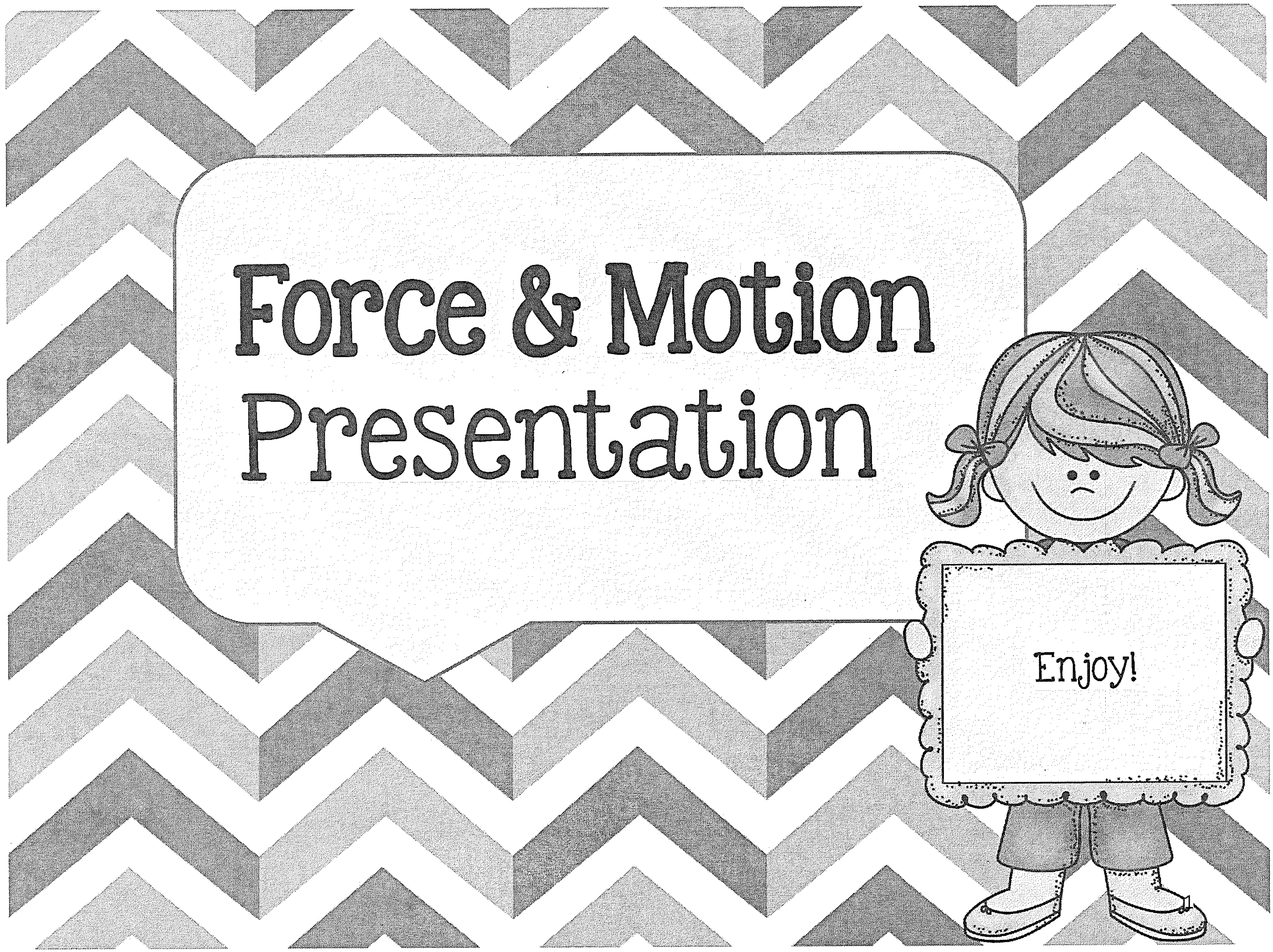

Force & Motion
Presentation
Enjoy!

What's so important about forces and motion?

Forces are constantly at work.

Forces cause motion.

Let's look into this further...

Force & Motion Vocabulary

force - A push or a pull.

motion - How an object's position changes over time.

speed- A measurement of distance over time.

acceleration- A change in motion caused by a change in speed.

velocity- An object's speed in a particular direction.

inertia- Objects remain at rest or in motion unless acted on by a force.

gravity- The force that pulls objects toward the center of the Earth.

friction- Forces that slow down or stop movement.

Name:

Force & Motion Vocabulary

force - A ________ or a ________.

motion - How an object's ____________ changes over ___________.

speed- A measurement of __________________ over _____________.

acceleration- A change in _____________ caused by a change in ____________.

velocity- An object's ______________ in a particular direction.

inertia- Objects remain at __________ or in ____________ unless acted on by a force.

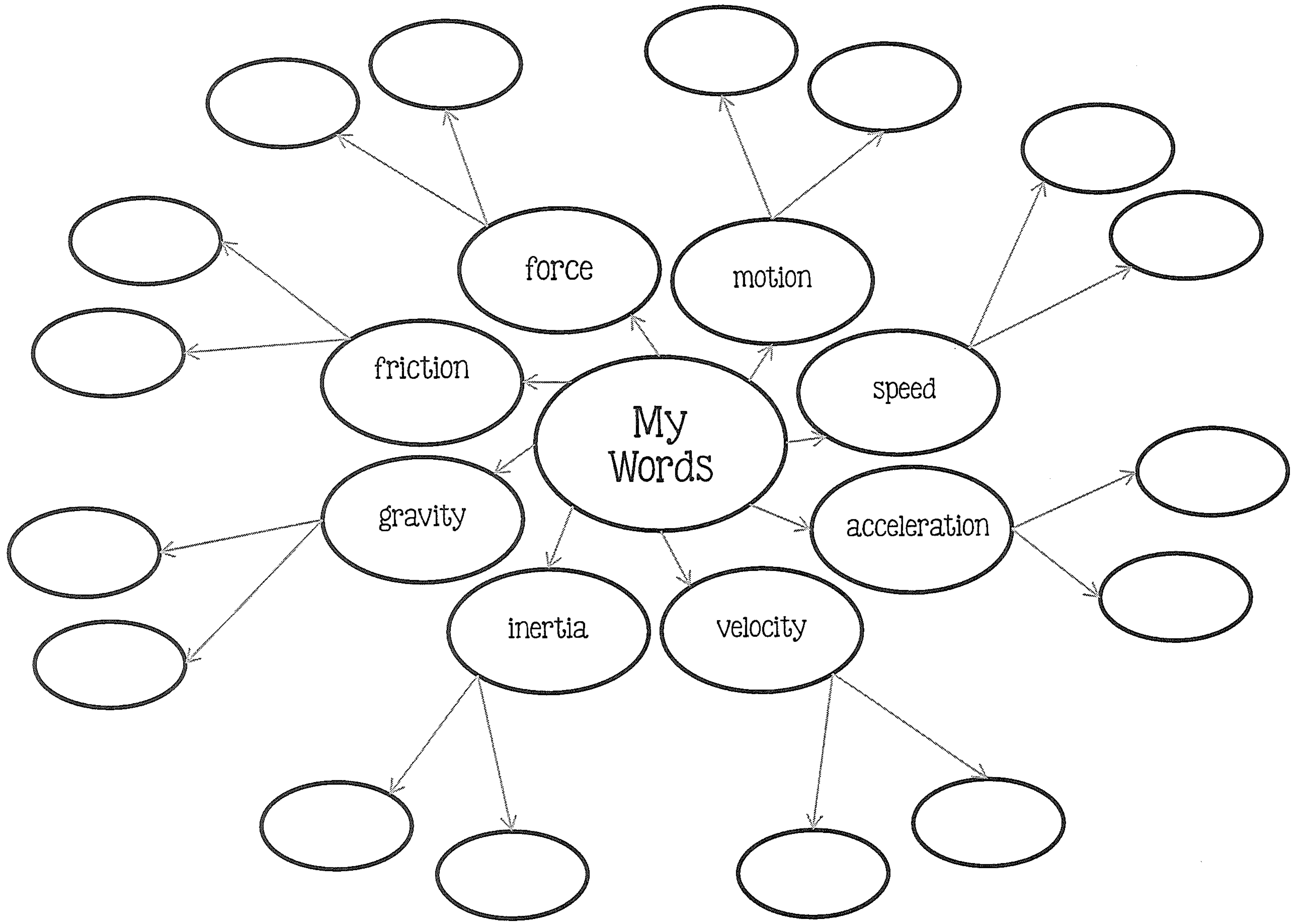
gravity- The ___________ that _________ objects toward the center of the Earth.

friction- Forces that _________ down or ___________ movement.

