

A Journey Through Time With Simple Machines

Grade 5 Science

Introduction

This center provides an opportunity for grade five students to explore some of the properties behind simple machines and how these machines transfer force and energy. The six activities in this center study key concepts behind inclined planes, screws, wedges, levers, wheel and axles, and pulleys.

Big Idea: Machines are devices that transfer force and energy.

Curricular Competencies:

- Make observations in familiar or unfamiliar contexts
- With support, plan appropriate investigations to answer their questions or solve problems they have identified
- Use equipment and materials safely, identifying potential risks
- Communicate ideas, explanations, and processes in a variety of ways

Content

1. Properties of simple machines and their force effects
2. Machines: constructed & found in nature

First People's Principle

- Learning is embedded in memory, history, and story.
- Learning involves patience and time.

Rational

For this center, students will form groups to explore all of the activities at once in different stations around the room. By providing students with an opportunity to build and explore simple machines, they can better understand the big idea from the science 5 curriculum that “Machines are devices that transfer force and energy.” This engaging and fun center encourages students to ask questions and solve problems while exploring knowledge and history that connects to each topic throughout time. Not only does this center revolve around key concepts in the grade five science curriculum, it connects with grade five “Applied Design, Skills, and Technologies” curriculum as students are encouraged to create prototypes and test their ideas using practice, effort and action. Students will be encouraged to write their observations, explore ideas and document knowledge about each activity in a booklet or journal.

Assessment

We suggest a journal or booklet for students to write down their thoughts and ideas from each activity. Assessments can also be made through observations of students during the activities.

Safety or Other Concerns

Wedge Station – Students must wear goggles and work gloves for splitting logs. Splitting logs may be difficult for teachers to prepare if they do not have access to a lot of logs. An alternative would be to glue pieces of wood together for students to split apart with a wedge and rubber mallet.

Screw Station Extension – due to sharp nails, this activity needs supervision, so we have designed it as an extension to do with teacher guidance.

Wheel and Axle Station - Students may poke themselves with the thumbtack as they push the pin through the wooden chopstick, make sure the chopsticks are soaked in water so that wood is softer and doesn't split.

Learning Centers

Before starting, students will receive a booklet to write and draw their ideas in. Each station will have a shoe box labelled with the simple machine on the top of the box and when students flip the lid of the box they will discover where they have travelled back to, glued on the inside of the lid. Along with the time they have travelled to, students will learn historical information about that device during that time period and location. Inside each box for each station will be the supplies and instructions for that simple machine. For groups to pick which station they start at, we suggest numbering all stations one through six and rolling a six sided dice to see where the groups end up first.

The following is a brief description each station and the time period and area we focus on with a list of instructions for the students to follow for each station. Please see appendix for details on historical information.

Station 1 - Inclined Plane

An inclined plane helps raise or lower an object. It is widely used to help move objects over something.

Historical facts: You have travelled back in time to...Maya Civilization (Southern Mexico)

It's the year 420 A.D. and you are in the Mayan city of Calakmul!

Materials: Labelled shoe box with instructions, wooden ruler or paint stick, small rock or object and 2 marbles. Also include a pool noodle cut in half.

Activity 1: Discover where you time travelled to and write down the information in your journal.

Activity 2: Using an Inclined Plane to Push an Object

Goal: to understand how an inclined plane can be used to lift an object over and on top of something.

Directions:

1. Lean the ruler against the shoe box.
2. Use your finger to push the rock up the ruler and on to the top of the shoe box.
3. Take the ruler away and try to push the rock up on to the top of the box using your finger only.
4. How do inclined planes help in this situation?

Activity 3: Pool Noodle Marble Track

Goals: to discover how different angles of inclined planes affect how fast marbles move and how far they travel afterwards.

Directions:

1. Find the marbles in the shoe box and the pool noodles.
2. Take the pool noodles and explore different ways of creating an inclined plane.
3. Test the inclined planes using a marble to see if the plane is steep enough to move a marble.
4. Play with the marble race tracks.
5. Write down your findings in the booklet.

**Station 2 - Screw**

A screw can hold things together or it can help lift an object. A screw is an inclined plane wrapped in a spiral shape around a cylinder.

Historical facts: You have time travelled back in time to...Greece

It is the year 234 B.C. and you are working with the Greek inventor Archimedes.

