Simple Machines

Preparation

Grade Level: 3-5	Group Size: 25-30
Time: 60 Minutes	Presenters: 3-4

Objectives

This lesson will enable students to:

- Describe and define simple machines.
- Identify simple machines in their world.
- Define and experience the definition of work and mechanical advantage.
- Identify a pulley, lever, gear, wheel and axle.
- Explain how pulleys, levers, gears, wheels and axles work to give mechanical advantage.

Standards

This lesson aligns with the following National Science Content Standards:

- Unifying Concepts and Processes in Science, K-12, 5-8
- Physical Science, K-4, 5-8
- Science and Technology, K-4, 5-8

Note: While we strive to make the lessons as safe as possible, there are risks inherent in using certain equipment or materials. Safety guidelines have been published where necessary within each lesson. Please ensure you have adequately reviewed the lesson and have the information and materials necessary to perform it safely. Micron is not liable for any injuries that result from use of these lessons. Some of the equipment used in the Machines lesson can pose a safety hazard if used incorrectly. Follow all safety guidelines and instructions as noted within the text of the lesson to avoid potential injury.

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Materials

Introduction

- "Machines" PowerPoint (overheads or flashdrive)

Note: This lesson is written to be used with the equipment provided through the Micron K-12 program.
When using your own equipment, adapt the lesson as necessary.
Plans for the specific equipment used can be obtained at k-12programs@micron.com.

Lever Station

- Fulcrum/pivot
- Lever arm/rod
- 5 lbs of weight
- Weight bag with carabineer on handles
- "Lever" poster – Appendix A

Pulley Station

- Pulley bar or board: 1 eye-bolt, 2 fixed pulleys
- Two tripods, modified to fit the pulley bar
  (can also use a ladder to hold the pulley bar)
- Weight bag, with pulley and rope attached
- 5 lb weight
- "Pulley" poster – Appendix B

Gears Station

- Gears demonstration board & Gears
  (Metal whiteboard and toy gears with magnetic backs. Need at least two different sizes of gears, 3 of each size)
- Gear activity set *(Learning Resources Gizmos & Gears)*, including:
  - 2 each 8 tooth gears
  - 2 each 12 tooth gears
  - 2 each 16 tooth gears
  - 6 gear bases
  - 6 attachments
- Sharpened Pencils
- "Gears" posters – Appendix C
- "Wheel and Axle" poster – App. D
- "All About Gears" activity sheet – Appendix E

Optional Classroom Activity

- Class set of unsharpened pencils 12" rulers

Setup & Assembly of materials – Appendix F

Preparation

Set up the stations for the activities with the equipment needed. Place the appropriate poster in a visible position near each station for reference.

Lever

Place the lever arm/rod on the fulcrum, at the notch that places the load end furthest from the fulcrum.

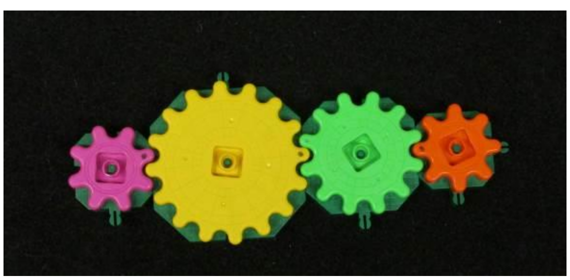
Pulley

Attach the pulley bar to the tripods as shown. This setup can be done on a table or on the floor; adjust the tripod legs accordingly.

Appendix F shows more thorough instructions for the pulley setup

Gears

Assemble gears on the gear demonstration board.



Set up 3 or 4 Gear Activity stations (depending on the number of students) with the gears in the above configuration

Divide the class into three groups. The students will rotate through each of the stations at the end of the introduction.

Introduction

Use the "Machines" PowerPoint slides for the introduction. Slides are also available at www.micron.com/lessonplans .

We are here to have fun with simple machines and learn how they work, how we use them, the different types, the importance of simple machines, and what work is.

If using an overhead, display only the title of the "What is a Machine?" slide. Cover the remainder of the overhead with a piece of paper.

Q: What is a machine?
A: A system or device which uses energy to perform a task.
A system that will help you do work.

Q: What is a simple machine?
A: A machine with few or no moving parts.