Name:

Vocabulary Practice #1 - Form A

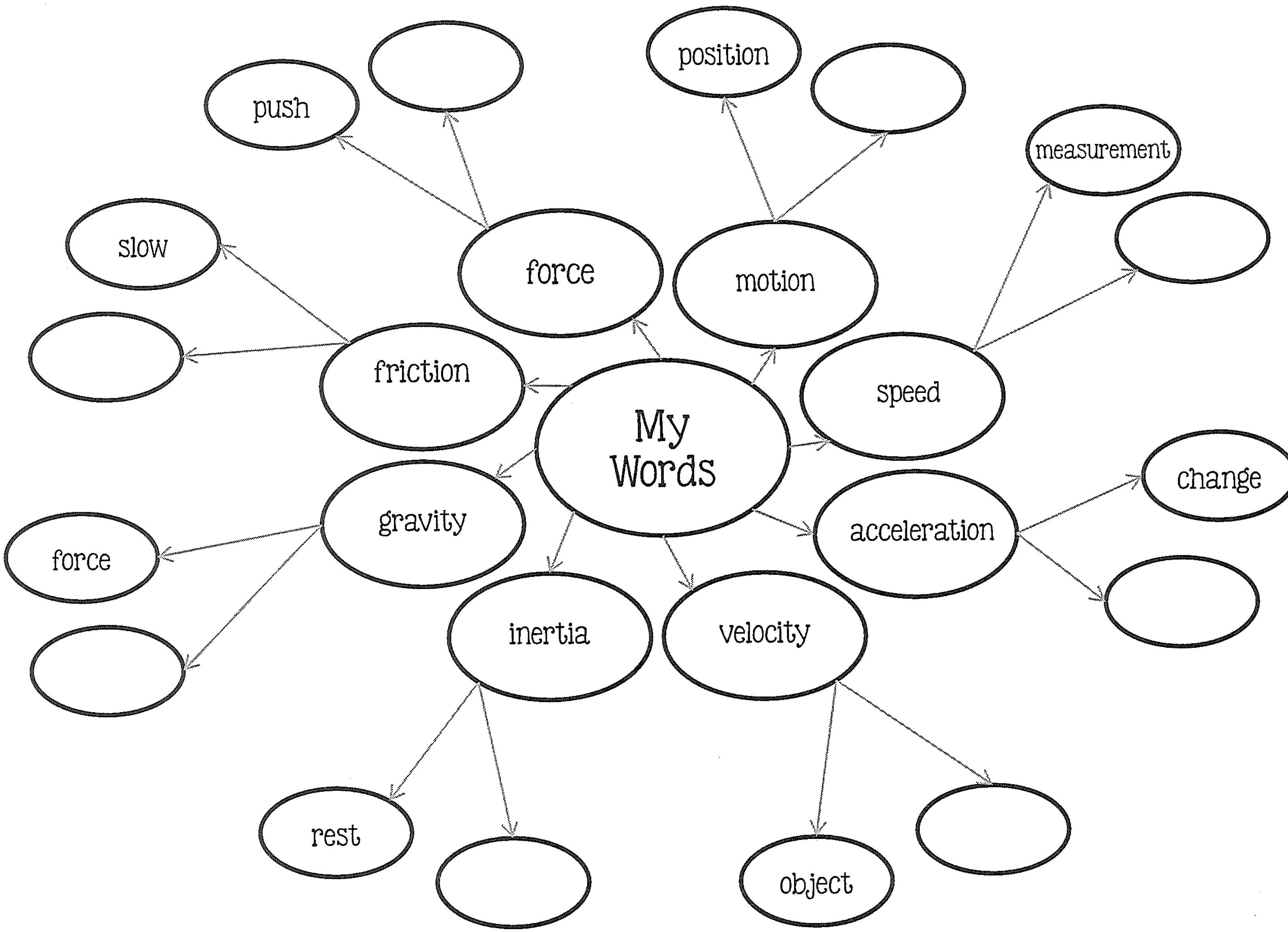
Directions - Using your notes, fill in the empty bubbles with words that describe each vocabulary word.



Name:

Vocabulary Practice #1 - Form B

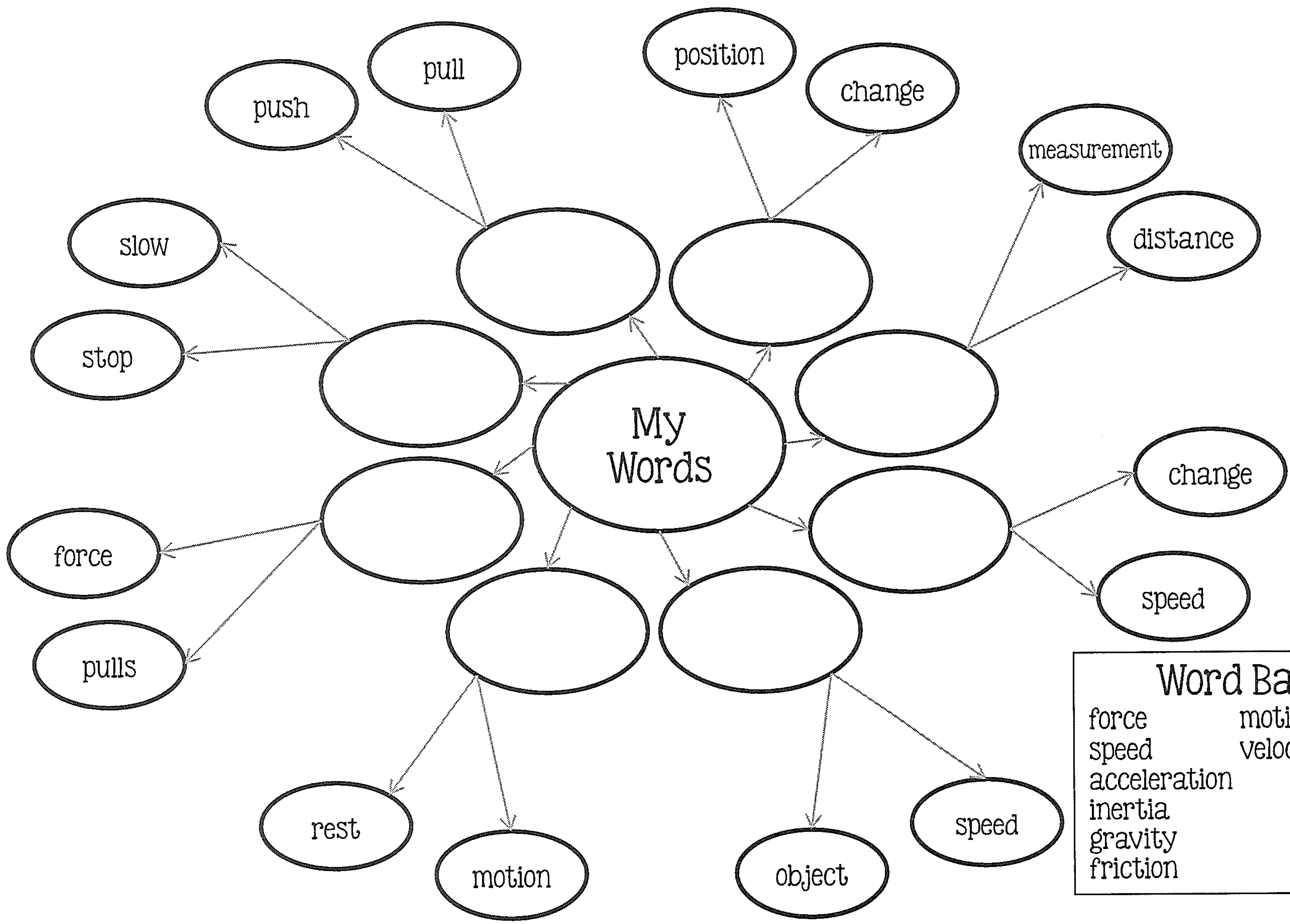
Directions - Using your notes, fill in the empty bubbles with words that describe each vocabulary word.



Name:

Vocabulary Practice #1 - Form C

Directions - Using your notes, fill in the empty bubbles with words that describe each vocabulary word.



Word Bank

force
motion
speed
velocity
acceleration
inertia
gravity
friction

Name:

Vocabulary Practice #2 - Form A

Directions - Draw a picture that represents the meaning of the word(s) in each box.

force	velocity
motion	inertia
speed	gravity
acceleration	friction

Name:

