

# **Machines at Work**

**Science Journal**

by

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# Wheels Rolling Along

Name \_\_\_\_\_

## Station I

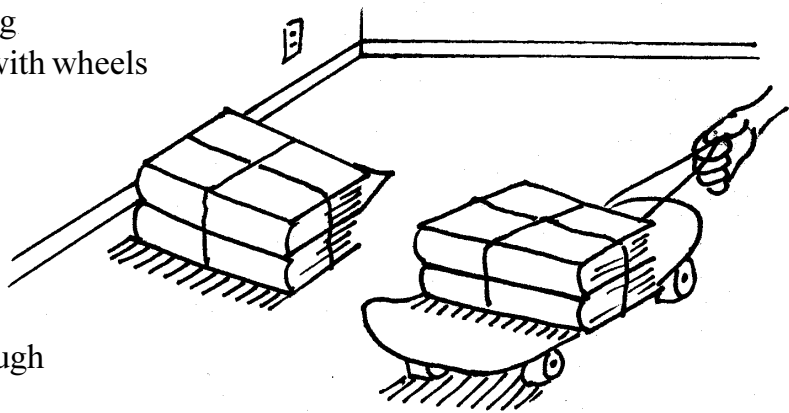
The wheel is one of the most important machines. It allows things to roll instead of slide when a force is applied. In this activity, you will observe how wheels help move an object.

### Materials

- Books tied together with string
- Skateboard or similar object with wheels
- Rubber band
- Ruler

### Procedure

1. Make a handle with the rubber band by looping it through the string.
2. Place the books on the floor and use the handle to pull them a short distance.
3. With the ruler, measure how far the rubber band stretches as you pull the books.
4. Place the books on the skateboard and use the handle to pull it a short distance. Use the ruler to measure how far the rubber band stretches.
5. Take turns doing steps 1-4 and discuss what you observe.



### Observations *(answer in complete sentences)*

1. What happened to the rubber band when you pulled the books without using the wheels?

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2. What happened to the rubber band when you pulled the books with the wheels?

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# Wheels Rolling Along *(continued)*

Name \_\_\_\_\_

**Station I**

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## Think About It!

1. Did it take more or less force to pull the books when they were on wheels? Why?

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2. Describe two ways a farmer uses wheels to make work easier on the farm.

a) \_\_\_\_\_

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b) \_\_\_\_\_

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3. Do you think using wheels in special ways makes the food we buy more or less expensive? Explain.

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# Levers Lifting the Load

Name \_\_\_\_\_

**Station 2**

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A lever makes it easier to move heavy things. Levers concentrate a force around a pivot point. A cattle rancher needs to use fences around the pasture. The heavy gates open and close easier because they have hinges that are levers. The gate fasteners are often levers too!

## Materials

- Light book tied with string
- Rubber band
- Ruler
- Yardstick marked at 24 inches
- Fulcrum or balance point of some kind such as metal bookend

## Procedure

1. Make a handle with the rubber band by looping it through the string.
2. With the ruler, measure how far the rubber band stretches as you lift the books off the table with your hand. This demonstrates the amount of force necessary to lift the books.
3. Place the fulcrum or bookend under the yardstick at the mark and put the books onto the short end of the yardstick. Attach the rubber band to the long end of the yardstick. Use the rubber band to pull the long end of the yardstick down, lifting the books on the short end of the yardstick. With the ruler, measure how far the rubber band stretches as you pull down.
4. Take turns doing steps 1-3 and discuss what you observe.

## Observations *(answer in complete sentences)*

1. Describe how it felt to pick the books straight up with your hand.

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2. Was it easier or harder to lift the books using a lever? Why?

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# Levers Lifting the Load *(continued)*

Name \_\_\_\_\_

**Station 2**

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## **Think About It!**

1. List two levers that make work easier for you.

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2. Describe how a farmer benefits from a hoe (a type of lever).

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# The Wedge Forces Apart

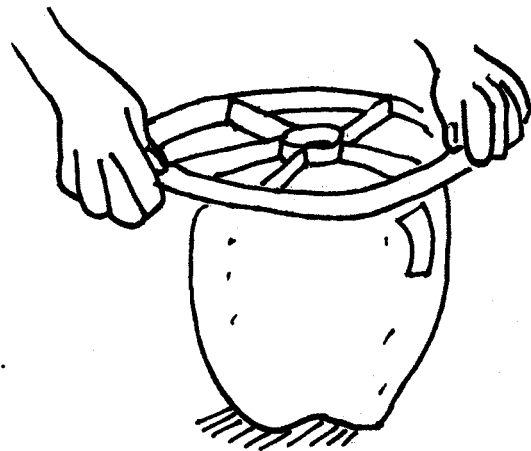
Name \_\_\_\_\_

**Station 3**

A wedge makes it easier to split things apart. When the wedge is pushed down, the object pushed upon splits apart. For example, after a farmer harvests apples and sells them, the apples are often peeled, cored and sliced to be used in pies. The knife, apple peeler, and cutter used to prepare the apples are wedges. You will use a wedge in this activity.