If using an overhead, display only the title of the "Types of Simple Machines" slide. Cover the remainder of the overhead with a piece of paper.

Q: What types of simple machines can you name?
A: Levers, pulleys, gears, wheel and axle, inclined plane, screw, and wedge.

There are seven main simple machines that are combined to form complex machines. Complex machines combine two or more simple machines to perform a task, or do work.

It is interesting to note that some of these simple machines are combinations of other simple machines.

Q: Does anyone know which of these simple machines is a combination of other simple machines?
A: The pulley is a wheel and axle with a rope.
The screw is a combination of a wedge and an inclined plane.
Gears are a type of wheel & axle.

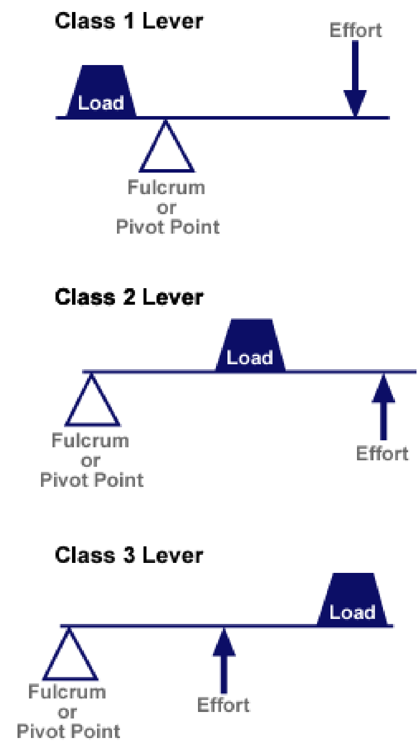
Show the slide of the crane and ask students to identify the simple machines that have been combined to make this complex machine: wheel, axle, gears, and levers. They may also note a pulley, inclined plane, screw and wedge, which can all be considered correct.

Today we are going to focus on four of the seven simple machines: levers, pulleys, gears, wheel and axle.

Lever

A lever is a simple machine used to lift, cut or open objects. The parts of a lever are the rod or lever arm which pivots on a point called a fulcrum, and a load and an effort (or force).

There are three types of levers, which are classified according to the position of the load and effort with respect to the fulcrum. The position of the fulcrum determines the class of the lever.



Class 1 Lever: The fulcrum is between the load and the effort. Examples include scissors and a seesaw.

Class 2 Lever: The fulcrum is on one end and the effort is on the other. The load is between the fulcrum and the effort. Examples include a nutcracker and a wheelbarrow.

Class 3 Lever: The effort is between the fulcrum and the load. Examples include a stapler, hockey stick, and a shovel.

Q: What are some examples of levers?
A: Answers will vary, refer to slide 8 or Lever Poster, Appendix A.

Pulleys

A pulley consists of a grooved wheel and axle and a rope. A pulley changes the direction or size of the effort force, typically used to make it easier to lift objects to a higher area. There are three types of pulleys: fixed, movable and combined.

Fixed pulley -- one pulley attached to a stable arm.

A fixed pulley is rigidly attached to something. The object being moved is attached to one end of a rope which is fed through the pulley, and the effort force is used to pull on the other end of the rope. The fixed pulley doesn't make the work easier; it just changes the direction of the force which can make it easier to lift.

- A single pulley changes the direction of the lifting force. You can pull down on a rope to lift an object rather than lifting up or pushing up.
- The same amount of effort is needed as would be without a pulley, but it feels less because you are pulling down.

Movable pulley

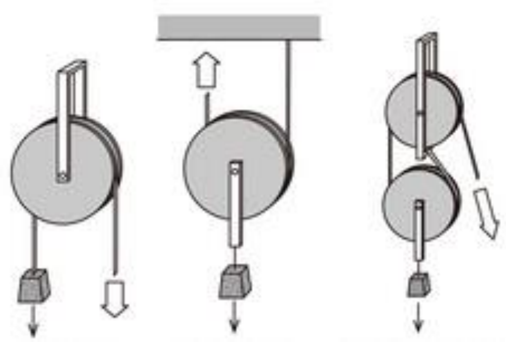
A movable pulley is a pulley that is free to move up and down, and is attached to a ceiling or other object by two lengths of the same rope.