Materials: Labelled shoe box with instructions, plastic water bottle with lid (larger bottles are easier), cardstock or thick paper, glue gun, pencil or chop stick, cereal, items to put in a mysterious box that are a screw such as a screw, jar lid, photo of spiral staircase, bolt, nuts, etc and items that are not screws such as a marble, Lego, toys etc.

Activity 1: Discover where you time travelled to and write the information in your journal.

Activity 2: Explore Mysterious Items

Directions:

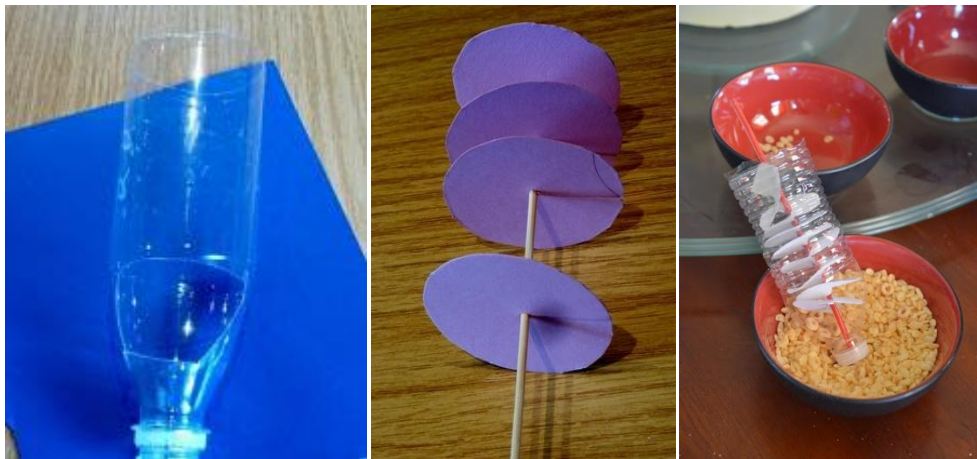
1. Look through the items in the box and decide which ones are screws. Write these items in your booklet.
2. Write down any ideas of other spiral devices that you can think of in your booklet.

Activity 3: Archimedes Screw Bottle

Goals: to understand how to move water (or cereal) from a low level to a higher level using an enclosed screw

Directions:

1. Cut the bottom off the plastic bottle
2. Cut a 1-2 inch hole in the neck of the plastic bottle
3. Cut 6 circles out of cardstock that fit snug inside the bottle
4. Cut a slit in each circle – to the center
5. Place onto the pencil
6. Use the glue gun to attach one side of the circle to the one above, then the other side to the one below, forming a spiral.
7. Stretch the spiral out and attach ends to pencil with glue gun
8. Place spiral into bottle, ensuring the bottom spiral is below the neck opening
9. Hold bottle at an angle, turning pencil at the top, this should move the cereal up the “screw” to the top of the spiral



Station 3: Wedge

A wedge is made up of two inclined planes and can be used to drive objects apart.

Historical facts: You have time travelled back in time to...Ancient Egypt

It is the year 2520 B.C. and you find yourself in the Al Giza desert in Egypt.

Materials: Labelled shoe box with instructions with another smaller box inside containing mysterious objects to identify whether or not they are wedges such as; zipper, nail, knife, fork,

corkscrew, doorstop, pencil sharpener, kitchen scraper, (all wedges), marble, rock, paper clip, magnet, fabric, toys, etc. (not wedges), 2 plastic wedges, rubber mallet, goggles and work gloves. Along with the shoe box you will need to cut pieces of log with split to put wedge in.

Activity 1: Discover where you time travelled to and write information in your journal.

Activity 2: Exploring Mysterious Items in Shoe Box

Set up:

- Decorate a shoe box with a sign that says “Mysterious Items To Explore”
- Put a variety of items in a shoe box that may or may not be a wedge

Goal: to explore what a wedge could be.

Directions:

1. Open up the box of items and decide which ones are wedges.
2. Check your answers against the answer key your teacher has.
3. Write and draw your findings in your booklet.

Activity 3 - Using a Wedge or Wedges to Drive a Log Apart

Set up:

- Clear a space on the floor.
- Put log on flat side with a split big enough for a wedge to fit inside

Goal: to use a wedge or both wedges with the rubber mallet to drive the wood apart.