## Materials

- Apple
- Paper towels
- Plastic knife or metal apple cutter



## Procedure

1. Wash your hands and the apple before starting.
2. Put the apple on the paper towel.
3. Position the wedge (knife or apple cutter) on top of the apple and push down with a lot of force to cut the apple into sections.
4. Discuss your observations with the group as you enjoy eating your apple wedges.

## Observations *(answer in complete sentences)*

1. What was the wedge in this activity?

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2. What did the wedge do?

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3. What wedges did you use that are located in your mouth?

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# The Wedge Forces Apart *(continued)*

Name \_\_\_\_\_

**Station 3**

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## **Think About It!**

1. Why are knives and apple cutters called wedges?

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2. Why do you think a slice of apple is called a wedge?

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3. List two wedges that are used in your kitchen.

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4. Tractor tire treads are wedges. Why are there treads on tires?

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# The Pulley Has Pull

Name \_\_\_\_\_

**Station 4**

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Pulleys make lifting easier for people by changing the direction of a pull. There are many different kinds of cranes that lift and move heavy loads. Imagine what it would be like if pulleys were not used to raise and lower flags or to place hay in a barn. In this activity, you will observe how pulleys make work easier for people.

## Materials

- Paperback books tied together with string
- Pulley
- 3 feet of string
- Rubber band

## Procedure

1. Tie a string around the books. Make a handle with the rubber band by looping it through the string.
2. Lift the books with your hand using the rubber band as a handle. Measure how far the rubber band stretches.
3. Remove the rubber band, and pass the string through the pulley.
4. Attach the rubber band to the end of the string, and pull down on the rubber band to lift the books up. Measure how far the rubber band stretches as you pull.
5. Take turns pulling down on the rubber band, and discuss your observations.

## Observations *(answer in complete sentences)*

1. What happened to the books when you pulled down on the pulley?

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# The Pulley Has Pull *(continued)*

Name \_\_\_\_\_

**Station 4**

2. Was it easier to lift the books with your hand or with the pulley—or was it the same?

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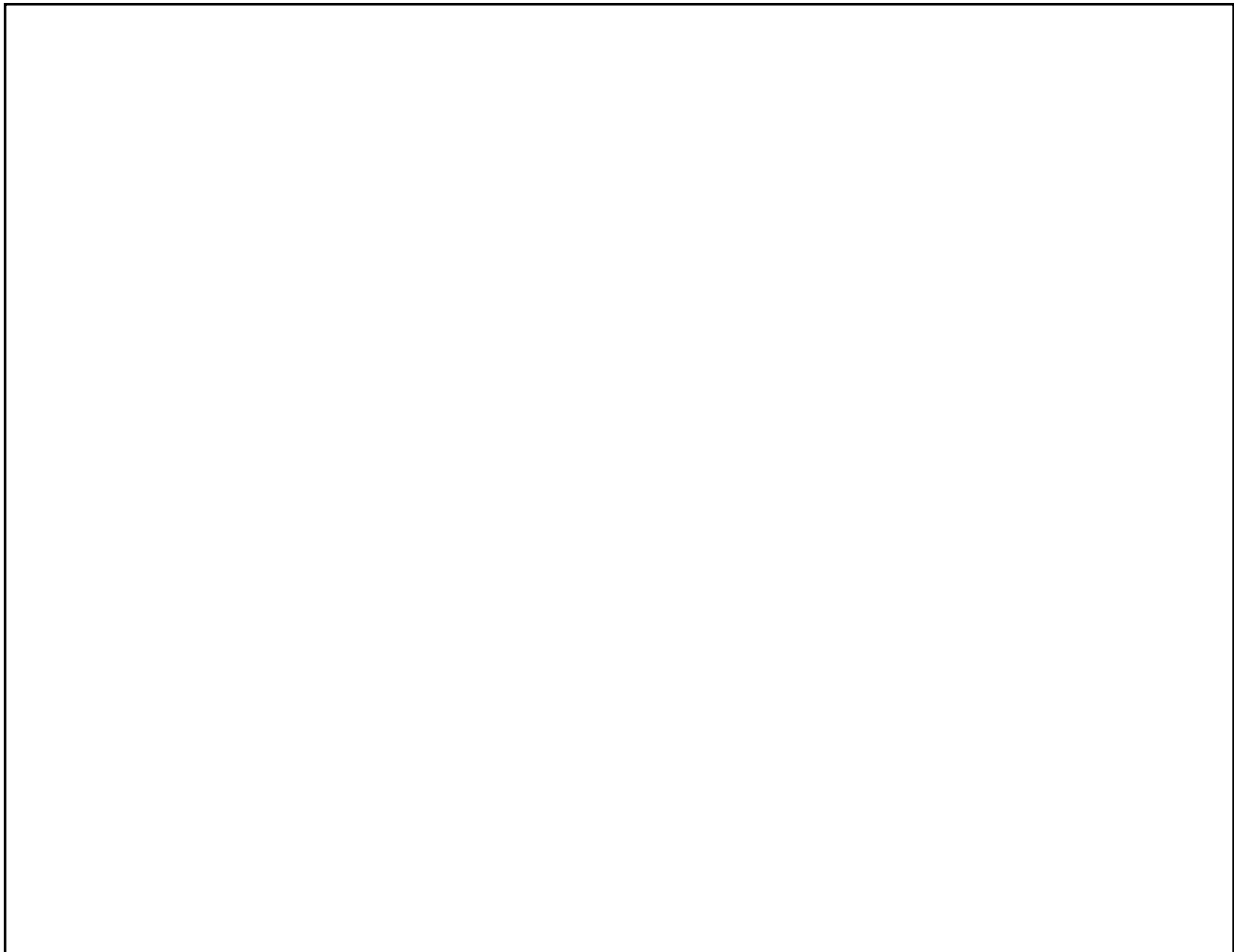
## **Think About It!**