- The pulley moves with the load.
- Allows the effort to be less than the weight of the load.
- With a single movable pulley, the effort required is ½ of the load.

Combination pulley

A combination pulley is a type of pulley that has and uses movable and fixed pulleys simultaneously.

- Combination of a fixed and movable pulley
- Depending on the rope configuration, can result in a change of direction *and* a decrease in effort force



Fixed **Movable** **Combination**

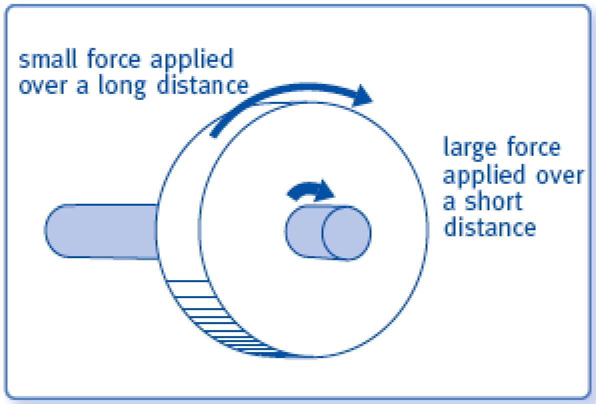
Q: What are some examples of pulleys?

A: Answers will vary, refer to slide 10 or Pulley Poster, Appendix B.

Wheel and axle

The wheel and axle consists of a large wheel rigidly secured to a smaller wheel or shaft, called an axle. The force applied to the wheel is multiplied when it is transferred to the axle, which travels a shorter distance than the wheel. The diameter of the wheel relative to the axle can be thought of like a lever; the bigger the difference, the more mechanical advantage there is.

Q: What are some examples of something with a wheel and axle?
A: Answers will vary, refer to slide 12 or Poster, Appendix C.



Gears

Gears are used to slow things down, speed things up or change direction. How gears operate relative to one another is determined by the gear ratios, or the size of the gears compared to one another.

Q: What are some examples of things with gears?
A: Answers will vary, refer to slide 14 or Gears Poster, Appendix D.

Work

Now before we divide into small groups to do the activities using simple machines to do work, we need to define what work is.

Show the title of the "What is Work" slide.

Q: What is work?

A: *Answers will vary.*

Work is a force applied through a distance.

W= F X D   Work = Force multiplied by the Distance

Simple machines make work easier by decreasing the amount of force needed at the expense of greater distance.

Work analogy

The following analogy presents the work equation in a scenario which helps to describe the terms. This analogy will help get the point across to young learners, and introduces the concept of defining terms in an equation with examples in real life.

The analogy is centered on taking out the garbage, a form of "work" for many students!

Q: How many of you have to take out the garbage?

In looking at the Work equation, imagine that the "W" represents the work you have to do, the "F" represents the weight of the garbage, and the "D" represents how far you have to take the garbage.

The garbage weighs ten pounds. You have two choices of where to take it: right outside your back door, or to the curb.

Q: Which is more Work, to take the garbage outside your back door or to the curb?

A: Students will answer: "To the curb"!

So in this equation, taking the garbage to the curb represents a further distance, so the work done is greater.

Now imagine you only have to take the garbage outside the back door, but there is a 10 pound bag and a 20 pound bag.

Q: Which is more Work, to take the 10 pound bag or the 20 pound bag?

A: Students will answer: "The 20 pound bag"

Point out that in the second example, even though it was the same distance, the weight (force) was bigger for the 20 pound bag, so more work was done.

This analogy can help introduce students to the fact that math and science are connected, and that the science terms used in math equations relate to objects and actions.

Optional Work Demonstration Activity – Pencil, Ruler and Book:

This activity can best be used either before or after the activity by the teacher to reinforce the lesson.

- **Remember**: Work = Force applied through a distance, or W= F x D

To make more sense of this definition we are going to use a ruler, a pencil, and a text book.

- Work (lifting the weight) = Force (how hard you had to push down on the ruler) multiplied by the Distance (how far down you push the ruler).

