BATTLE CREEK AREA
Mathematics & Science Center

Student Journal

5PS

Forces and Motion

A Fifth Grade Unit
supporting the
Michigan Science K-7 Content Expectations

Name: ______________________

Name: ______________________

Date: ______________________

ACTIVITY

Marble Motion

1

1. Write the question you are investigating.

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2. List the materials you are using.

3. Draw a diagram of your investigation.

A C T I V I T Y

Marble Motion (cont.)

1

Name: ______________________

Date: ______________________

4. Write what you think will happen.

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5. Record your observations and data.

Name: ______________________

Date: ______________________

ACTIVITY
Marble Motion (cont.)
1

1. Draw a diagram of your revised investigation.

2. Make a chart to record your time and distance traveled.

JOURNAL

Marble Motion (cont.)

Name: ____________________

Date: ____________________

1

Write a conclusion for your investigation. Include a description of the forces that affect the motion of the marble. State what factors best increased the travel time of the marble. Use your data from your investigation to support your conclusion.

Name: ______________________________

Date: ______________________________

ACTIVITY
Describing Motion
2

1. Describe the motion of the toy frog. Include a point of reference and motion words in your description. (motion, direction, speed, and distance)

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2. Make a data chart to record the distance the frog traveled in three trials.

Name: ______________________

Date: ______________________

3. Use your data to make a bar graph that shows the distance the frog traveled in the three trials.

4. Did your frog move the same distance for each trial? ______________

Discuss with your group some of the variables that may change the frog's motion. List your ideas.

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Name: ____________________

Date: ____________________

Look around your classroom. Look outside the window. Look in the hallway.

1. List as many objects as you can that are moving.

2. What is the evidence that you have that tells you they are moving?

3. List as many objects as you can that are not moving.

4. How do you know they are not moving?

ACTIVITY

3

Measuring Speed

Name: ______________________

Date: ______________________

Average Speed Data Table

Motion	Distance	Time	Speed
walk			
bunny hop			
walk backwards			
hop on one leg			
skip			

1. What form of motion moved at the fastest speed?

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2. What form of motion moved at the slowest speed?

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Name: ____________________

Date: ____________________

3. Rank in order from slowest to fastest the different forms of motion.

4. Write a conclusion that explains the fastest and slowest form of motion. Use your data in your conclusion.

A C T I V I T Y

Measuring Speed (cont.)

3

Name: ______________________________

Date: ______________________________

1. Write the question you are investigating.

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2. Make a data table to record the measurements and calculations of the average speed of the marble.

Average Speed of the Marble

Name: ______________________

Date: ______________________

1. Explain how you know that the marble was moving in your investigation.

2. What measurements are needed to find the average speed of a moving object?

3. Paul and Janine built a sled that they wanted to enter into the "Homemade Sled Contest" at the Winter Carnival. The rules require that sleds must travel at a minimum speed of 1 meter per second. Explain how Paul and Janine can determine if their sled qualifies for the contest.

ACTIVITY

4 Graphing Motion

Name: ______________________

Date: ______________________

1. Record your data on the chart below.

Motion Data Chart

Distance	Time Trial 1	Time Trial 2	Time Trial 3	Final Walk Heel-to-Toe
2 meters				
4 meters				
6 meters				
8 meters				
10 meters				

2. Describe the motion of your mover.

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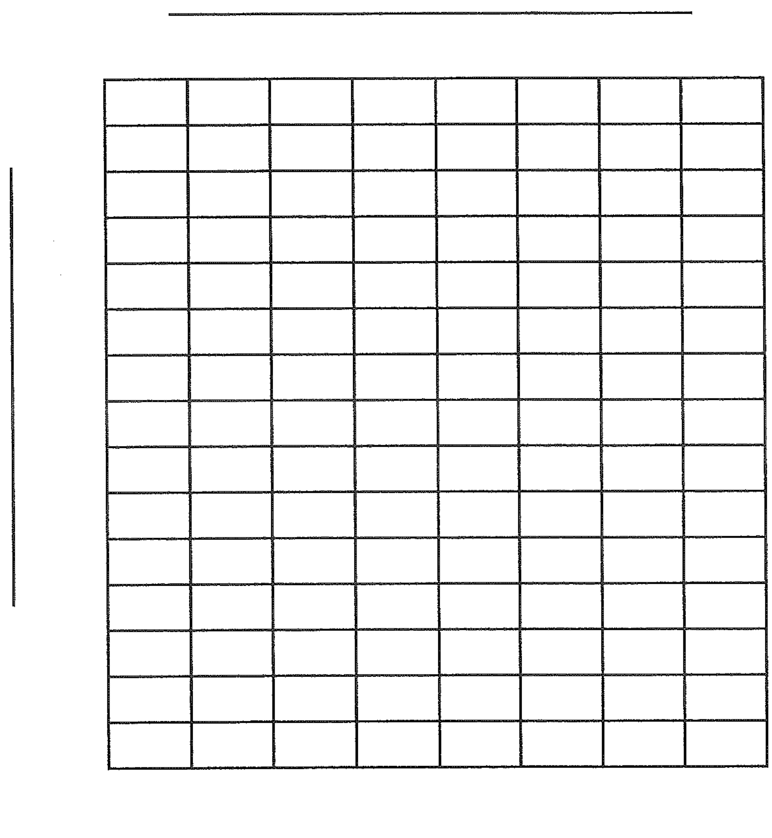
Name: ____________________

Date: ____________________

3. Make a line graph using your *Motion Data Chart*. Record the time trials and final walk in different colors on the graph.