1. Describe a situation where using a pulley would be helpful.

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2. Most elevators have pulleys. Draw a sketch of an elevator, including the pulley.



# Inclined Plane Going Up

Name \_\_\_\_\_

**Station 5**

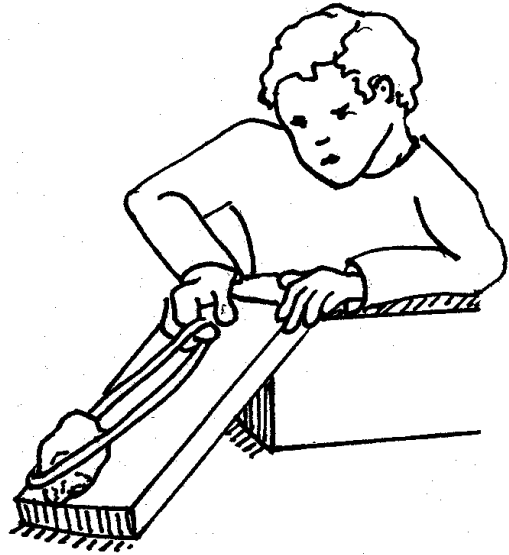
It is much easier to move a heavy weight up or down if an inclined plane is used. A ramp (a type of inclined plane) is very useful when a cattle rancher loads cattle onto trucks to move them from one pasture to another. In this activity, you will observe the usefulness of inclined planes.

## Materials

- Several books
- Rock tied with a string
- Rubber band
- Ruler
- Shoe box lid

## Procedure

1. Make a handle with the rubber band by looping it around the string.
2. With the ruler, measure how far the rubber band stretches as you use one hand to lift the rock straight up from the desk to the top of the books.
3. Stack three books on the desk. Rest the shoe box lid, top side up, against the books to make an inclined plane or slope. Use the ruler to measure how far the rubber band stretches as you pull the rock up the inclined plane. Stack more or less books to vary the steepness of the slope.
4. Take turns doing steps 1-3 and discuss your observations.



## Observations *(answer in complete sentences)*

1. Describe what happened when you changed the steepness of the inclined plane.

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2. When did the rubber band stretch less—using or not using the inclined plane?

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# Inclined Plane Going Up *(continued)*

Name \_\_\_\_\_

**Station 5**

## **Think About It!**

1. Do you think it would be easy or hard to run up a steep inclined plane? Why?

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2. Farmers use ramps to load and unload animals from trucks. When does an inclined plane come in handy for you?

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Draw a comical cartoon that shows a farmer loading cattle into a truck without a ramp.