Place the book on a flat surface with the binding facing your left hand. Slide the ruler under the edge of the book binding up to the half inch mark. Position the pencil under the ruler at the six inch mark. Press down on the twelve inch mark of the ruler until the book is completely lifted. Do this once again and observe the distance between the table and the twelve inch marker on the ruler.

Move the pencil to the four inch marker on the ruler and use your little finger to lift the book.

Q: What difference did you notice in the amount of force necessary to lift the book?
A: It was a bit less.

Q: What has happened to the distance between the table and the ruler since we moved the pencil to the four inch marker?
A: The distance doubled.

Finally, move the pencil to the two inch marker on the ruler and use your little finger to lift the book.

Q: What difference did you notice in the amount of force necessary to lift the book?
A: It got even easier and took a lot less force.

Q: What has happened to the distance between the table and the ruler since we moved the pencil to the two inch marker?
A: Again, the distance doubled.

The lever made it much easier to lift the book, as the distance increased the amount of force needed decreased.

Activity Stations and Safety

Use the Activity Stations and Safety slide to introduce the stations.

Now we are going to work! Each of you will have an opportunity to use all of the simple machines set up around the room. When you start each station, gather at each station and listen closely to the volunteer who will give you an introduction to the activity. It is very important to be safe when using simple machines. At Micron when working, we always put safety first to ensure team members are not injured. We want to do the same today.

Here are a few safety guidelines that you need to follow:

- Listen to instructions carefully.
- Keep your hands to your sides.
- Wait your turn.
- Do only what you are instructed to do.

You will be going to the different stations:

- At the lever station we will investigate how weight can be lifted with very little effort.
- At the pulley station we will learn about how pulleys are used in machines where it is required to change the direction of or reduce an effort force.

At the gears and wheel and axle station you will experience how to gain mechanical advantage with a wheel & axle, and also will explore how gears, gear trains and gear ratios work.

Lever Station

Have the students gather in a line in front of and parallel to the lever arm.

Q: What is a lever used for?
A: A lever is a simple machine used to lift objects and can be modified so that it can be used to cut or open objects.

A lever is made up of four parts: rod (sometimes called an arm), fulcrum (or pivot), load, and effort.

Q: Which part of our lever is the load?
A: The bag of weights (object being lifted).

Q: Which is the arm?
A: The long bar

Q: Which is the fulcrum?
A: The support that the bar is on.

The fulcrum is sometimes called the pivot. It can be described as a fixed point upon which the arm or rod will pivot. Some fulcrums are stationary and others can be moved. Seesaws have stationary fulcrums.

The fulcrum that we are going to use to lift the weight is movable.

Q: Where is the effort?
A: Point of force applied to move the load.

Pay close attention each time the fulcrum is moved and the weight is lifted to:

- The change in force needed to lift the weight
- The distance the force end of the arm moves
- The distance the load moves

Have students line up on one side of the lever. The lever arm should be placed on the fulcrum at the point furthest from the load. Explain how to apply force to the arm (only with a hand, never with a foot or other body part), how to move the weight slowly up and then down, and where to stand to avoid being bumped with the end of the lever arm when lowering the weights. Instruct the students to participate one at a time, and to return to the line when finished.

Caution: The load must be lowered slowly to avoid possible injury from the weights or the lever arm. Have the students return to the line to avoid injury when the next student is participating.

NOTE: The lever arm should only be pushed on by one student at a time, using one or both hands. At no time should students stand or sit on the lever arm to lift the load, nor should more than one student be trying to lift the load.

The students will participate one at a time trying the lever at each setting. For the first group have the weight bag unattached and ask them to each lift the bag, discussing how difficult it would be to have to lift this weight repetitively.
For each setting of the lever arm have each student take a turn at lifting the load by pushing on the end of the lever arm. They will note that at the first setting it is more difficult to lift the load than without the machine!

After each student has a turn, ask the following questions.

Q: How do you think the effort will change when we move the fulcrum closer to the load?
Encourage all responses. Allow time for students to respond.
A: It will change the amount of effort required.

Move the arm so that the fulcrum is closer to the load. Have each student lift the load again.

Q: Was the work you did this time different than before?
A: Yes, the force required to lift the load was less, but the distance that the arm moved was greater.