4. What information does your graph show about the motion of your mover? Compare the time trials to the final heel-to-toe walk.

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J O U R N A L

Graphing Motion (cont.)

Name: ____________________________

Date: ____________________________

4

You have heard the story of *The Tortoise and the Hare*. The hare never admitted that the tortoise was a faster runner or won the race. The other animals collected data to help the tortoise show the hare that he was faster in the long race. They had timekeepers stationed every 200 meters along the race course and recorded the following data.

1. Look at the data table below and make a line graph to represent the speed of the tortoise and the hare in their race. Label the x-axis and y-axis and write a title for your graph.

The Race Between the Tortoise and the Hare

Distance	Tortoise Time	Hare Time
0 meters - start	0 minutes	0 minutes
200 meters	20 minutes	2 minutes
400 meters	40 minutes	4 minutes
600 meters	60 minutes	98 minutes
800 meters	80 minutes	100 minutes
1,000 meters	100 minutes	102 minutes

Name: ______________________

Date: ______________________

2. At what part of the race did the hare decide to take a nap? Use your line graph to explain your answer.

3. Predict what would happen if the race was 200 meters longer. Explain your answer.

5

JOURNAL

Get Moving!

Name: ______________________

Date: ______________________

1. Describe the forces when tug-of-war teams pull away from each other but there is no movement.

2. Describe the forces when one tug-of-war team pulls harder than the other.

Name: ____________________

Date: ____________________

3. Draw and label one example of balanced forces.

4. Draw and label one example of unbalanced forces.

ACTIVITY

6

Balloon Challenge

Name: ______________________________

Date: ______________________________

1. Describe the challenge you are trying to solve.

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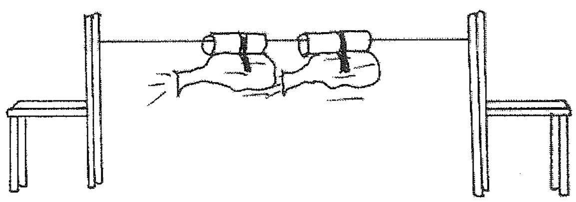
2. Draw a picture of how your group will demonstrate the balanced force with the balloon rocket.

3. Draw a picture of how your group will demonstrate the unbalanced force with the balloon rocket.

Name: ______________________

Date: ______________________

1. Look at the drawings. Label the drawings as balanced or unbalanced.



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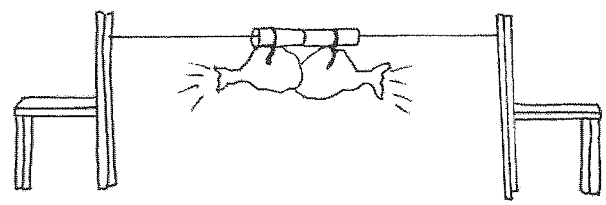

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B.

2. Write how balanced forces acting on an object affect its motion.

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3. Write how unbalanced forces acting on an object affect its motion.

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7

ACTIVITY

Measuring Force

Name: ______________________________

Date: ______________________________

Make a chart to show your data of the amount of force it takes to move the block of wood over different surfaces.

Measuring Force

Name: ______________________________

Date: ______________________________

Make a chart that shows your data for the amount of force it takes to move the block up the ramp and down the ramp. Be sure to include the angle of the ramp and the different surfaces the block travels over.

Moving Up and Down a Ramp

JOURNAL

Measuring Force (cont.)

Name: ______________________

Date: ______________________

7

Write a conclusion statement using your data from your investigations of the force to move the block without the ramp, with the ramp, and over different surfaces. Include your claim (what you think), evidence from your data, and reasoning (why it makes sense).

Name: ______________________

Date: ______________________

Newton's First Law of Motion

An object at rest tends to remain at rest unless acted on by an unbalanced force. An object in motion in a straight line tends to remain in motion in a straight line unless acted upon by an unbalanced force.

1. What started the motion of the marble down the track?

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2. Describe the motion of the marble.

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3. Read Newton's First Law of Motion. Describe how the marble "obeyed" or "disobeyed" Newton's Law.