Directions:

1. Take turns within your group to work through the following steps.
2. Place one wedge into the split of the log.
3. One student at a time uses the rubber mallet to hit the wedge and try to make the split bigger. Each student gets to hit the wedge 4 times.
4. Put the other wedge in the split once the split becomes big enough to fit two wedges.

Activity 4:

1. Write in your booklet all the wedges you can think of in nature.

Station 4: Lever

A lever is a beam or rod that rotates on a fulcrum to help lift heavy things with less effort.

Historical facts: You have time travelled back in time to...Medieval Scotland

The year is 1304 A.D. and you are helping King Edward I lay siege to Stirling Castle!

Materials: Labelled shoe box with instructions, a wooden ruler, small rock, large rock, few pieces of Lego stuck together or something to use as a fulcrum, small popsicles sticks, small marshmallows, lids off juice jars or plastic spoons, elastic bands and a tape measure and a glue gun. Optional: a bull’s eye for students to aim at or make into a target.

Activity 1: Discover where you time travelled to and write information in your journal.

Activity 2: Lift a Large Rock with a Small Rock Using a Lever

Goals: to figure out where to put the fulcrum as compared to the effort and load with a lever. (This is a first class lever where the fulcrum is in between the load and the effort.)

Directions:

1. Take the wooden ruler, clip or Lego and two rocks out of the shoe box.
2. Try to create your own lever with the materials supplied.
3. First, lift the small rock with the large rock.
4. Second, lift the large rock with the small rock. Think about how you can move the fulcrum along the lever in different directions.
5. Draw a picture of the lever in the position that you used to lift the large rock with the small rock.

Activity 3: Making a Catapult

Goals: learn how a lever can be used as a catapult which is a second class lever where the load is in between the fulcrum and the effort.

Directions:

1. Stack 5 regular size Popsicle sticks together.
2. Use two elastic bands (one on each end of the stack) to hold together.
3. Take two Popsicle sticks and stack them together. Wrap one rubber band around one end of these two sticks to hold them together.
4. Pull the two Popsicle sticks slightly apart and place the larger stack of sticks in between the two.
5. Attach the larger stack to the stick on the top using a rubber band.
6. Attach a small container lid to the end of the top Popsicle stick, using a glue gun.
7. Launch marshmallows or pompoms.



Station 5: Wheel & Axle

A wheel and axle is a device that consists of a wheel joined to an axle, where both parts rotate together when a force is applied. There may be a hinge or bearing to support the axle to help with rotation. Wheels and axles are often used to help carry loads over long distances.

Historical facts: You have time travelled back in time to...Mesopotamia.

It is around 1000 A.D. and you are in the village of Nashtifan, Mesopotamia (modern day Iran).

Materials: Labelled shoe box with instructions, cheap wooden chopsticks (or wooden skewers), square pieces of origami paper, thumbtacks, beads, scissors, pinwheel template and samples of

pinwheel already made. Before the station begins, make sure to place a small plastic cup with some water in it nearby.

Activity 1: Discover where you time travelled to and write the information in your journal.

Activity 2: Making a Pinwheel

Goals: Make a pinwheel and think about how it compares it to a Dutch style windmill.

Directions:

1. Soak the thick end of the chopstick in water. (The thumbtack is easier to push through the wood and doesn't split when it is wet).
2. Fold the square origami paper corner to corner on both sides so you have a folded "X" going through the square.
3. Cut along the folds towards the center, just past half way like the template example.
4. Use the template and notice the holes. Use the template holes to see how the thumbtack pokes through each right hand corner of each side cut corner. Poke through each corner joining the corners together. Go slowly and be careful not to poke your fingers.
5. Once all the corners are poked through, poke the thumbtack through the center and add a bead at the back.
6. After you have added the bead, push the thumbtack on to the thick end of the chopstick. See the example in photograph below. *Please be careful of the sharp thumbtack that may stick out of the back of wooden chopstick.*
7. Play with your pinwheel. What do you notice about it? Please write your findings in your booklet.



Station 6: Pulley

A pulley uses a rope or string around a wheel to lower, raise or move a load.

Historical facts: You have time travelled back in time to...Halifax, Nova Scotia
The year is 1921 and you find yourself setting sail on the Blue Nose schooner.

Materials: Labelled shoe box with instructions with carabiner, small rope, rolling pin and cloth shopping bag. Students will also need two chairs or two tables the same height and something heavy such as books.

Activity 1: Discover where you time travelled to and write information in your journal.