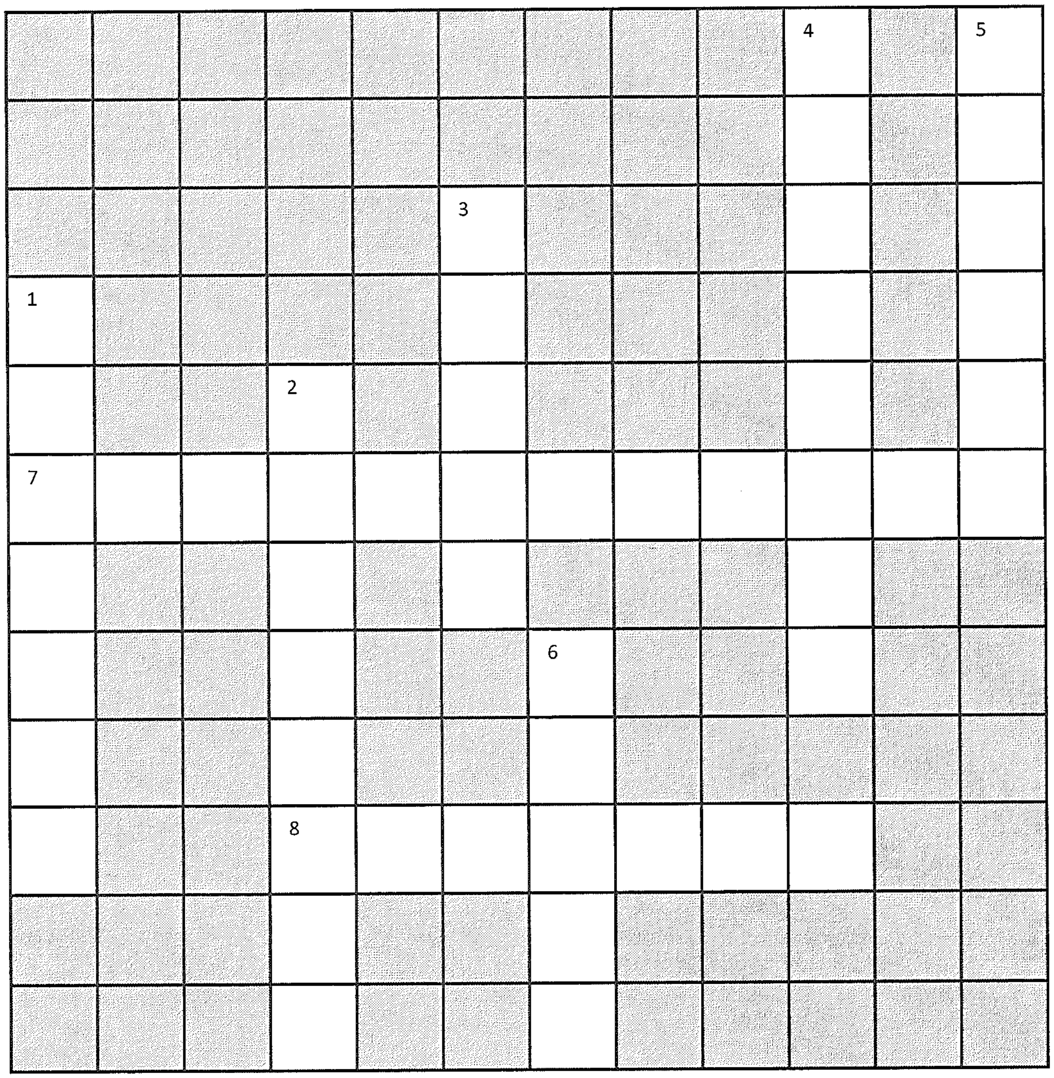
Vocabulary Practice #2 - Form B

Directions - Draw a picture that represents the meaning of the word(s) in each box.

force A push or a pull.	**velocity** An object's speed in a particular direction.
motion How an object's position changes over time.	**inertia** Objects remain at rest or in motion unless acted on by a force.
speed A measurement of distance over time.	**gravity** The force that pulls objects toward the center of the Earth.
acceleration A change in motion caused by a change in speed.	**friction** Forces that slow down or stop movement.

Name:

Force and Motion Vocabulary Examples



Down

1. A book that falls off a desk lands on the floor because of ________.

2. The bowling ball was moving straight forward with great ________.

3. The woman's driving ________ was 30 miles per hour.

4. The ball rolled slower on the carpet than on the smooth floor because the carpet had more ________.

5. The boy was in ________ when he was running to the next base.

6. She pushed the door with great ________ because it was jammed.

Across

7. The ________ of the race car was amazing as it passed all of the other cars.

8. When the car stopped fast, the luggage kept moving forward until it fell to the ground because of ________.

Side A

Teacher directions: Copy side A and B, FRONT TO BACK on 1 piece of paper.
Student directions: Cut off the side strips. Fold in half on the middle line.
Cut the front flaps only to reveal definitions behind the words.

cut here

Glue this side to your notebook.

force	motion	speed	acceleration	velocity	inertia	gravity	friction

cut here

Cut these flaps only after folding. ↑

Side B - Option 1

cut here only

Force and motion fun facts:

*If you threw a ball in space, it would continue to move in the same direction and at the same speed forever (unless it ran into something).

*Planet Earth is always in motion.

*Sir Isaac Newton is most widely recognized for his 3 Laws of Motion.

A push or a pull.

How an object's position changes over time.

A measurement of distance over time.

A change in motion caused by a change in speed.

An object's speed in a particular direction.

Objects remain at rest or in motion unless acted on by a force.

The force that pulls objects toward the center of the Earth.

Forces that slow down or stop movement.

cut here only

Force & Motion 1

Slamming a door shut is an example of which type of force?

a. push
b. pull
c. both

Force & Motion 2

Pulling the chair out before you sit down is an example of

a. motion
b. force
c. motion and force

Force & Motion 3

A balloon is in __________ when it is floating away.

a. friction
b. motion
c. gravity

Force & Motion 4

A driver can gain ____________ by **accelerating**.

a. friction
b. inertia
c. speed

Force & Motion 5

A ball sitting on the ground will stay still until a **force** acts upon it because of

a. inertia
b. acceleration
c. friction

Force & Motion 6

If you are measuring the **speed** of a car in a particular direction, you are measuring its

a. friction
b. acceleration
c. inertia

Force & Motion 7

Which surface would have the most **friction**?

a. wood
b. ice
c. sandpaper

Force & Motion 8

Which choice below is described by **distance** over **time**?

a. friction
b. speed
c. velocity

Force & Motion 9

Which is an example of a **force** that will slow down or stop movement?

a. a soccer ball rolling on grass
b. a bat hitting a baseball
c. a bird flying through the air

Force & Motion 10

What **force** keeps objects from floating away?

a. friction
b. gravity
c. inertia

Force & Motion 11

Which surface would have the **least** amount of **friction**?

a. wood
b. ice
c. sandpaper

Force & Motion 12

The game, Tug of War, uses which kind of **force**?

a. push
b. pull
c. neither

Force & Motion 13

Write 2 sentences about a time that you experienced 1 type of **force**.

Force & Motion 14

Write an example of a time you experienced **friction** in 2-3 sentences.

Force & Motion 15

Have you ever been on a roller coaster or a different type of ride that used a lot of **force**? Tell about this experience in 2-3 sentences.

If not, tell about another time you experienced a strong **force**.

Force & Motion 16

Imagine a world with very little **gravity**. How might life be different? Explain your thoughts in 3 sentences.

Force & Motion 17

Which surface would have more **friction** and slow a ball down faster, sand or grass? Why?

Force & Motion 18

Use **2** of your vocabulary words in **1** complete, logical sentence.

Force & Motion 19

Why is it important to be able to **measure speed**? Explain your thoughts.

Force & Motion 20

Why is it important to wear a seatbelt in a vehicle? Give at least 1 reason.

Force & Motion 21

On the back of your response sheet, sketch an example of a **force** (a push or a pull).

Force & Motion 22

On the back of your response sheet, sketch an example of **friction**. Remember, this is a force that slows down or stops movement.

Force & Motion 23

On the back of your response sheet, sketch an example of **gravity**. Remember, this is the force that pulls objects toward the center of the Earth.

Force & Motion 24

On the back of your response sheet, sketch an example of an object in **motion**. Remember, motion is how an object's position changes over time.

Name:

Vocabulary Quiz: Words in Context

force	motion	speed	acceleration
velocity	inertia	friction	gravity

1. When the ball flew through the air, it was in ______________.

2. ______________ makes it more difficult to skate on rough surfaces than on smooth surfaces.

3. If a rock is dropped from the top of a building, it will fall to the ground because of

______________.

4. It took a lot of ______________ to move the heavy furniture.

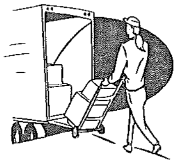
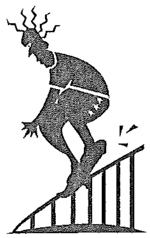
5. The ball gained ______________ as its speed increased rolling down the steep hill.

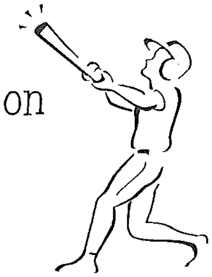
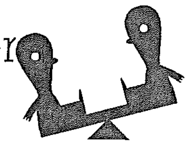
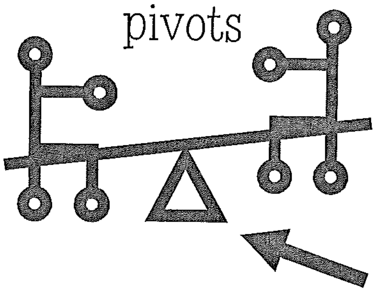
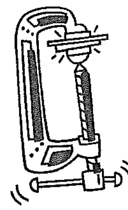
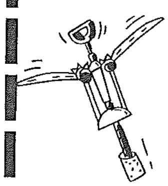
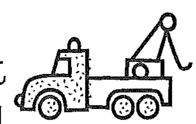
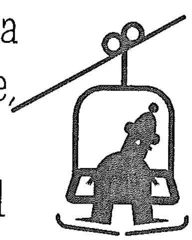
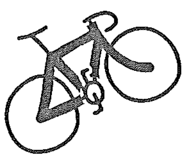
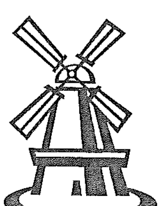
6. Wearing your seatbelt in the car is important. ______________ causes you to keep moving forward when the car stops fast. It takes a force, such as a seatbelt, to stop your movement.