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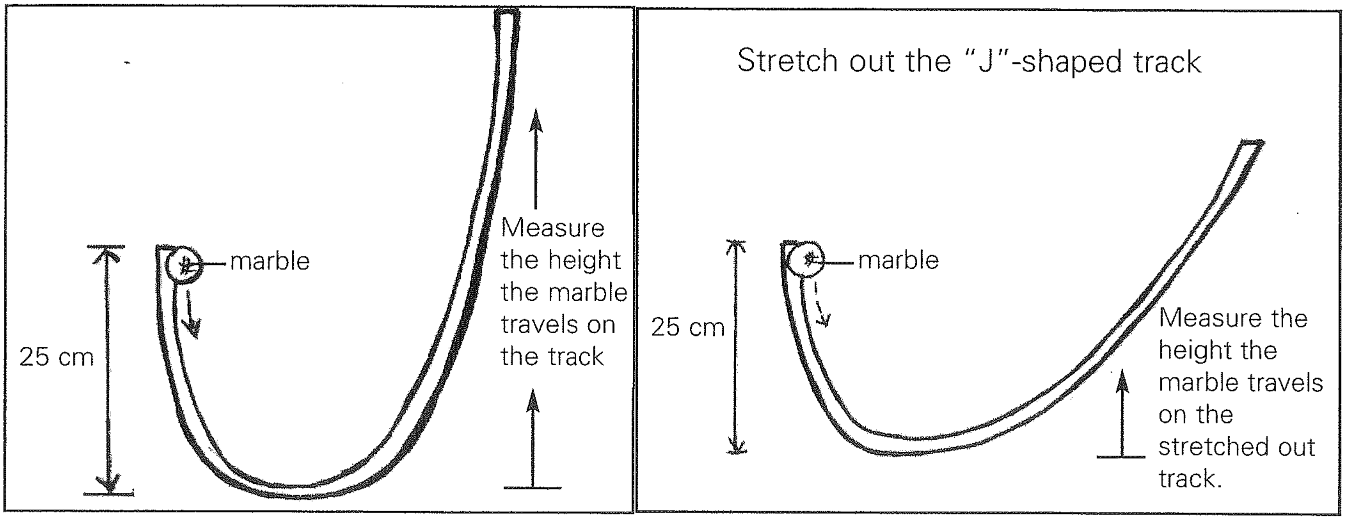
ACTIVITY

8

Why Does the Rolling Ball Stop Rolling? (cont.)

Name: ______________________

Date: ______________________



1. Within your group, decide who will hold the short end of the "J", the long end of the "J", measure the height the marble travels, and start the marble down the track at the short end.
2. Drop the marble down the SHORT end of the "J".
3. Measure the height the marble traveled up the long end of the "J".
4. Make a data table and record the measurement.
5. Repeat the procedure until you have completed 3 trials.

Name: ____________________

Date: ____________________

Why Does the Rolling Ball Stop Rolling? (cont.)

Isaac Newton and Aristotle were both scientists who tried to make sense of the world through observation and investigation. Read the conclusions of each scientist. Write which scientist you agree with and tell why.

Aristotle: Objects in motion need an applied force to keep them moving.

Newton: Objects in motion will remain in motion unless acted upon by an applied force.

ACTIVITY

Mass and Motion

9

Name: ____________________

Date: ____________________

Part 1

Measure the mass and weight of the balls:

Ball	Mass (grams)	Weight (newtons)
steel ball		
wooden ball		
shooter marble		

1. Write the question you are investigating.

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2. Write what you already know and think will happen.

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Name: ______________________

Date: ______________________

3. List the materials you will use.

4. Write or draw the steps you will take.

Name: ______________________________

Date: ______________________________

5. Make a chart and record your observations and results.

Name: ______________________

Date: ______________________

Part 3

1. Write the question you are investigating.

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2. What is the variable in your investigation?

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3. Record the height of your ramp.

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4. Write or draw the steps you will take.

Mass and Motion (cont.)

Name: ______________________

Date: ______________________

5. Make a chart and record your observations and data.

Name: ____________________________

Date: ____________________________

Part 3

Use your data and complete the data table below. Analyze the data from the investigation and write a conclusion about the speed of the balls with different masses. Include the variable of the investigation and what part of the investigation stayed the same.

Ball	Mass	Trial 1		Trial 2		Trial 3	
		Time	Distance	Time	Distance	Time	Distance
steel ball							
wooden ball							
shooter marble							

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ACTIVITY

The Force of Simple Machines

10

Name: ______________________

Date: ______________________

1. Draw and label your model lever.

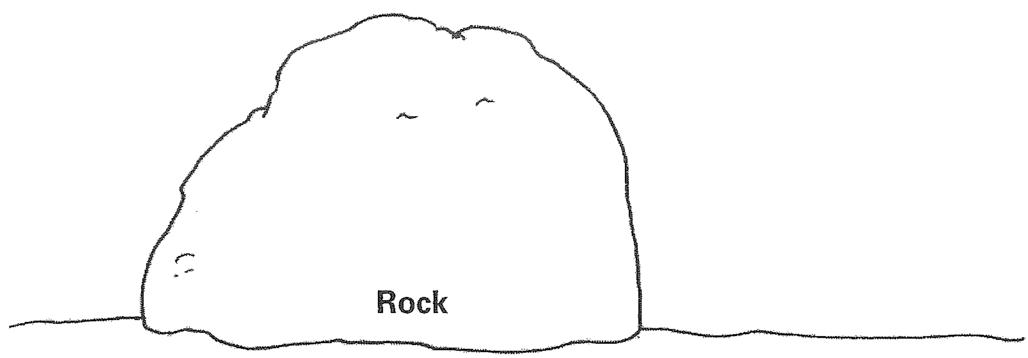
2. Label the direction of the force to move the rock. Label the direction the rock will move.

3. Write how your lever will help the boy move the rock. Include how many washers were needed to move the rock in your model.