**I wish I had an inclined plane!**

# Screw a Firm Hold

Name \_\_\_\_\_

## Station 6

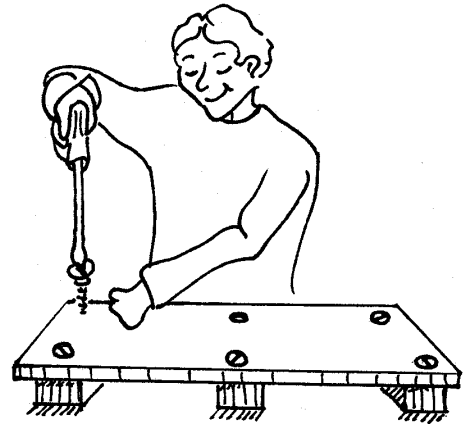
A screw is very useful because it attaches things together. Screws also can be used to raise and lower things. In an agricultural machine called a “combine,” an auger, or moving screw, pushes grain into a container.

### Materials

- Wood with holes (2 pieces)
- Screw
- Screwdrivers

### Procedure

1. Stack the two pieces of wood together.
2. While holding the screw over the top piece of wood, use the screwdriver to turn the screw through the pieces of wood. They will be held together firmly.
3. Your teacher may have used a drill to pre-make holes for you.
4. Take turns using the screwdriver and discuss your observations.



### Observations *(answer in complete sentences)*

1. Describe what you did to put the screw through the pieces of wood.

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2. Did the screw go away from you or towards you? Explain.

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### Think About It!

1. Which would be easier to get out of a piece of wood—a nail or screw? Why?

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# Friction and Grease

Name \_\_\_\_\_

## Station 7

Friction is not wanted when using some machines. It not only causes the machines to work harder, but it can wear out the parts more quickly. Friction converts some energy to heat. Lubricating the parts can make the machines more efficient. Many lubricants, such as hydraulic brake fluid, are made from cattle by-products. Others are made from fossil fuels, such as oil or coal, or plant oils. Farmers use lubricants to keep their equipment running smoothly.

### Materials

- 2 blocks of wood
- Plastic knife
- Petroleum jelly

### Procedure

1. Take turns rubbing the two pieces of wood together. Notice the resistance or friction that slows down the movement.
2. Lubricate the sides you rubbed together by putting a tiny dab of grease between them. Take turns rubbing the two pieces together now.



### Observations *(answer in complete sentences)*

1. Describe the difference you felt when you rubbed the blocks of wood together before and after putting on the grease.

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### Think About It!

2. Name at least two machines that work better when they are lubricated or greased.

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# Friction and Grease *(continued)*

Name \_\_\_\_\_

**Station 7**

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3. Where do lubricants come from?

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4. When might friction be a useful force?

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# Ball Bearings are Friction Fighters

Name \_\_\_\_\_

**Station 8**

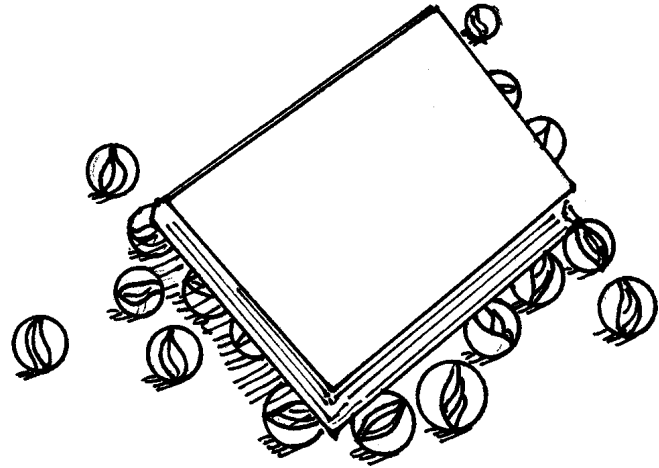
Ball bearings are often used inside machines. Ball bearings reduce the amount of friction so the moving parts turn more easily and do not wear out as quickly.

## Materials

- Carpet piece
- Book
- Marbles

## Procedure

1. Push the book along the carpet. When the two surfaces rub together, a force called friction prevents them from moving easily.
2. Put some marbles under the book and push it along the carpet. The marbles are like ball bearings in machines.
3. Take turns doing steps 1 and 2 and discuss what you observe.



## Observations *(answer in complete sentences)*

1. Describe what happened when you pushed the book with the marbles under it.

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## Think About It! *(answer in complete sentences)*

1. Sometimes friction is useful. How is friction useful when riding a bicycle?

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# Ball Bearings are Friction Fighters *(continued)*

Name \_\_\_\_\_

**Station 8**

2. You might find ball bearings in wheels. Where in the wheels might they be?

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3. Draw a picture of what you think ball bearings might look like in a machine.