7. Wind blowing to the North at 15 miles per hour describes the wind's ______________.

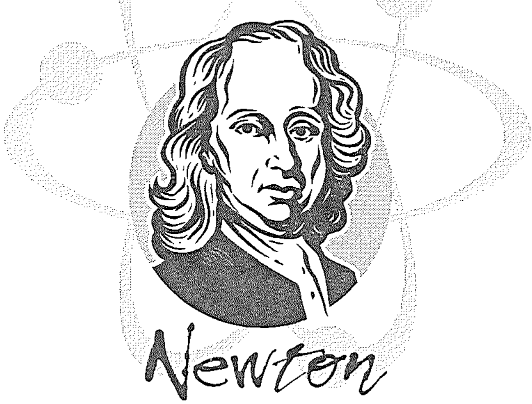
8. The runner won a medal for having the fastest ______________ in the race.

force	something that causes change in motion; a push or a pull	position
an object's location	motion	the change in an object's position over time
direction	the path in which an object is facing or moving	speed
how fast an object is moving; the distance an object travels over time	gravity	a force that pulls an object towards Earth

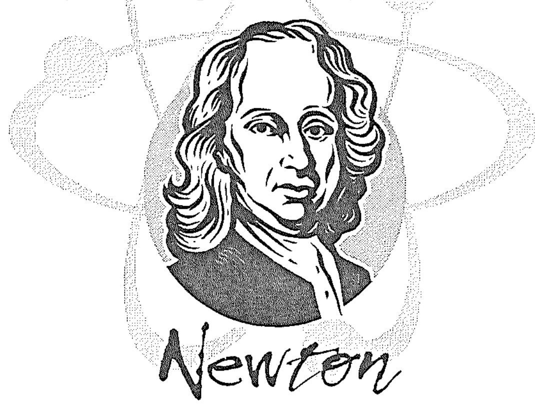
mass	the measurement of matter in an object	friction
an outside force that occurs when two objects rub together	work	using a force to move an object a distance
simple machine	a device that helps make work easier to perform	inclined plane
an even sloping surface that makes it easier to raise or lower an object  	wedge	an object with at least one slanting side ending in a sharp edge used to separate materials 

lever	a stiff bar that rests on a support called a fulcrum which lifts or moves loads  	fulcrum
the point on which a lever pivots 	screw	  an inclined plane that winds around itself; used to raise and lower objects or hold objects together
pulley	simple machine that uses grooved wheels and a rope to raise, lower, or move a load  	wheel and axle
  a moveable simple machine centered around a fixed point	(blank card)	(blank card)

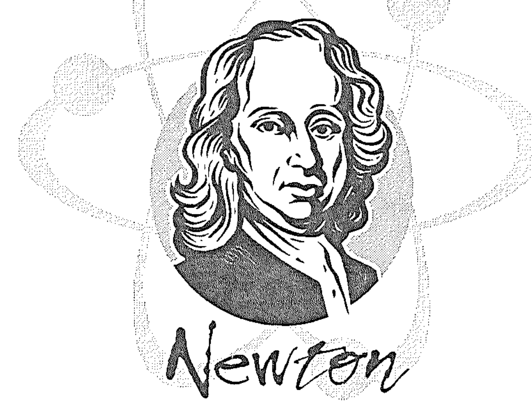
THE FIRST
LAW OF MOTION



THE SECOND
LAW OF MOTION



THE THIRD
LAW OF MOTION



NEWTON'S THREE LAWS OF MOTION

__________'s Flipbook

Illustrate Newton's First Law of Motion above.

Illustrate Newton's Second Law of Motion above.

Illustrate Newton's Third Law of Motion above.

An object at rest will remain at rest unless acted on by an unbalanced force. An object in motion continues in motion with the same speed and in the same direction unless acted upon by an unbalanced force.

Simply put, an object will keep doing what it is doing unless it is stopped by another force.

Acceleration is produced when a force acts on a mass. The greater the mass, the greater the amount of force needed.

Simply put, the heavier the object, the more force you will need to move it.

For every action there is an equal and opposite reaction.

Simply put, whenever an object pushes another object, it gets pushed back in the opposite direction equally hard.

Force

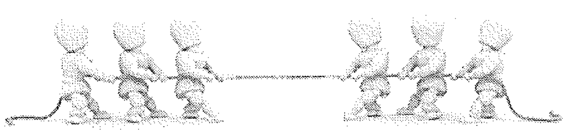
What is force? How is it measured?

What 2 things does every force have?

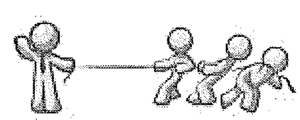
How can forces affect an object?

Describe and give examples of:

Balanced Forces



Unbalanced Forces



Force - KEY

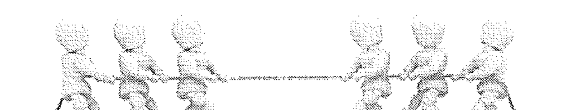
A force is a push or pull. It is measured in units called Newtons (N).	Every force has a magnitude (strength) and a direction.	Forces can set a stationary object in motion, change a moving object's speed and/or direction, or act on a stationary object by changing it's shape. (like when you sit on an inner tube and the sides bulge out).

Describe and give examples of:

Balanced Forces

These forces cause no change in motion. And object that is moving will maintain its speed and direction if balanced forces are acting on it. An object that is not moving will stay motionless.

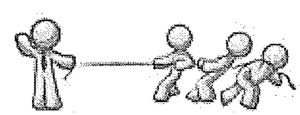
Ex: A book on a table will stay at rest.



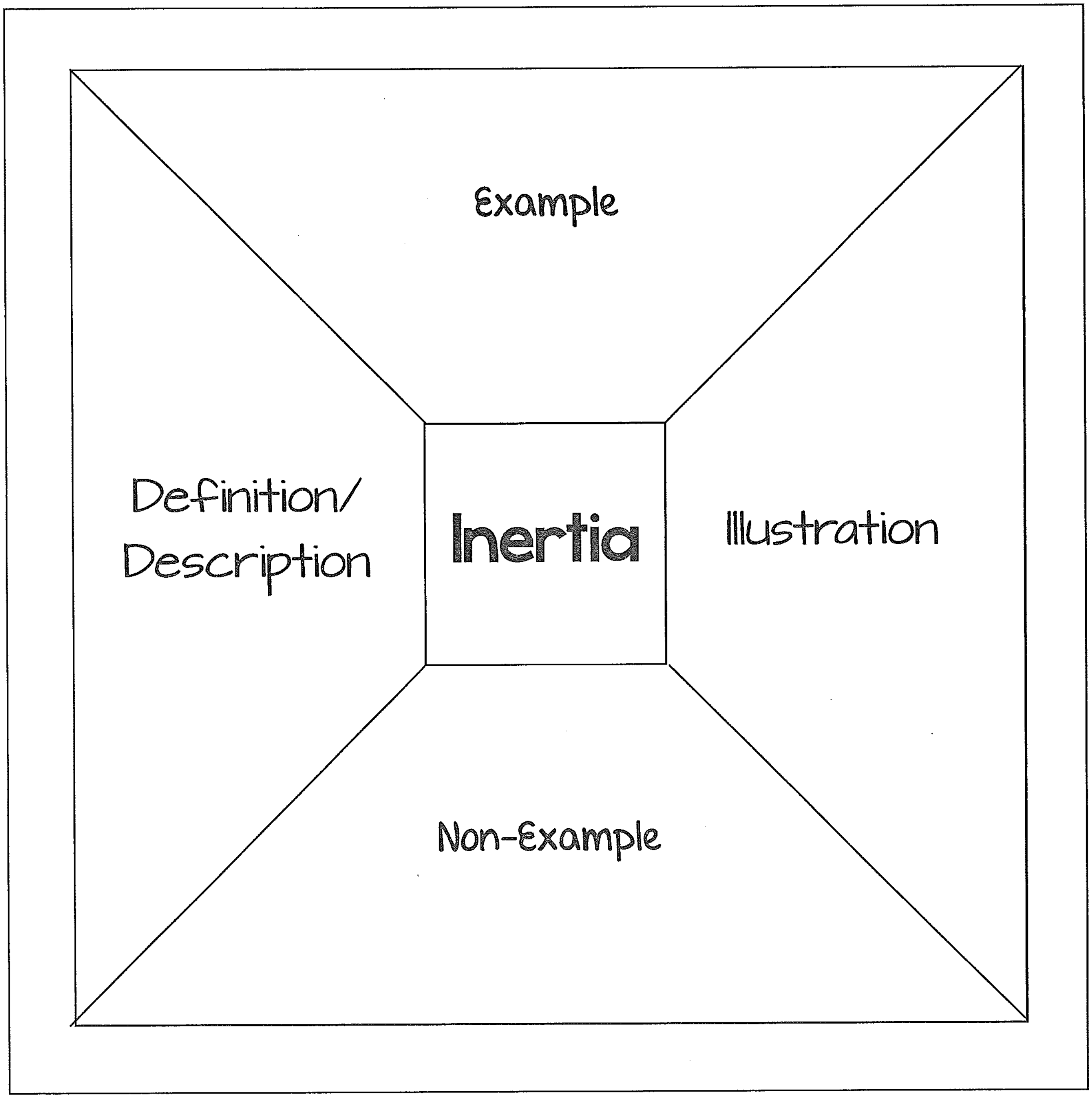
Unbalanced Forces

These forces cause a change in the motion of an object. A motionless object will begin to move, while an object that is already moving will change its speed and/or direction

Ex: A ball rolling on the ground will come to rest because friction between the ball and the ground creates an unbalanced force.

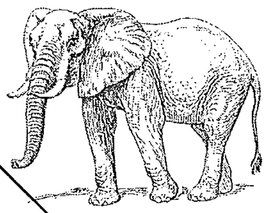


Inertia



The center square may be cut out completely and glued into the notebook to become the center of the template; or only 3 sides of the square may be cut, leaving it attached to one of the tabs.