Name: ______________________________

Date: ______________________________

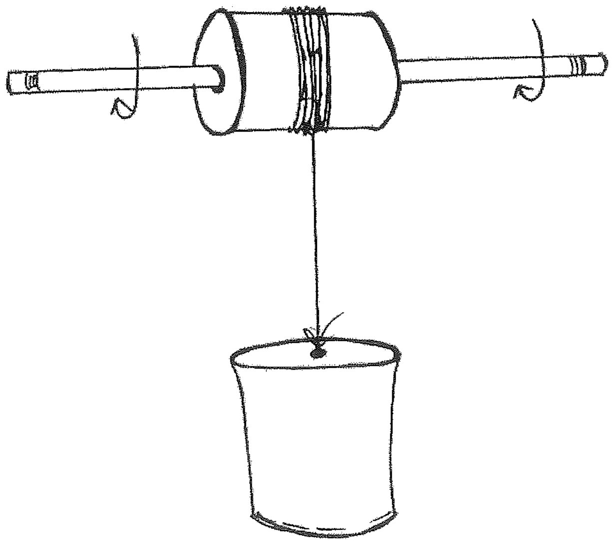
4. Draw a lever in the picture that will help to lift the rock. Label the fulcrum, load, lever arm, and effort force in your picture.



Name: ______________________

Date: ______________________

This wheel and axle demonstration has two different set-ups. (See illustrations.)



Set-up A

For Set-up A:

1. Push the pointed end of the pencils into each end of a spool. Make sure they are secure.

2. Thread the string through the holes in the paper cup and tie the string, making a bucket.

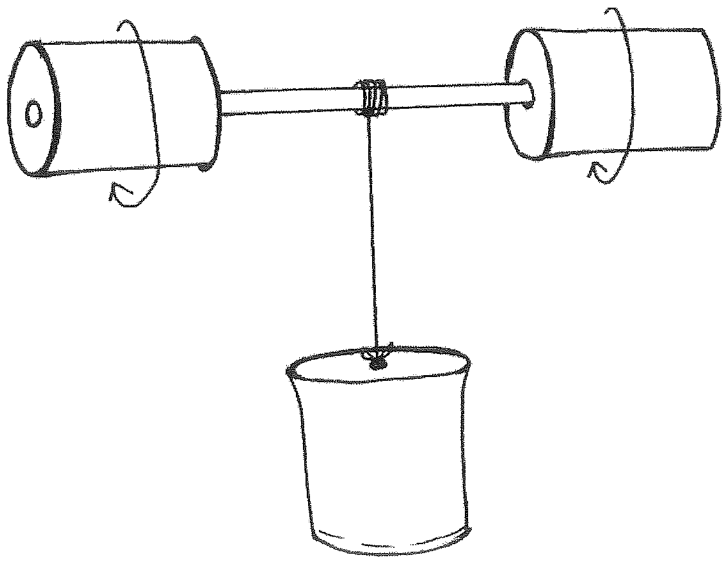
3. Tape the other end of the string to the middle of the spool.

4. Place 20 washers in the cup.

5. Wind up the cup of washers by turning the pencils.

Name: ______________________

Date: ______________________



Set-up B

For Set-up B:

1. Insert one pencil between two spools.

2. Tape the string with the cup and washers to the center of the pencil.

3. To raise the bucket, turn the ends of the spools.

Which bucket required less effort force to raise the cup of washers?

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How is this experiment with the bucket of washers similar to the axle and steering wheel?

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Name: ____________________

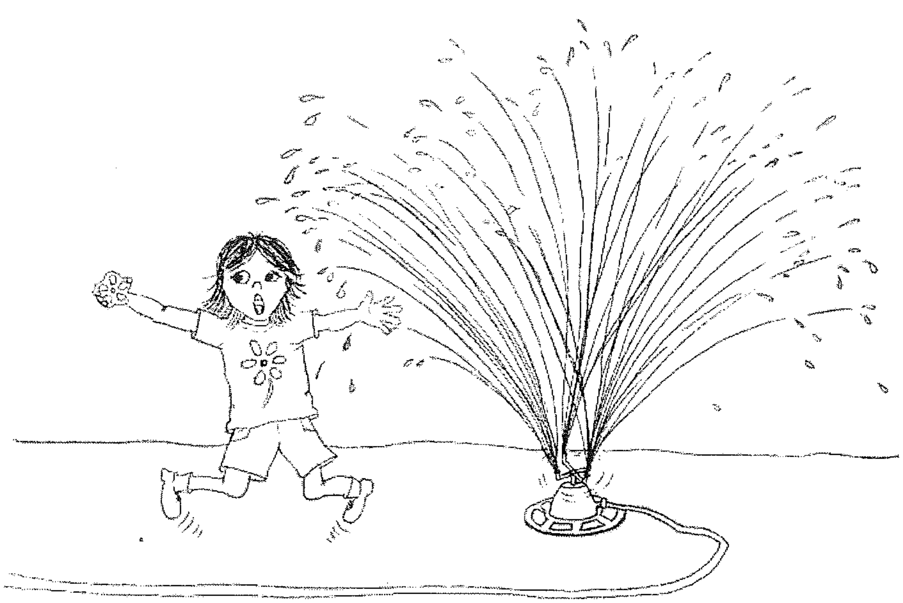
Date: ____________________

Flora's Faucet

Summer at last! Flora raced home from school. This was the first day of her new job. Last night, Flora's next door neighbors, Mr. and Mrs. Peterson, packed their new RV for a long trip out west. Mr. Peterson asked Flora if she would water the lawn and garden while they were gone. He gave Flora directions on when to water, how long to water, where to put the sprinklers, and how to coil and store the hoses. Mr. Peterson was very particular about his lawn and garden.