Activity 2: Building a Pulley

Set up: Have two chairs the same height or two tables to fit a rolling pin across (see photo).

Goal: to understand the basics of how a pulley works.

Directions:

1. Put the rolling pin over the back of two chairs (please see photo).
2. Tie the rope to the bag and wrap it around the rolling pin.
3. Pull down on the rope over the rolling pin and see if it feels different than pulling up on the handles of the bag.
4. Next attach a carabiner to the handle of the bag and loop the end of the rope through the carabiner. Pull up on the rope that comes through the carabiner (please see photo).
5. What do you notice now about how heavy the load is?
6. Write down your findings in your booklet.



Sources:

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Appendix

- Historical information about each of the six simple machines
- Simple Machine Student Booklet

You have travelled back in time to Mesopotamia!



It is around 1000 A.D. and you are in the village of Nashtifan, Mesopotamia (modern day Iran).

Walking through the village, you see vertical windmills constructed to grind flour for bread.

[File:Wind mills of Nashtifan 2.jpg ...](#)
[Commons.wikimedia.org](https://commons.wikimedia.org)

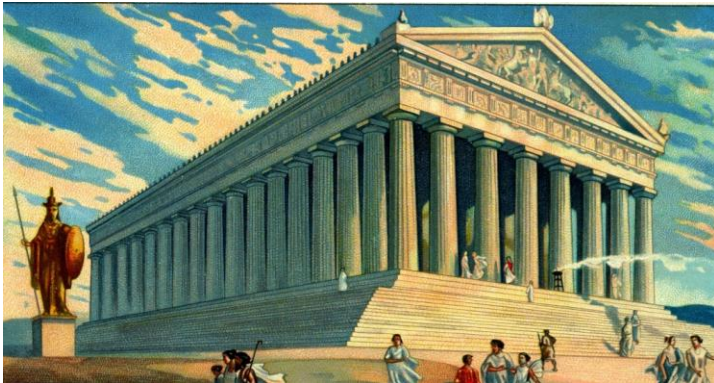
Keen to share what you know about windmills, you make a replica of Dutch style windmills to compare the two types.



The vertical style of windmill at Nashtifan is powered by drag, instead of lift. European-style windmills are powered by lift.

https://commons.wikimedia.org/wiki/File:Dutch_windmills,_Holland,_ca._1905.jpg

You have arrived in Ancient Greece!

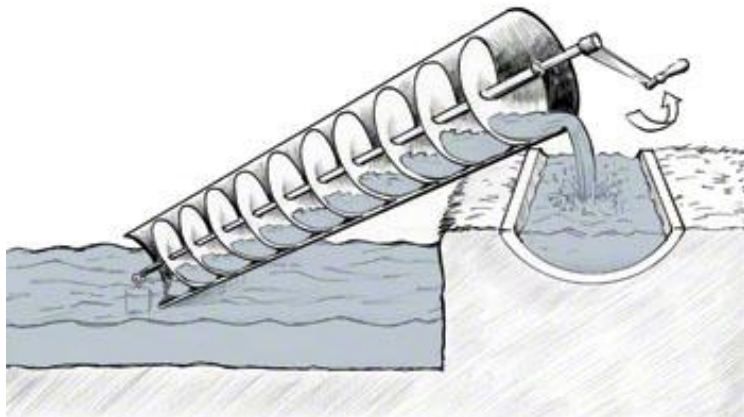


It is the year 234 B.C. and you are working with the Greek inventor Archimedes. He has returned from Egypt with a plan for retrieving low-lying water and moving it to higher ground.

You are asked to construct a water screw that can lift water up in elevation!

<https://www.needpix.com/photo/1509869/temple-palas-athens-parthenon-ancientgreece-greekgods-vintage>

Can you make a “water” screw that transports cereal upwards?



The Archimedes screw is made up of a large screw inside a hollow pipe. It is actually a water screw – or screw pump - that was originally invented in Egypt. Archimedes brought the idea back to Greece with

him after visiting Egypt and seeing how well it worked transferring low-lying water to higher-level farming ditches.

https://en.wikipedia.org/wiki/Archimedes%27_screw

This invention is still used today.

<https://www.sciencefacts.net/archimedes-screw.html>

You have landed on a ship in Halifax harbour, Nova Scotia!



The year is 1921 and you find yourself setting sail on the Blue Nose schooner.