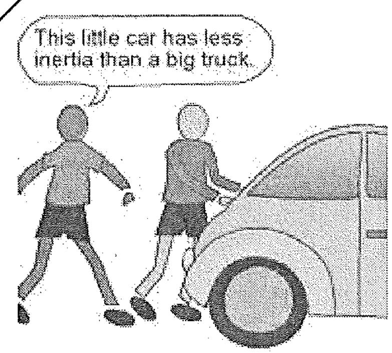
Inertia



It is harder to push an elephant than to push a ladybug.

The tendency of an object to resist a change in motion. The greater an object's mass, the greater its inertia and the larger the force needed to overcome the inertia.

Inertia



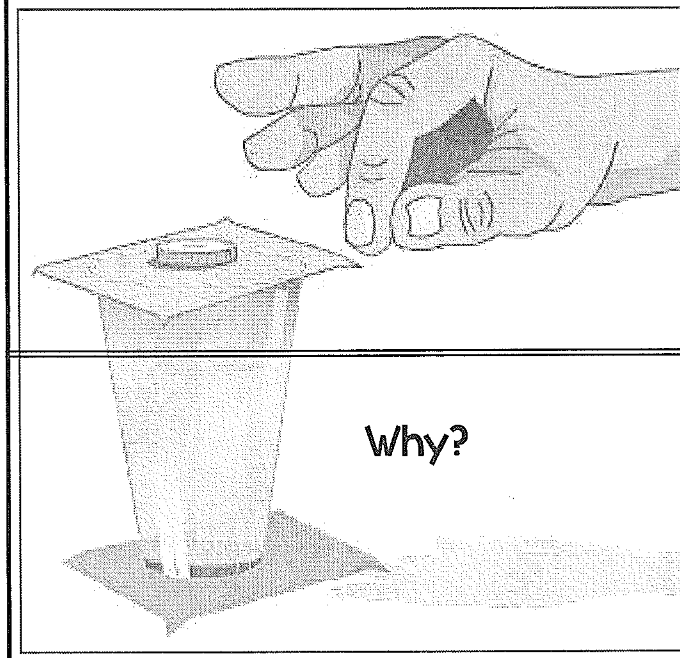
Accept all reasonable responses

The center square may be cut out completely and glued into the notebook to become the center of the template; or only 3 sides of the square may be cut, leaving it attached to one of the tabs.

Inertia

Law of Inertia

What will happen?

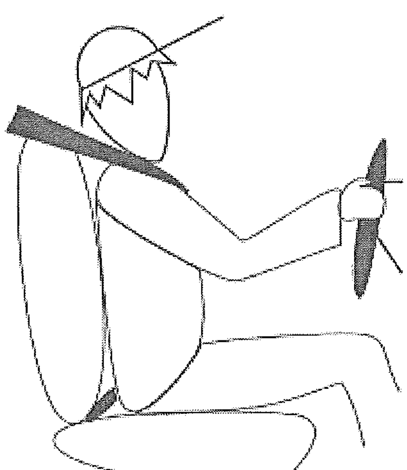


Why?

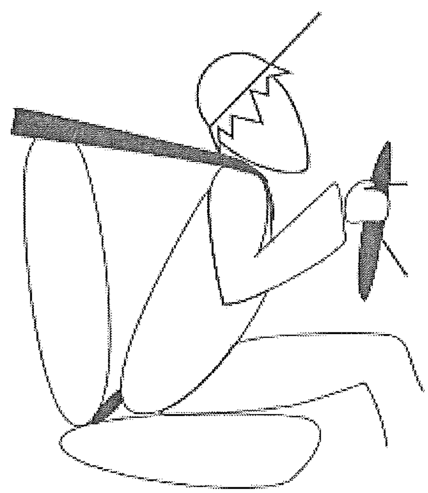
What is the relationship between *inertia* and mass?

Explain Newton's First Law in terms of why we wear seatbelts.

You are driving down the road at 50 miles per hour. What forces are present? What has inertia?



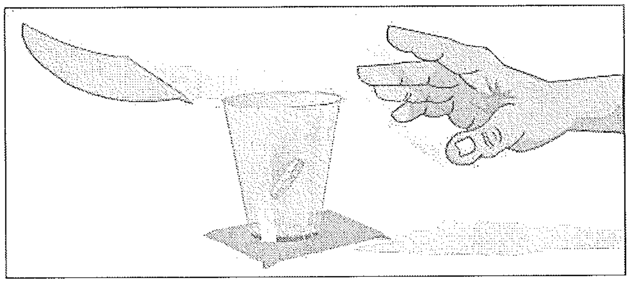
You suddenly slam on the brakes to avoid a deer. Explain what happens to your body and why. Why do we wear seatbelts?



Inertia

Law of Inertia

What will happen?



The card will fly away and the coin will fall into the cup.

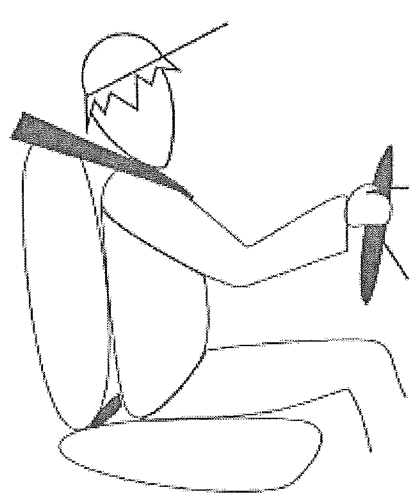
Why?

This will happen because Newton's First Law states that an object at rest will remain at rest, unless an unbalanced force acts upon it. In this case, everything is at rest until your finger flicks the card. If the force is great enough, only the card will go flying (and not the coin) because the card is the only thing that received the force. Note: If the force applied to the card is not great enough, the friction between the card and the coin will be greater causing both objects to move together.

The greater the mass, the greater the inertia.

Explain Newton's First Law in terms of why we wear seatbelts.

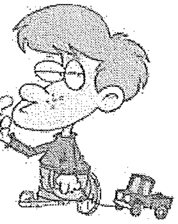
Everything in the car, including the driver, are traveling at a speed of 50 mph. The tires are pushing back on the road, while the road pushes the tires forward.



When you slam on the brakes, your body and everything in the car continues to travel straight down the road at a speed of 50 mph. This is why we wear seatbelts. The seatbelt is intended to stop the forwad motion of your body, so that you don't go flying through the windshield.

Newton's Second Law of Motion: Law of Force and Acceleration

How well do I understand Newton's Second Law: Law of Force and Acceleration?



A toy car pulled by a little boy has an acceleration of $3.0\ m/s^2$. What is the mass of the car if the net force on the car is 10 N? Show your work.

Why is it harder to throw a bowling ball than it is to throw a baseball?

Explain the relationship between force, mass and acceleration.

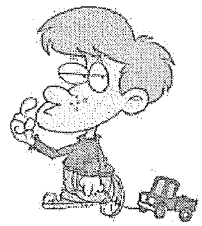
$F = ma$

Second Law of Motion

Newton's Second Law of Motion: Law of Force and Acceleration

How well do I understand Newton's Second Law: Law of Force and Acceleration?

$m = F \div a$



$m = 10N \div 3.0\ m/s^2$

$m = 3.3\ kg$

Because a bowling ball has more mass, it also has more inertia. Therefore, it takes more force to overcome the inertia of the bowling ball than the baseball.

The acceleration of an object is inversely proportional to the mass of the object meaning that as one increases, the other decreases by the same ratio. (Ex: The greater the mass of an object, the less acceleration it will have (assuming the force remains the same). The acceleration of an object is directly proportional to the force which means that as one increases, the other increases. (ex: The harder you throw a ball, the greater the acceleration.)

F = ma

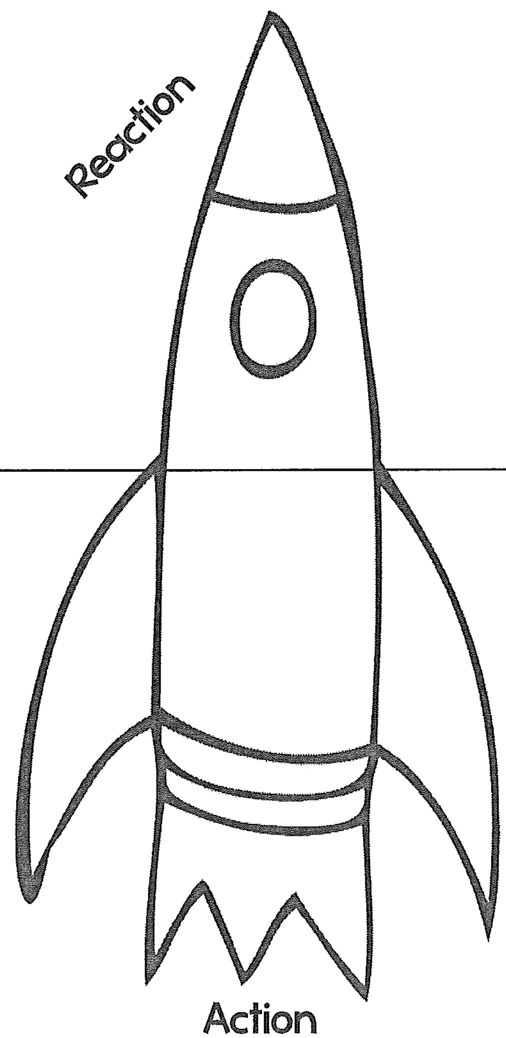
Teacher note: Fold this flap down

A given force exerted on a small mass produces a greater acceleration than the same force exerted on a large mass.

