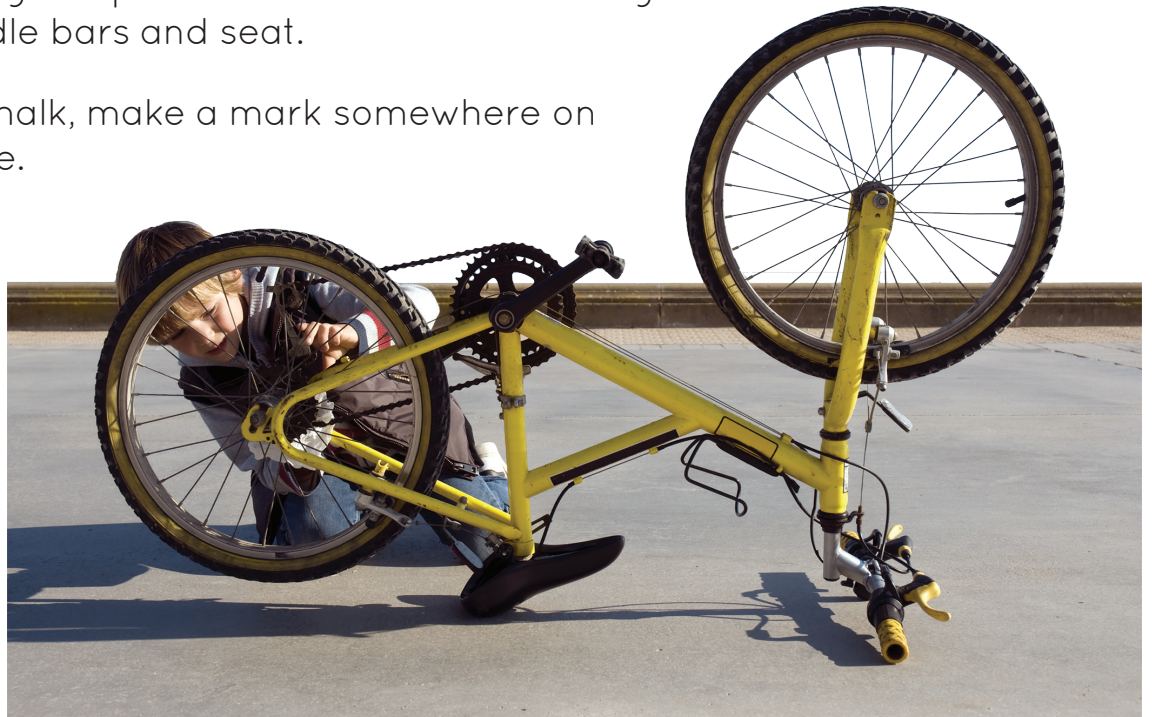
## Materials Needed:

- a bicycle with multiple gears settings
- a piece of chalk

## What To Do:

### (Part A)

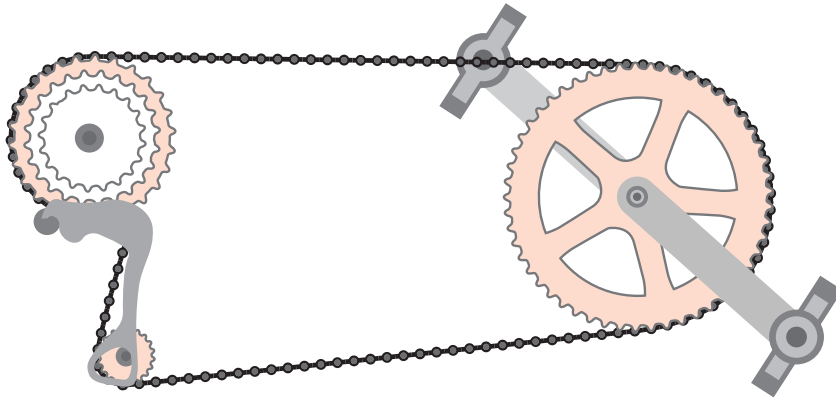
1. Turn the bicycle upside down so that it is resting on the handle bars and seat.
2. Using the chalk, make a mark somewhere on the back tire.





**(Part B)**

3. Put the bicycle in low gear. Count the number of gear teeth on the front and rear sprockets that are being used. Record your observations in the chart on Worksheet 7.

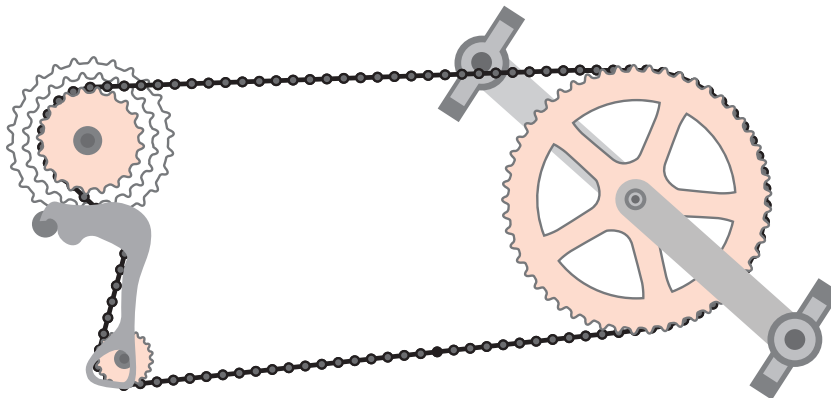


The bicycle is in low gear when the chain passes around the largest rear sprocket.

4. Turn the pedal on the bicycle one complete turn. Observe how many turns the back wheel makes. Record your observations in the chart.

**(Part C)**

5. Put the bicycle in high gear. Count the number of gear teeth on the front and rear sprockets that are being used. Record your observations in the chart.



The bicycle is in high gear when the chain passes around the small rear sprocket.

6. Turn the pedal on the bicycle one complete turn. Observe how many turns the back wheel makes. Record your observations in the chart.
7. Make conclusions about what you observed.

## Let's Observe

	Number of gear teeth on front sprocket	Number of gear teeth on rear sprocket	Total Number of gear teeth being used	Number of turns rear wheel does with one pedal turn
Low Gear				
High Gear				

## Let's Conclude

Describe the force you needed to use in order to turn the pedal when putting the bicycle in low gear.

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Describe the force you needed to use in order to turn the pedal when putting the bicycle in high gear.

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Which gear would be best to use when travelling up a steep hill? Which gear would be best to use when traveling fast on flat ground? Explain your thinking.

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You turn the pedals of a bicycle up and down and the tires turn up and down as well. Are the gears and wheels operating at 90 degrees apart from each other? Or do they operate parallel to each other?

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