Continue to move the arm on the fulcrum closer to the load one notch at a time allowing each student to experience how the effort/force required changes. Each time you move the arm draw the students' attention to how the force decreases and the distance that the arm increases. Explain that each time the fulcrum is moved closer to the load in this type of lever, mechanical advantage is gained.

Brainstorm with the students examples of levers: hinges, seesaw, hammer, bottle opener, fork, nutcracker, crowbar, fishing rod, wheelbarrow, wrench, stapler, scissors, and shovel.

Time permitting discuss the difference between first, second, and third level levers.

The position of the fulcrum determines the class of the lever.

<u>Class 1 Lever</u>

- The fulcrum is between the load and the effort.
- Examples:
  - Scissors
  - Seesaw: The load is the person who goes up, and the effort applied is the weight of the person who goes down. The rod is the board that you sit on and the fulcrum is the center pivot.

<u>Class 2 Lever</u>

- The fulcrum is on one end and the effort is on the other. The load is between the fulcrum and the effort.
- Examples:
  - Nutcracker
  - Wheelbarrow: The axle of the wheel is the fulcrum, the handles take the effort, and the load is between them.

<u>Class 3 Lever</u>

- The effort is between the fulcrum and the load. Examples include a stapler, hockey stick, and a shovel.
- Examples:
  - Stapler
  - Hockey stick
  - Shovel

Pulley Station

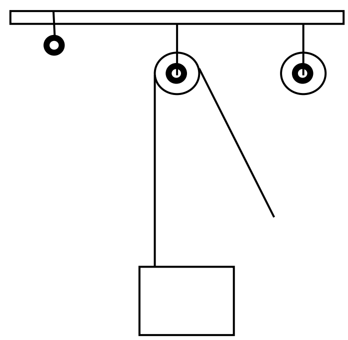
Have students stand in a line or semi-circle in front of the station. Introduce the concepts of fixed, movable, and combined pulley systems, explaining that they will get a chance to experiment with each type. Explain to the students that it is important to pull up or down on the rope in direct alignment with the direction of the pulley.

Single pulleys are used in machines where the direction of movement must be changed. *(Discuss examples, such as an elevator).* This change of direction can be arranged with a wheel and a rope. The wheel is fixed to a support, and the rope is run over the wheel to the load. A pull downward on the rope can lift the load as high as the support. The load moves the same distance as the rope is pulled.

Show the students the bag of weight. Have each student lift the bag. Discuss with the students how a pulley can help to lift this weight, especially in a repetitive situation.

Fixed Pulley

Thread the rope through the center pulley attached to the pulley bar.



Q: What type of pulley is this?

Encourage students to look back at the poster to find the answer.

A: This is a fixed pulley. One pulley attached to a stable arm.

Q: Do you think that the force required to lift the bag will be less than, equal to, or more than the weight in the bag?

Encourage each student to make a prediction.

Have each student pull down on the rope to lift the weight.

A: The effort force is equal to the weight of the bag.

*This point can be reinforced by observing that there is essentially **one** length of rope holding up the weight.*

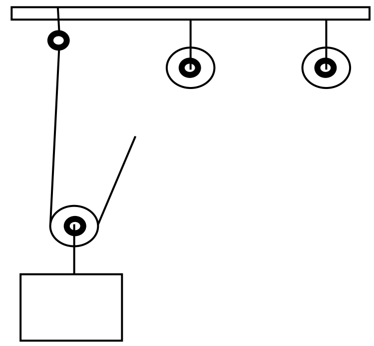
Have the students observe how far the rope has to be pulled to lift the bag to the pulley.

Movable Pulley

Q: What do you think will happen to the amount of force required to lift the bag if we use a movable pulley?
A: Answers will vary

Thread the rope hanging from the pulley bar through the pulley on the bag. Have each student pull up on the rope to lift the weight.

Note: Do not attach rope to the right pulley as shown in the photo. It is attached only for ease of photography.