Second Law of Motion

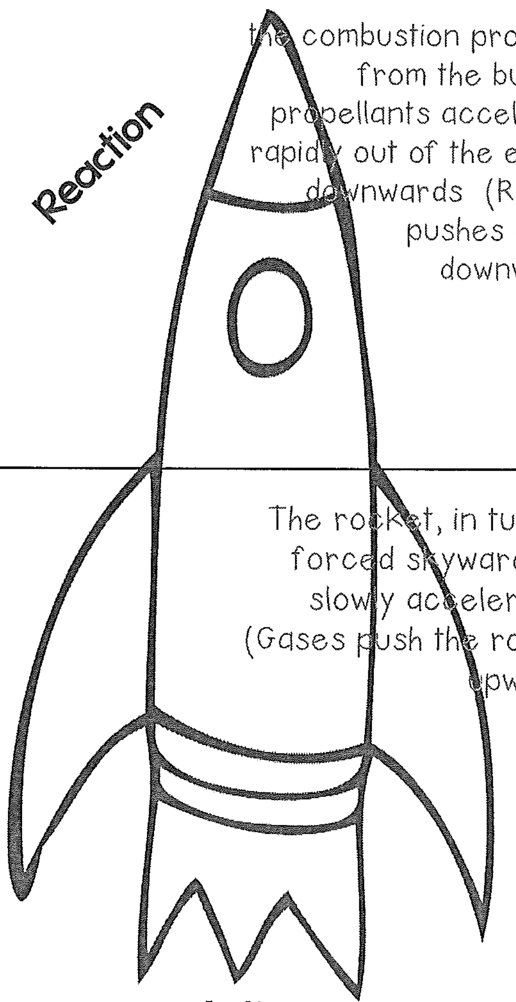
Newton's Third Law of Motion: Law of Action-Reaction

Describe the force pairs present when a rocket launches.



Newton's Third Law of Motion: Law of Action-Reaction

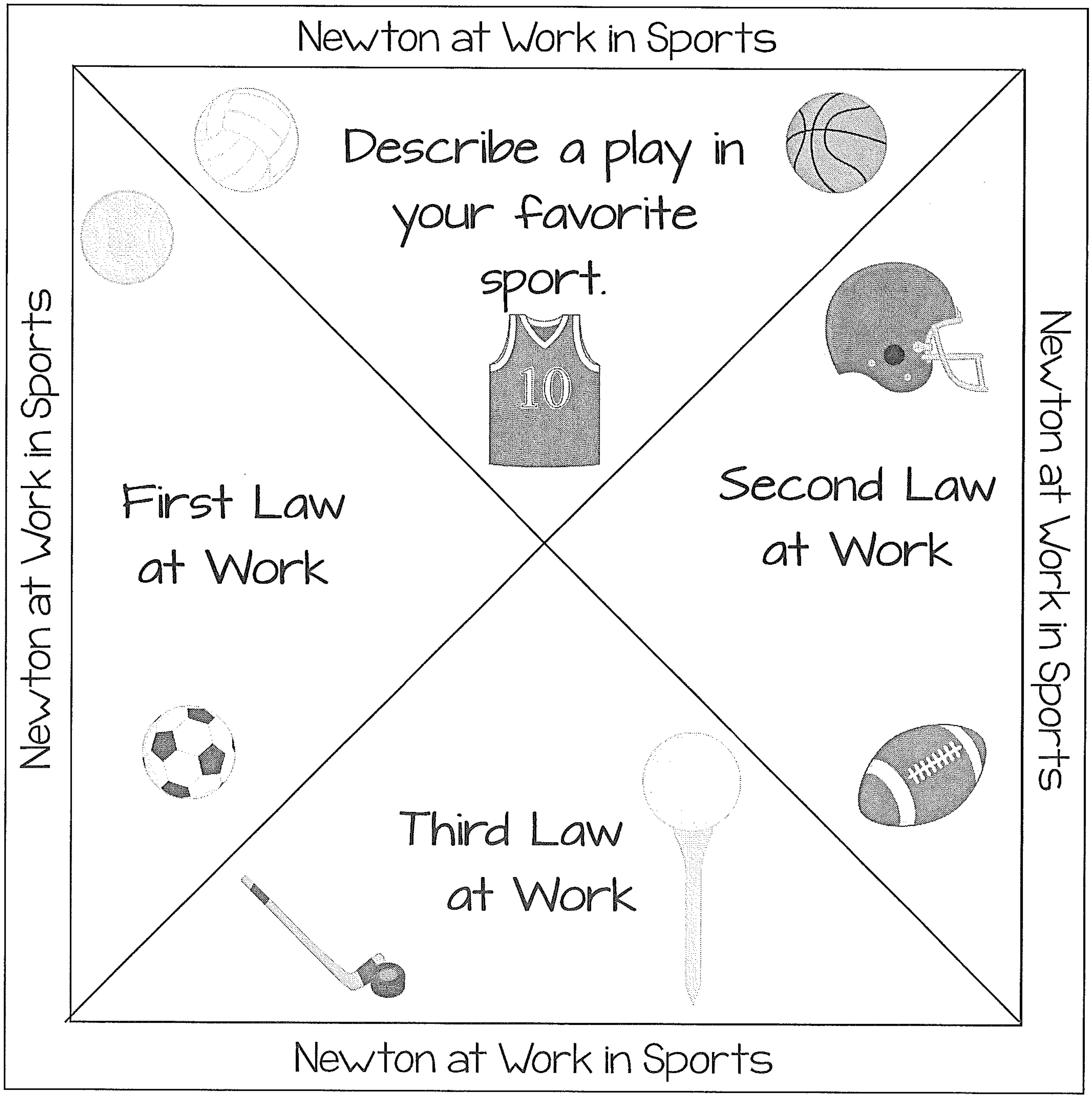
Describe the force pairs present when a rocket launches.



Reaction: the combustion products from the burning propellants accelerate rapidly out of the engine downwards (Rocket pushes gases downward.)

Action: The rocket, in turn, is forced skyward and slowly accelerates. (Gases push the rocket upward.)

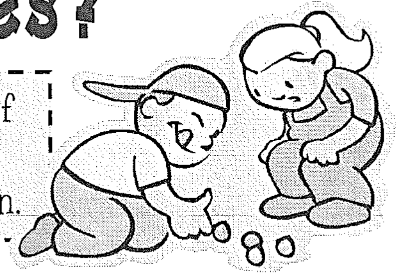
Newton's Laws at Work



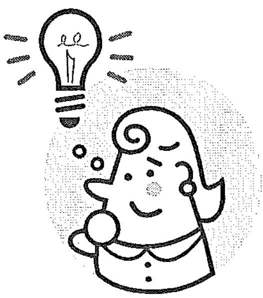
 Name: ______________________ Date: ____________ #: ______

Have You Lost Your Marbles?

In a small group, you will work to design an experiment testing the motion of marbles. Use what you know about how objects move to conduct this experiment. Create an experiment that will be easy for others to repeat again.



Problem



As a group, list two things that you can change about the motion of a rolling marble.

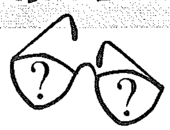
____

____

Now, choose one of those two things to test for your experiment.

____

Question



Form a testable question.

How can the ______________________ of a rolling marble be changed?

Hypothesis

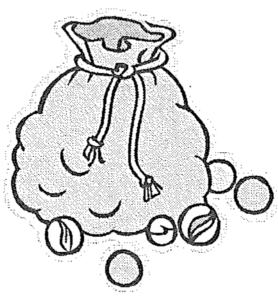
Based on what you already know about motion, form a hypothesis. Use an "If, Then" statement to create your hypothesis.

____

____

____

Materials



With your group, decide the materials you will need to conduct your experiment. Be sure that your materials are easily accessible. List them below.

______________________ ______________________

______________________ ______________________

______________________ ______________________

______________________ ______________________

______________________ ______________________

______________________ ______________________

 Name: ____________________ Date: ______________ #: ______

Experimental Design

Use the table below to specifically design your experiment in order to test your hypothesis.

Step-by-Step Directions	**Details** (Materials, how much, how often, when, time, distance, etc.)
1.	
2.	
3.	
4.	
5.	
6.	
7.	
8.	
9.	
10.	

Name: ______________________ Date: ____________ #: ______

Observations and Data

How will you record your observations and data? In the space below, create tables, charts, graphs, etc. to show how you recorded your data.

Name: ______________________ Date: ______________ #: ______

Conclusions

Answer the following questions to make conclusions about your experiment.

1. What was the **independent variable** in this experiment? The **independent variable** is the factor that is changed in the experiment. What did you change each time in the experiment?

2. What was the **dependent variable** in this experiment? The **dependent variable** is the measured outcome of the independent variable. What was the outcome of the experiment based on what you changed with the independent variable?

3. What were the **controlled variables** in the experiment? The **controlled variables** are the factors that are not changed throughout the experiment. What did you keep the same throughout the entire experiment?

4. What conclusions can you make about your experiment?

Was your hypothesis correct?

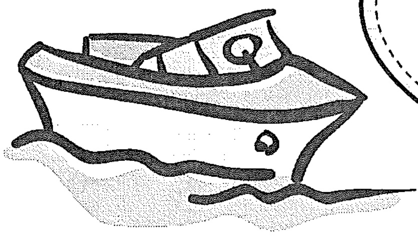
Why or why not?

5. If you were to do this experiment again, what changes would you make?

Name: ______________________________

Date: ___________________ #: ________

What Really Floats Your Boat?