Today Flora was scheduled to set up the sprinkler on the front lawn and let it run for one hour and water the vegetable garden in the backyard using the hose and nozzle. It was a warm afternoon and Flora looked forward to setting up the sprinkler and spraying the vegetables. She positioned the sprinkler in the middle of the front yard, just the way Mr. Peterson had instructed her. Flora turned the faucet on all the way. The water shot out of the sprinkler, high into the air! The sprinkler started twirling wildly. It was spraying water everywhere! The water hit the house, soaked the sidewalk, and sprinkled into the street and driveway. A woman pushing a baby stroller crossed the street to avoid getting soaked. Cars passing on the street turned on their windshield wipers. Quickly, Flora started to turn the water faucet when all of a sudden the handle broke off in her hand. Flora tried to turn the post but it wouldn't turn. She tried to put the handle back on and it wouldn't stay. Water was soaking everything!

As a group, discuss Flora's problem in the story. What could Flora do to turn off the water?



Name: ______________________________

Date: ______________________________

Read "Flora's Faucet" again. Draw and write about a tool that will help Flora turn the water off. Label your drawing to show the effort force.

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ACTIVITY

The Inclined Plane, Wedge, and Screw

11

Name: ____________________

Date: ____________________

Food Delivery

Steven and Will volunteered to deliver boxes of food and gifts to families in the community who needed a little extra help during the holiday season. First they had to load the boxes into the delivery van and then unload the boxes and carry them into the families' homes.

"This is hard work," complained Steven.

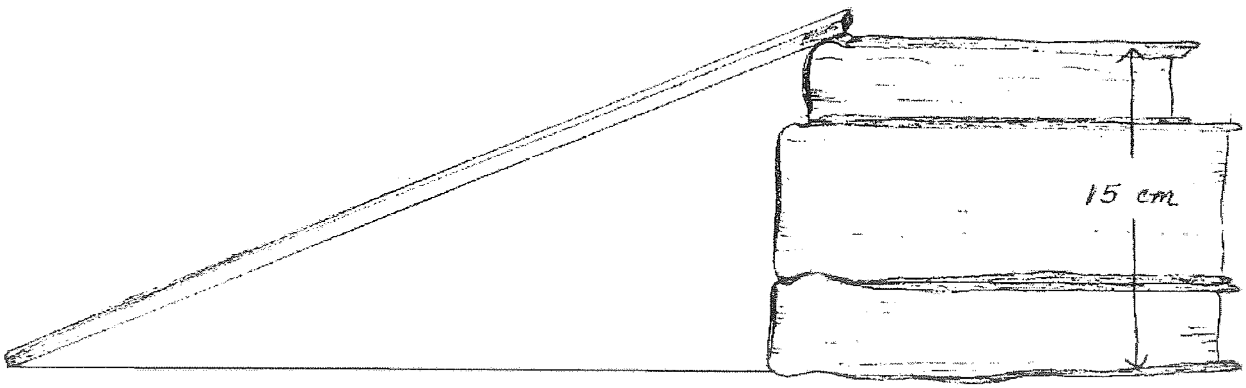
"We need to think of an easier way to load these heavy boxes," agreed Will.

Think of ways that Steven and Will can make it easier to load and unload the boxes. Write your ideas below.

Name: ____________________

Date: ____________________

1. Set up the ramp so the height measures 15 cm. (See picture.)



2. Measure the length of the ramp. ________ cm

   Measure the mass of your block of wood. ________

   Measure the force to lift the block of wood straight up 15 cm. __________

3. With the wood block attached to the spring scale, place the block at the bottom of the ramp, smooth side down. Slowly pull the wood block up the inclined plane and have another student read the spring scale.

4. The amount of force needed to pull the block up the inclined plane is ________ newtons.

ACTIVITY

11 The Inclined Plane, Wedge, and Screw (cont.)

Name: ______________________

Date: ______________________

5. Repeat steps #3 - #4 using the block on the sandpaper side. Record your data on the chart below.

Force to lift the block 15 cm without ramp	
Force used to pull the wood block (smooth side) up the ramp	
Force used to pull the wood block (sandpaper side) up the ramp	

6. Which method of moving the wood block required the least amount of force, smooth or sandpaper? Use evidence from your data to support your answer.

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7. How does this simple machine make a job easier to do?

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Name: ____________________________

Date: ____________________________

JOURNAL

The Inclined Plane, Wedge, and Screw (cont.)

11

1. Draw a picture of someone using a ramp to make a job easier to do. Label the forces that affect the motion of the object on the ramp.