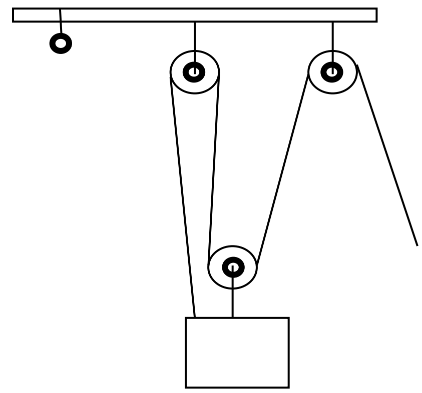
Q: Did it take more force or less force to lift the weight than when we used a fixed pulley?
Let students first observe what they felt with respect to the weight. Emphasize that the weight is not "lighter", but that this pulley setup gives greater mechanical advantage.

A: Using a movable pulley it took less effort force to lift the load because the weight of the load is supported by two rope segments.

Encourage students to notice how far the rope has to be pulled to lift the weight to the bar, especially in comparison to using only the fixed pulley. Point out to students that the distance that the rope had to travel increased when the force to pull the load decreased. This will help to reinforce that the force required decreases at the expense of the distance.

Combination Pulley

Thread the rope as indicated in the diagram through the center pulley, the movable pulley and the second pulley on the pulley board. The rope will be pulled in a downward direction with three pulleys.



Q: Do you think it will be easier or harder to lift the bag with the combination pulley system?
Let the students make predictions.

A: The force should be about 1/3 of the weight because it is being supported with three rope segments. This is how pulley systems work. The third fixed pulley does not actually change how much effort is needed to raise the weight, it only changes the direction of the force required to lift the load.
Encourage students to notice how far the rope has to be pulled to lift the weight to the board. Point out to students that the distance that the rope had to travel increased when the force to pull the load decreased. This will help to reinforce that the force required decreases at the expense of the distance.

Q: Which pulley system gave the most mechanical advantage?
A: The combination pulley system gives the most mechanical advantage, evidenced by the fact that it took less effort to lift the same load.

Time permitting, review the types of pulleys:
Fixed pulley -- one pulley attached to a stable arm.

- Requires the same amount of force as the load itself.
- The single pulley changes the direction of the lifting force. You can pull down on the rope to lift the object rather than lifting up or pushing up. The same amount of effort is needed as would be without a pulley, but it feels less because you are pulling down.

Movable pulley

- The pulley moves with the load.
- Allows the effort to be less than the weight of the load.

Combination pulley – combination of a fixed and movable pulley

- When you add the second and third pulley at the pulley station you create a combined pulley.
- The amount of effort required to lift the load required is less than with either the fixed or the movable pulley.

Brainstorm with the students examples of pulleys: flag pole, mini-blinds, elevator, winch, wishing well, crane, window washing platform, sail rigging on a sailboat, swing at the Discovery Center.

Gears / Wheel and Axle Station

Wheel and Axle

The wheel and axle is a simple machine consisting of a large wheel rigidly secured to a smaller wheel or shaft, called an axle. The force applied to the wheel is multiplied when it is transferred to the axle, which travels a shorter distance than the wheel.

Gears are a special type of wheel and axle. The size of a gear determines the amount of work it is able to transmit.

Gears

Gears are used to slow things down, speed things up or change direction. How gears operate relative to one another is determined by the gear ratios.

Place the gears with magnets on the board provided or on a whiteboard. Demonstrate the following:

1. Line up two gears, show that the 2nd gear moves the opposite direction
2. Line up three gears, show that the 3rd gear moves the same direction as the 1st
3. Use the large gear to drive the small gear, demonstrate that this is an example of using gears to speed something up
4. Use the small gear to drive the large gear, demonstrate that this is an example of using gears to slow something down.

Q: Thinking of the gears like a wheel & axle, which gear ratio (large gear driving a small gear or small gear driving a large gear) will provide the most mechanical advantage? (Hint: think of using the lowest gear on your bicycle)
A: A small gear driving a larger gear provides more mechanical advantage – the force needed to move the gear is less. But the reduction in input force results in a reduction in distance for the driven wheel.