You are tasked with making sure the ship's rigging works properly, and all the pulleys are ship shape!

Have you seen this ship before? (Hint – look at some Canadian coins!)

https://commons.wikimedia.org/wiki/File:Bluenose_II_Toronto_01.jpg

Follow the instructions to assemble a pulley system strong enough to carry a heavy load!



Pulleys on a ship are often known as blocks. There are often grooves in the pulley to keep the ropes or cables moving freely and can be used to lift weights.

<https://en.wikipedia.org/wiki/Pulley>

What are the ship's pulleys holding up?

How does the pulley make loads easier to lift?

You have travelled to Medieval Scotland!



The year is 1304 A.D. and you are helping King Edward I lay siege to Stirling Castle!

Castles and walled cities are difficult to conquer – catapults are needed to lay siege to them!

<https://pxhere.com/en/photo/819430>

A battle is underway and you have been tasked with building a catapult!

Find the diagram and supplies inside this box to build your catapult. Test it for accuracy using the marshmallows!



A **catapult** is a **lever**, a stick or beam propped up by a fulcrum (a pivoting point).

<https://www.scienceworld.ca/resource/catapults>

Can you identify the fulcrum on your catapult?

What about the point of effort?

<https://pixabay.com/photos/medieval-catapult-medieval-catapult-4578210/>

You have travelled back to the time of Ancient Mayan civilization!

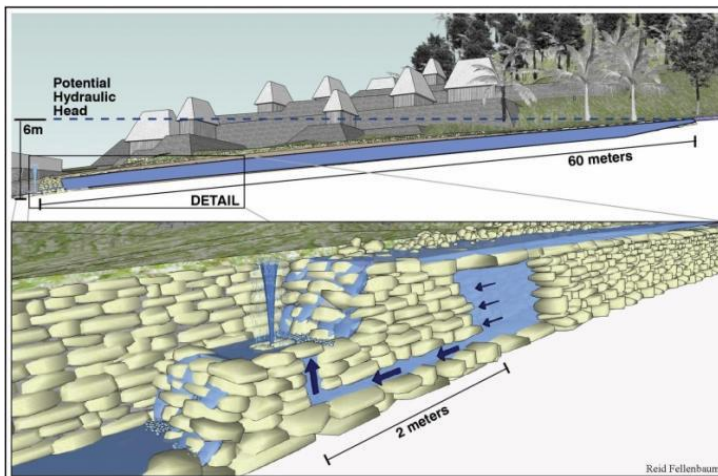


It's the year 420 A.D. and you are in the Mayan city of Calakmul! You arrived just in time to help construct a temple in the middle of the city. Inclined planes are used to move the heavy stones and stack them to make the temple!

<https://www.pikrepo.com/search?q=ancient+stone+temple&page=4>

Move a heavy load up an inclined plane, and then try to move the load without an inclined plane!

Test your canal building skills! Follow the instruction to learn how inclined planes help move loads.



The water system surrounding the inner city also uses inclined planes to move the water in the canals – covering a distance of 22-square-kilometers!

[en.wikipedia.org > wiki > Calakmul](https://en.wikipedia.org/wiki/Calakmul)

How does changing the angle of the slope affect the rate of objects flowing down the canal?

<https://whyfiles.org/2010/plumbing-ancient-mayan-plumbing/index.html>

You have arrived in Ancient Egypt!