2. If you were to move an object that was two times the mass, how would it affect the size of the force needed to move the object up the ramp? Write what you could to to make the more massive object move up the ramp more easily.

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ACTIVITY

12 The Forces and Motion of Flight

Name: ____________________

Date: ____________________

1. Record your observations of the flight path of your first design of the paper airplane.

2. Record the distance of each trial for the flight of your first design of the paper airplane.

Data Chart for Original Design of Paper Airplane

Trial	Observations of Flight	Distance
Trial 1		
Trial 2		
Trial 3		

Name: ______________________________

Date: ______________________________

A C T I V I T Y

The Forces and Motion of Flight (cont.)

12

1. Record your observations of the flight path of your modified design of the paper airplane.

2. Record the distance of each trial for the flight of your modified design of the paper airplane.

Data Chart for Modified Design of Paper Airplane

Trial	Observations of Flight	Distance
Trial 1		
Trial 2		
Trial 3		

JOURNAL

The Forces and Motion of Flight (cont.)

12

Name: ______________________

Date: ______________________

1. Compare the data of your first airplane design and the modified design. Draw a picture of each design and label the different forces that affect the flight.

First Airplane Design

Modified Airplane Design

Name: ____________________

Date: ____________________

2. Write how you modified the airplane and use your data to tell if your modifications improved its flight. Tell how changing designs helps to learn more about how things fly.

A C T I V I T Y

13

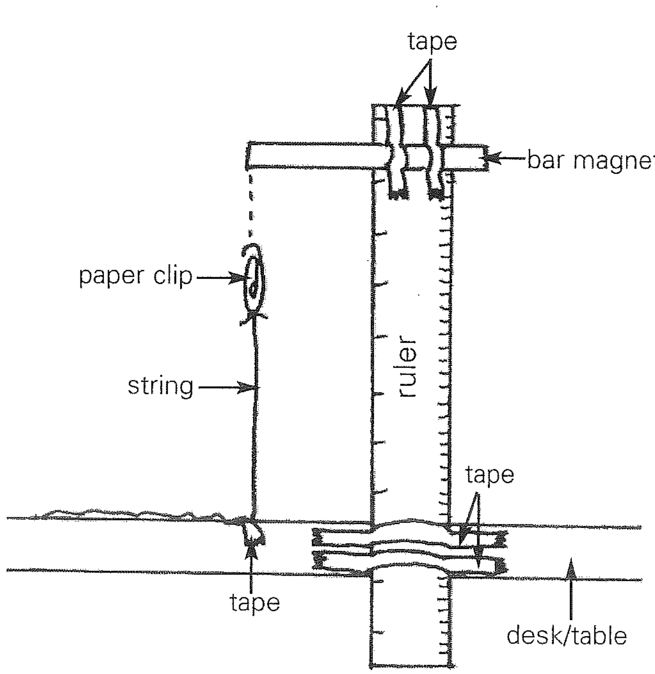
Motion At a Distance: Non-Contact Forces

Name: ______________________

Date: ______________________

Invisible Pushes and Pulls:

1. Tape a magnet to one end of the ruler.
2. Tape the ruler to the side of the desk or table.
3. Tie a paper clip to one end of the string.
4. Explore the motion of the hanging paper clip as it gets closer to and farther from the magnet on the ruler.
5. Can you make the paper clip float in mid-air? Tape the other end of the string to the top of the desk, about 3 cm from the bottom of the ruler. (See diagram.)
6. Pull the paper clip straight up as close to the magnet as possible. Now let go. What happens?



1. Describe what happens when the hanging paper clip gets closer to the magnet in step #4. Tell what force moved the paper clip.

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2. Describe what happens when you let go of the paper clip in step #6. Tell what forces were acting on the paper clip.

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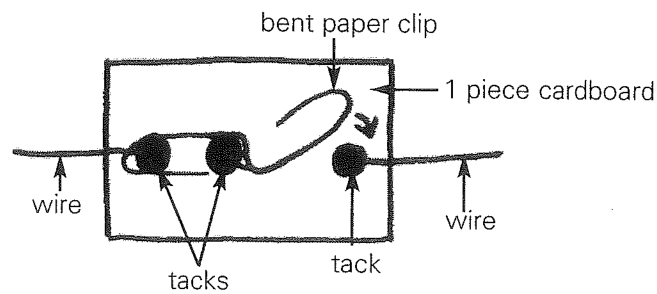
Name: ______________________

Date: ______________________

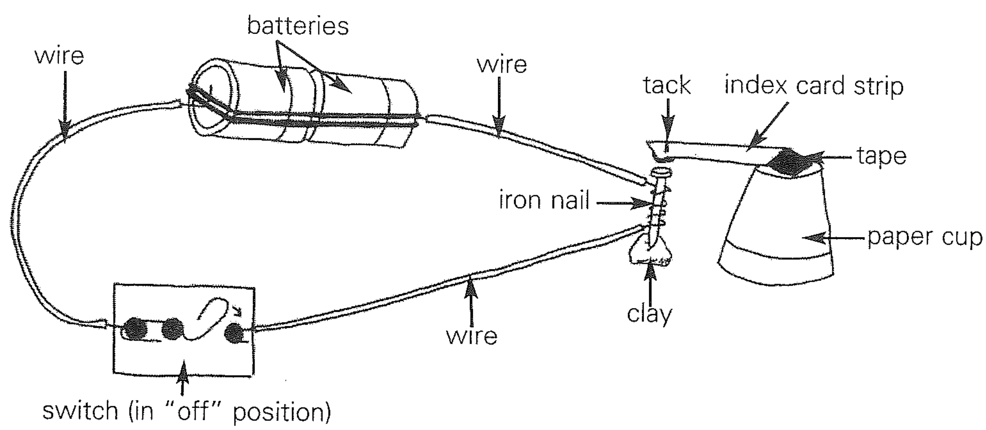
ACTIVITY
Using Magnetism to Make Things Move!
14