Problem

Newton's Third Law of Motion states that for every action there is an equal and opposite reaction. Simply put, this means that whenever an object pushes another object, it gets pushed back in the opposite direction equally hard. Newton's law brings up questions about **potential** and **kinetic energy**. **Potential energy** is the energy that is stored up in a object, and **kinetic energy** is the energy an object has while in motion. How can Newton's Third Law, potential, and kinetic energy be shown in a real-world situation?

Question

How does winding a rubber band affect the movement of a tin boat?

Hypothesis

Write an "If, Then" statement explaining your hypothesis. Think about what you know about rubber bands, potential and kinetic energy, and Newton's Laws of Motion.

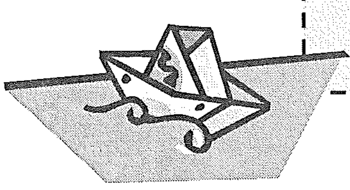
____

____

Materials

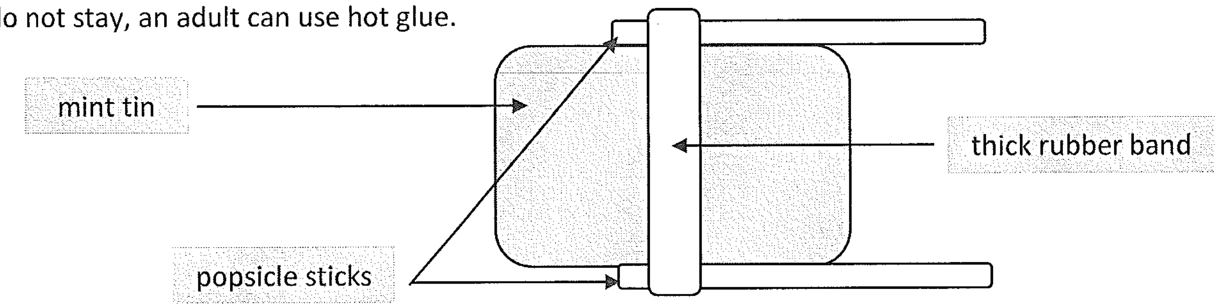
You will need the following materials for this experiment:

- 1 small mint tin
- 2 popsicle sticks
- 1 2 ½ in. wide x 1 in. long piece of plastic (cut rectangle from a coffee can lid)
- 1 thin rubber band
- 1 thick rubber band
- 1 pair of scissors
- *hot glue gun (if necessary, for adult use only)
- 1 large container of water for testing (large sink or cooler)
  *Students can take them home and test them in the bathtub!

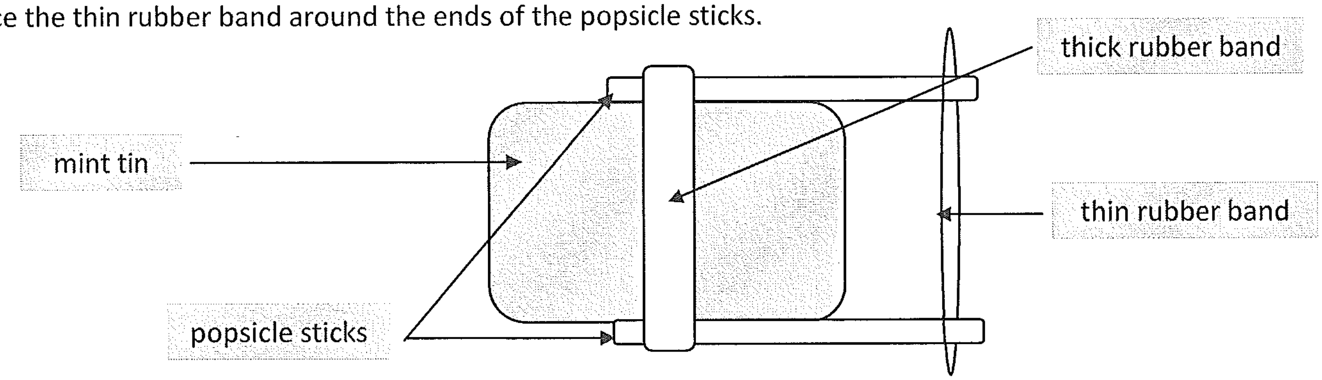


Experimental Design

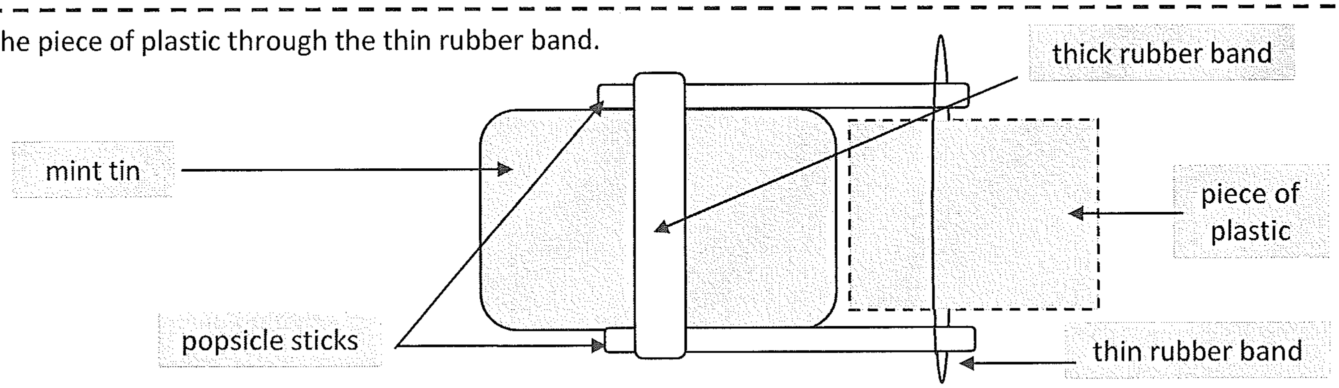
1. With the mint tin closed, secure the popsicle sticks flat against the sides with the thick rubber band, so that about ¼ to ½ of each stick is extending out beyond the tin.
*If the sticks do not stay, an adult can use hot glue.



2. Place the thin rubber band around the ends of the popsicle sticks.



3. Slip the piece of plastic through the thin rubber band.



4. Twist the plastic piece around the thin rubber band a few times in order to store **potential energy**. Decide which direction you want to twist the plastic piece (away from the tin can or toward the tin can) for the first test. This will be your first trial run.

5. Place the boat into the water and let it go, allowing the rubber band to untwist. This action turns the **potential energy** into **kinetic energy**. Observe the movement of the boat.

6. Repeat the test 3 times with the following adjustments:
    - Twist the plastic piece away from the tin 3 times.
    - Twist the plastic piece towards the tin 3 times.
    - Twist the plastic piece away from the tin 5 times.
    - Twist the plastic piece towards the tin 5 times.

Observations and Data

Record what you observe about the movement of the boat in the water after making the adjustments below.

Test #	Away – 3 times	Towards – 3 times	Away – 5 times	Towards – 3 times
1				
2				
3				

Conclusions

Based on your observations, what conclusions can you make about how the winding of the rubber band affects the movement of the boat? Was your hypothesis correct? Why or why not? Be sure to identify the **independent**, **dependent**, and **controlled variables.**

Extension

There are many ways to extend this experiment. If you could do this experiment again, what would you do differently? What changes to the variables would you make? Instead of testing the rubber band, what other parts of the boat could you test? How could you measure the speed of the boat? How could you measure how far the boat travels?

MY FORCE AND MOTION CARTOON

Name:______________________

Date: ____________________

FRICTION

GRAVITY

LUBRICATION

MASS

SURFACE AREA

MY FORCE AND MOTION CARTOON RUBRIC

You will be creating a Force and Motion Cartoon to show your understanding of how friction, gravity, lubrication, mass, and surface area can affect an object's motion. Use the following rubric to create your cartoon.

Required Element	Points Possible	Points Earned
Name and Date	5	
Each box includes: ✓ A complete illustration showing understanding of how the term affects an object's motion ✓ A written caption using appropriate unit vocabulary showing understanding of the term and how it affects an object's motion	45	
Each box includes: ✓ A colored illustration that takes up the entire space ✓ Correct use of spelling, grammar, and punctuation ✓ Evidence of organization and effort	25	
All 5 boxes complete	20	
Turned in on time	5	

Name: ______________________

Final Grade: ______

Comments:

MY FORCE AND MOTION CARTOON RUBRIC

You will be creating a Force and Motion Cartoon to show your understanding of how friction, gravity, lubrication, mass, and surface area can affect an object's motion. Use the following rubric to create your cartoon.