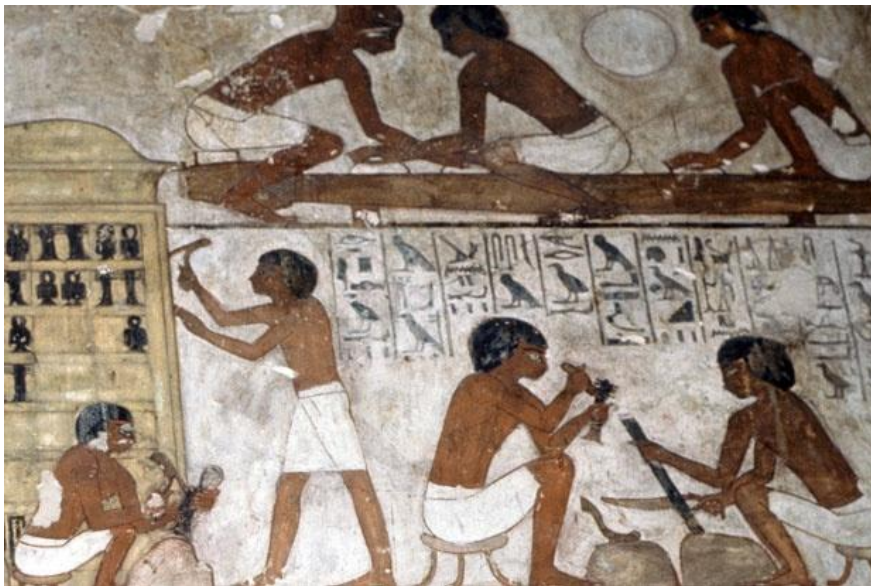


It is the year 2520 B.C. and you find yourself in the Al Giza desert in Egypt.

You are put to work splitting stones for the construction of the great pyramids of Giza.

https://en.wikipedia.org/wiki/History_of_ancient_Egypt

Follow the instructions to see how much effort it takes to split the wood.

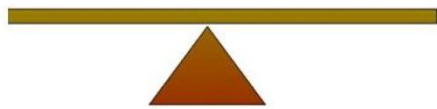


Ancient Egyptians soaked wooden wedges in water and inserted them into crevices in the stone. As the wood swelled from the water, it split the stones apart!

<https://www.quora.com/>

Another method of stone splitting requires placing a wedge in the crevice and hitting it with a mallet.

A Journey Through Time With Simple Machines



Lever



Inclined Plane



Wedge



Screw



Pulley



Wheel & Axle

<https://www.clipart.email/download/633791.html>

Name: _____

Inclined Plane



An inclined plane helps raise or lower an object. It is widely used to help move objects over something.

Write some facts about what you learned about an inclined plane found in history.

What object was the inclined plane? Please provide a description.

What time period was this item used? _____

What part of the world was this object from? _____

Please write some examples of inclined planes that you can think of:

What did you learn about inclined planes today? Does it matter how steep or flat the inclined plane is? How can you make a marble move down an inclined plane faster?

Screw



A screw can hold things together or it can help lift an object. A screw is an inclined plane wrapped in a spiral shape around a cylinder.

Write some facts you learned about a screw device found in history.

What object was the screw? Please provide a description.

What time period was this item used? _____

What part of the world was this object from? _____

Look through the items in the box and decide which ones are screws and write your answers here:

Please write down some other examples of screws that you can think of:

(Hint: spiral staircase, lid on a jar...)

Wedge



A wedge is made up of two inclined planes and can be used to drive objects apart.

Write down the facts you learned about a wedge found in history.

What object was the wedge? Please provide a description.

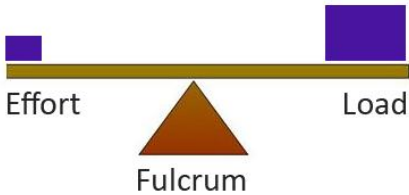
What time period was this item used? _____

What part of the world was this object from? _____

Please write some examples of wedges from the mystery box or ones that you can think up:

Please list all of the wedges you can think of in nature (Hint: sharp teeth):

Lever



A lever is a beam or rod that rotates on a fulcrum that can help lift heavy things.

Write some facts about what you learned about a lever found in history.

What object was the inclined plane? Please provide a description.

What time period was this item used? _____

What part of the world was this object from? _____

What did you learn about levers today? Draw a lever with a fulcrum, effort (small rock) and the load (large rock) you created where the small rock was able to move the large rock below.

Please write some examples of levers that you can think of:

Wheel and Axle



A wheel and axle is a device that consists of a wheel joined to an axle, where both parts rotate together when a force is applied. There may be a hinge or bearing to support the axle to help with rotation. Wheels and axles are often used to help carry loads over long distances.

Write some facts about what you learned about wheel and axles found in history.

What object was the wheel and axle? Please provide a description.

What time period was this item used? _____

What part of the world was this object from? _____

Please write anything you found interesting about creating and playing with your pinwheel.

Please draw or write some examples of devices that use wheel and axles? (Hint: door handle, wagon...)

Pulley



A pulley uses a rope or string around a wheel to lower, raise or move a load.

Write facts you learned about a pulley found in history.

What object was the pulley? Please provide a description.

What time period was this item used? _____

What part of the world was this object from? _____

Please write down what you discovered after creating your own pulley system.

Please write or draw some examples of a pulley.