1. Look at the illustrations below. Use your electromagnet model and the provided materials to build a model of a telegraph sounder.

Switch



Telegraph Sounder



2. Describe the force and motion that produced the sound in your model.

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J O U R N A L

Using Magnetism to Make Things Move! (cont.)

Name: ______________________

Date: ______________________

14

Using your research findings about the Maglev train, write how the motion of the train is due to a non-contact force. (Include the following terms in your response: *non-contact force, contact force, attract, repel, motion, magnetic force*)

Name: ____________________

Date: ____________________

1. Draw a picture of how the balloons push or pull on each other.

2. Write what you think is happening.

ACTIVITY

15

Electricity Makes Things Move! (cont.)

Name: ______________________

Date: ______________________

Write your observations of the motion of the balloons and hair:

1. Two balloons rubbed on human hair become negatively charged. What motion do you observe?

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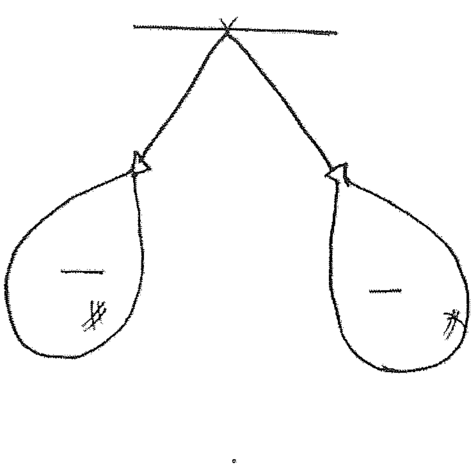

2. Describe the motion of the balloons when the hair is removed.

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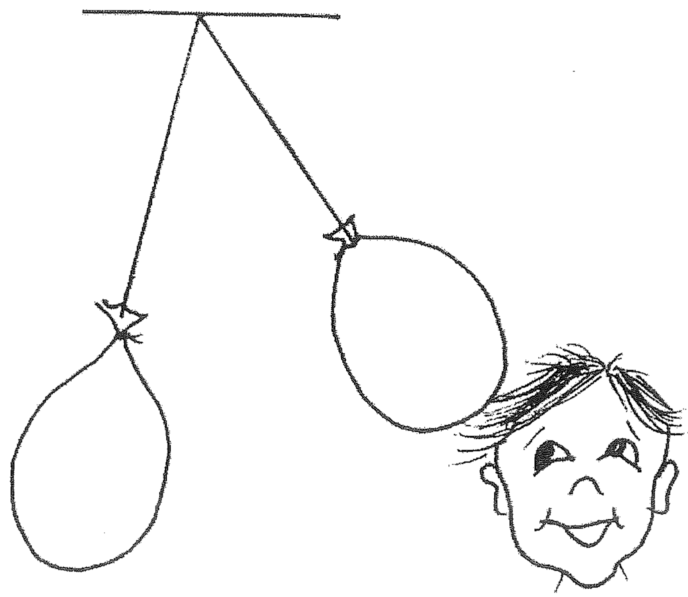
Name: ______________________

Date: ______________________



3. Describe the motion when the hair moves to one side of the balloons.

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4. Write a statement that describes the motion of objects using the non-contact force of an electrical charge. Include the terms *attract* and *repel* in your statement.

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J O U R N A L

Electricity Makes Things Move! (cont.)

Name: ______________________

Date: ______________________

15

Write how the magnetic force and electrical force are non-contact forces. Describe the difference between contact and non-contact forces.

Name: ______________________

Date: ______________________

ACTIVITY
Putting a Spin on Motion
16

1. Draw how you assembled the axle and steering wheel to make a top.

2. Compare the construction of the top that did not spin well and top that spun for a long time.

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ACTIVITY

16

Putting a Spin on Motion (cont.)

Name: ____________________

Date: ____________________

3. Draw and write about the motion and design of each top in your "bag of tops."

Draw	Write
Top #1:	
Top #2:	
Top #3:	

Name: ______________________

Date: ______________________

1. Write the materials you chose to use to build a top.

2. Draw a picture of the top you built.

Putting a Spin on Motion (cont.)

Name: ______________________________

Date: ______________________________

3. Make a chart and record the performance of your top. Be sure to run three trials and record the time the top spun for each trial.