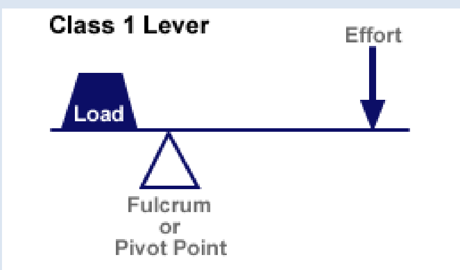
Hand out the gear activity sheets to each student, and assign a gear grouping to each group of children (2 – 4 in a group). Have the students explore gears with the gear activity kits and activity sheets. Help them to explore and think through the questions about how gears work. Guide the students through the "All About Gears" Activity Sheet, starting with the "Explore" side and continuing with the "Gear Math" side if there is time.
Brainstorm with the students examples of gears: clock, automobile, drill, motorcycle, and bicycle. Also brainstorm why it would be important to need to change the speed of the driven gear in different applications.

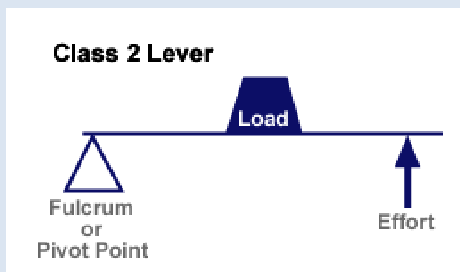
Conclusion

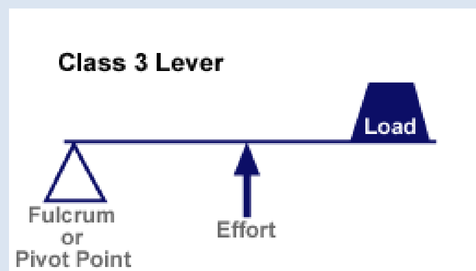
Now we have learned about four types of simple machines.
Ask students to name one thing they learned about each of the four types of simple machines: levers, pulleys, wheel & axle and gears. Lead them to the answers about how each machine helps to gain mechanical advantage.

Levers

- A lever is a simple machine used to lift, cut or open objects.
- Parts of a lever:
  - *Straight rod or arm* that pivots on a point called a *Fulcrum*, a *load* and an *effort (or force)*
- Three types of levers:





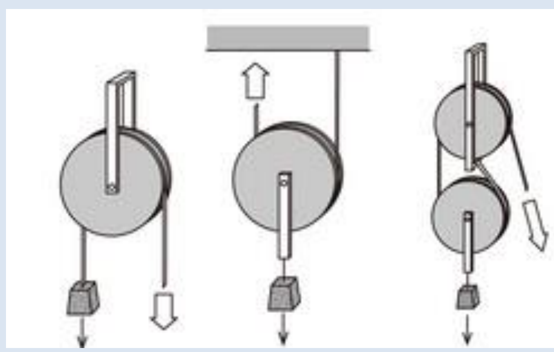


Examples of Levers

- Door on hinges
- Seesaw
- Hammer
- Bottle opener
- Fork
- Nutcracker
- Shovel
- Crowbar
- Fishing rod
- Wheelbarrow
- Wrench
- Stapler
- Scissors

Pulleys

- A pulley can change the direction or size of the effort force, making it easier to lift objects to a higher place.
- A pulley is made up of a grooved wheel that turns around an axle with a rope passing through it.
- Three types of pulleys:
  - Fixed
  - Movable
  - Combined



Examples of Pulleys

- Flag pole
- Mini-blinds
- Elevator
- Winch
- Wishing well
- Crane
- Window washing platform
- Ski lift
- Rigging on a sailboat
- The swing at the Discovery Center!

Wheel and Axle

- The wheel and axle consists of a large wheel rigidly secured to a smaller wheel or shaft, called an axle.
- A force applied to the wheel is multiplied when it is transferred to the axle, which travels a shorter distance than the wheel.

Examples of Wheel and Axle

- Pencil sharpener
- Rolling pin
- Windmill
- Roller blades
- Dishwasher rack rollers
- Bike wheel
- Car wheel
- Wagon Wheel
- Door knob
- Skate board wheels

Gears

- Gears are used to slow things down, speed things up, or change direction
- Gear description:
    - Toothed or pegged wheels that fit together

Examples of Gears

- Clock or watch
- Automobile
- Drill
- Hand-mixer
- Motorcycles
- Bicycles

All About Gears

Demonstration Materials:

- Small portable metal whiteboard
- From the Lakeshore Learning "Turn and Learn Magnetic Gears" set:
    - Two large gears
    - Two small gears

Activity Materials:

For each student:

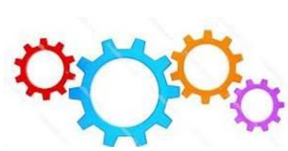
- All About Gears Activity Page (from Micron K12)
- Pencil

For each group of two students:
Using the Learning Resources "Gizmos & Gears" set

- 2 each 8 tooth gears+
- 2 small bases
- 1 each 12 tooth gear+
- 1 medium base
- 1 each 16 tooth gear+
- 1 large base

+ Each gear should have a dot next to one of the teeth
+ Gears can be marked with "8", "12", and "16" as appropriate

Initially assemble the base/gears so that the large gear is adjacent to both a small gear and a medium gear. The 2nd small gear should be adjacent to the medium gear. *Example:*



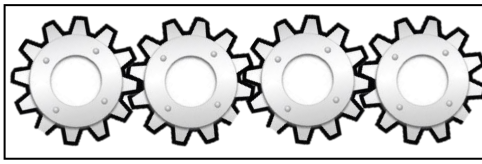
Name: ___________________

All About Gears

Activity Sheet2015

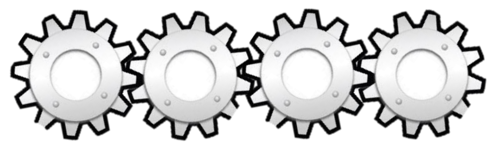
Explore with the gears to answer the following

How many gears does it take (minimum) to make one gear turn another gear in the **opposite** direction? _________



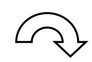
Put arrows on the gears that are used, showing the direction they

How many gears does it take (minimum) to make one gear turn another gear in the **same** direction? __________

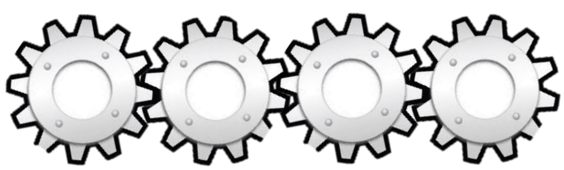


Put arrows on the gears that are used, showing the direction they

Think about it:

If you have **four** gears together and the **first** one turns clockwise  which way does the **fourth** gear turn? ____________________________

Show it:



Try it! (put four gears together) Were you right? _______

Extra thinking:

If you have a lot of gears next to each other, how do you know which direction any one gear is going to go?

<u>Gear Math</u>

1. Find a pair of gears so that if you turn one of the gears **once**, the other gear will turn **twice.** How many teeth are on each of the gears?

    The gear that turns **once** has: _______ teeth

    The gear that turns **twice** has: _______ teeth

2. Find a pair of gears so that if you turn one of the gears **twice** the other gear will turn **three** times. How many teeth are there on each of the two gears?

    The gear that turns **twice** has: _______ teeth

    The gear that turns **3 times** has: _______ teeth

3. Find a pair of gears so that if you turn one of the gears **four times** the other gear will turn only **three** times. How many teeth are there on each of the two gears?

    The gear that turns **4 times** has: _______ teeth

    The gear that turns **3 times** has: _______ teeth

Think about it:

How do you use gears to speed something up?

How do you use gears to slow something down?

Assembly and Setup of Machines activity stations

Lever station

1. Set up the lever arm in the slot furthest from the weight.

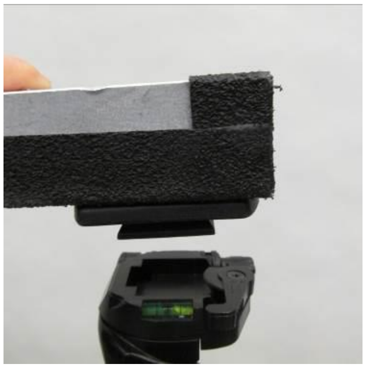
2. Wait to attach the weight bag until after the first group has gotten to the station

3. Move the lever arm as you go through the exercise

Pulley Station

1. Set up the tripods, making sure that:
    a. The legs are fully extended and locked
    b. The base is level
    c. There is an adequate space between the tripods for the students to raise the pulley.

2. Attach the pulley bar to each tripod, as shown



3. Attach the weight bag according to the lesson details.