4. Record any adjustments you made to the top to increase the spin time.

Name: ______________________

Date: ______________________

1. Draw a picture of your final design of your top.

2. Describe the role of unbalanced forces, friction, and gravity on the motion of your top.

ACTIVITY

17 The Forces and Motion of Roller Coasters!

Name: ______________________________

Date: ______________________________

1. List the materials your group has chosen to use to make a model of a roller coaster.

2. Draw a picture of the path of your roller coaster.

Name: ______________________________

Date: ______________________________

3. Make a chart and record your observations of at least three trials of your roller coaster.

4. Describe the modifications you made to increase the "thrill" and safety of the roller coaster model.

J O U R N A L

The Forces and Motion of Roller Coasters! (cont.)

Name: ______________________

Date: ______________________

17

1. Draw and label a picture of your roller coaster. Place arrows to show the direction of the marble and place dots to show when there was a speed or direction change. Label the force that changed the direction or speed of the marble.

Name: ______________________________

Date: ______________________________

2. Write about the main ideas that you learned in making a roller coaster. Use the terms *force, balanced force, unbalanced force, contact force, non-contact force, speed, direction, friction,* and *gravity* in your writing.

Key Terms

air resistance - Air resistance is the friction between an object and particles in the air.

average speed - Average speed is determined by dividing the trip distance by the total time of the trip.

balanced forces – Balanced forces exist when all the forces acting on an object result in the object staying at rest or moving at a constant speed in the same direction.

change of direction - Change of direction is to alter the path or course of a moving object.

change of motion - Change of motion is to alter direction, speed, or position of an object.

change of speed - Change of speed is to alter the amount of time it takes to travel a distance.

constant speed - Constant seed is a rate of motion that remains steady or unchanged over a given distance and amount of time.

contact force - A contact force is a push or a pull that touches or comes in contact with an object to change motion.

direction - Direction is the path along which something moves, lies, or points. Some direction terms are: right, left, north, south, east, west, up, down, forward, and backward.

distance – Distance is a measurement of how far from each other two points or places are. Distance can measure how far an object traveled from one point to another.

effort force - The effort force is the force exerted by the user on the simple machine. All simple machines involve an effort force and a force on the load.

electromagnet – An electromagnet is produced when electricity flows through a wire. Coiling the wire around an iron bar increases the strength of the magnetic field.

force - A force is a push or a pull on something. A force is necessary to change the motion of something.

force on the load - The force on the load is the force exerted by the simple machine on the load. All simple machines involve a force on the load and an effort force.

force strength - Force strength refers to the intensity of a push or a pull on an object.

friction - Friction is a force that acts on an object when it rubs against another object or material. The force of friction acts on an object when we try to move it across a surface.

fulcrum - The fulcrum is the fixed point on which the lever moves.

graph – A graph is a representation of data plotted on an x-axis and y-axis.

gravitational force - Gravitational force refers to the pull of Earth's gravity.

gravity – Gravity is a force where one object pulls on another object. Because of the gravity of the Earth, we are pulled toward the Earth.

inclined plane – An inclined plane is a simple machine made with a flat slanted surface.

instantaneous speed - Instantaneous speed is how fast an object moves at a certain point in time.

lever - A lever is a bar that tilts around a fixed point to produce a useful motion.

Key Terms (cont.)

load - The load is the object to be moved by the simple machine.

magnetic attraction - Magnetic attraction is the pull of magnetic objects toward a magnet.

magnetic repulsion - Magnetic repulsion is the push of magnetic objects away from a magnet.

mass - Mass is the measure of the amount of matter in an object. The mass of an object remains the same no matter what the gravitational pull.

motion – Motion is the changing of position of an object.

newton – A newton is a metric unit use to measure the force applied to objects.

non-contact force - A non-contact force is a push or a pull that does not touch an object to change motion. Non-contact forces change motion over a distance, such as magnetic and electrical fields and gravity.

non-zero net force - A non-zero net force is an unbalance force resulting in the motion of an object or a change in the speed or direction of a moving object.

point of reference – A point of reference is a background or non-moving object in the background used in describing the motion of another object.

pulley - A pulley is a simple machine. It is a wheel with a groove in it.

relative position - Relative position refers to the location of an object in relation to other objects or a point of reference.

screw – A screw is a simple machine that is an inclined plane wrapped around a rod or core.

simple machine - A simple machine is a device that makes a job easier to do by changing the amount of force, the direction of a force, or the distance through which a force moves.

speed – Speed is the measurement of how fast an object travels from one point to another.

spring scale - A spring scale is used to measure the approximate weight, or the pull of gravity, on an object.

time – One way to describe time is the measurement of the period between events. We measure the time it takes for an object to move from one place to another.

unbalanced forces – Unbalanced forces exist when all the forces acting on an object result in a change of motion of the object. If it was at rest, it begins to move. If it is moving, it changes speed or changes direction.

variables - Variables are the properties of things that can change, be changed, or vary in an investigation. Variables can affect the results of an experiment. Some examples of variables are time, distance, and temperature.

wedge – A wedge is a simple machine that helps cut or split objects.

weight - Weight is the measure of the amount of gravity pulling on an object. The weight of an object is affected by the mass of the object and also by gravity.

wheel and axle - A wheel and axle is a simple machine that has a center rod that is attached to a wheel.

zero net force - A zero net force is a balanced force resulting in an object remaining at rest or at a constant speed in the same direction.