Required Element	Points Possible	Points Earned
Name and Date	5	
Each box includes: ✓ A complete illustration showing understanding of how the term affects an object's motion ✓ A written caption using appropriate unit vocabulary showing understanding of the term and how it affects an object's motion	45	
Each box includes: ✓ A colored illustration that takes up the entire space ✓ Correct use of spelling, grammar, and punctuation ✓ Evidence of organization and effort	25	
All 5 boxes complete	20	
Turned in on time	5	

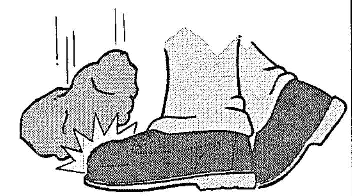
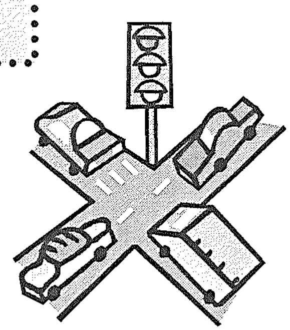
Name: ______________________

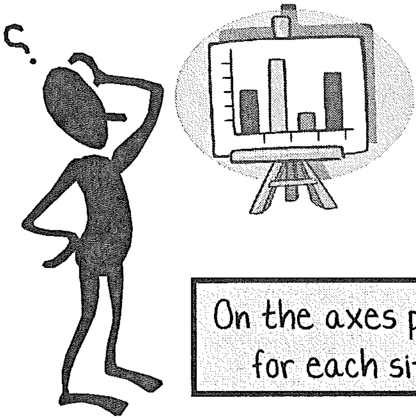
Final Grade: ______

Comments:

Name: ______________________ Date: __________ #: ________

Gravity and Friction: Helpful or Harmful?

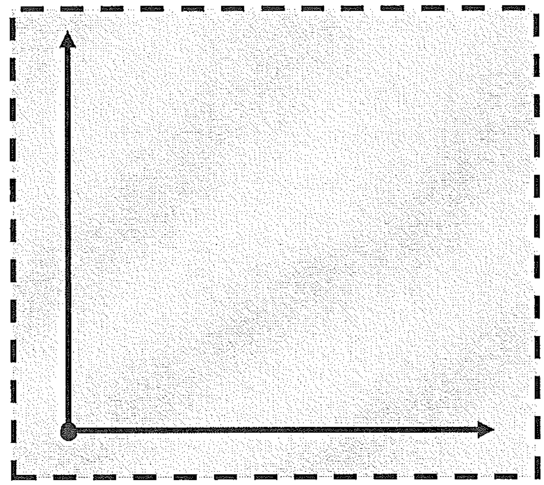
	helpful	harmful
Gravity	 Gravity helps rain and snow fall to the ground. The moisture is then able to flow to streams and rivers because of gravity. Can you think of 3 more examples of how gravity is helpful?	Can you think of 3 more examples of how gravity is harmful? Gravity causes things to fall to the earth, so we need to be careful if a rock falls near our feet! 
Friction	Can you think of 3 more examples of how friction is helpful?  Friction causes the brakes in our cars to work properly so we are safe from collisions when stopping.	Can you think of 3 more examples of how friction is harmful?  There is little to no friction on an ice skating rink, therefore it is difficult to stop from slipping and falling!



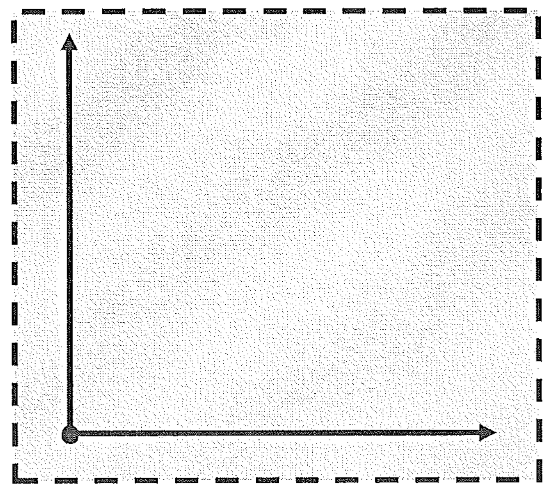
GRAPHING: WHAT DOES IT ALL MEAN?

On the axes provided, draw a graph for each situation listed below.

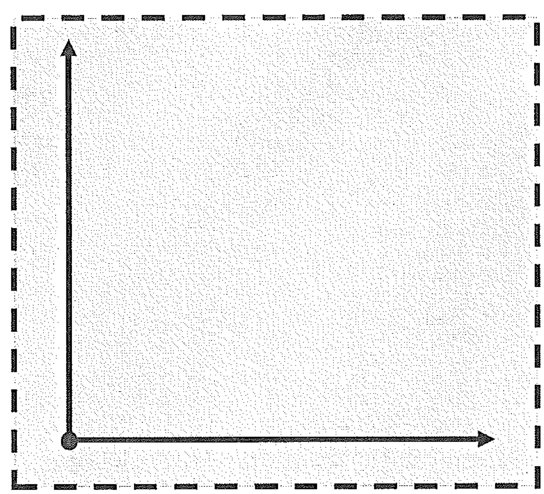
While Katherine was standing on the beach, she threw a rock as high as she could before the rock landed in the water.



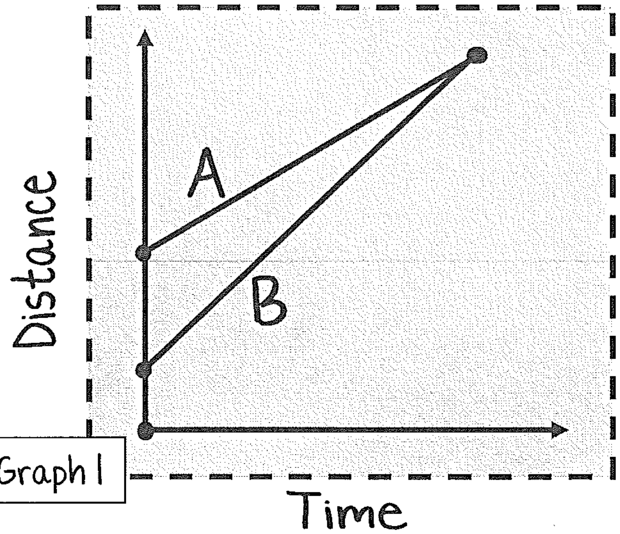
The pilot decreased the plane's altitude because of rough turbulence. Once the turbulence was over, the pilot returned the plane to its previous altitude.



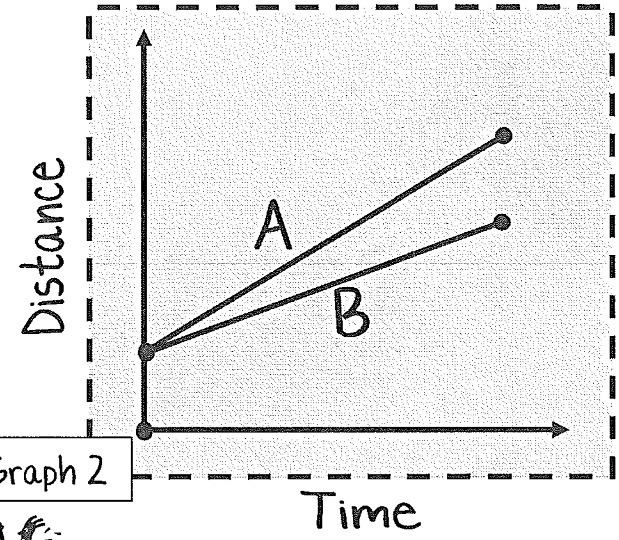
Matthew threw his paper airplane. The airplane lowered at a constant speed, leveled off, and then rose at a constant speed until it was caught by Matthew's teacher.



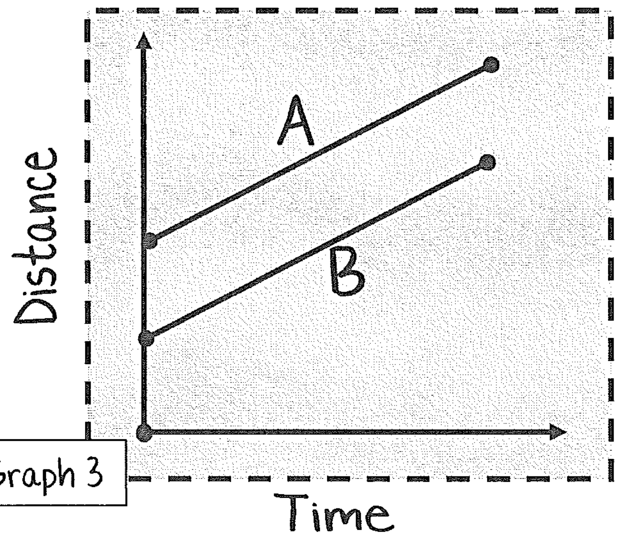
Graph 1



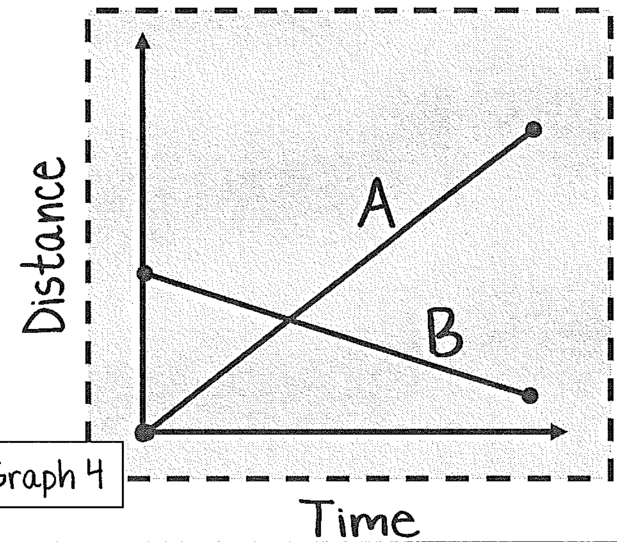
Graph 2



Graph 3



Graph 4



Describe the situation of Runners A and B in Graph 1.

____

____

Describe the situation of Runners A and B in Graph 2.

____

____

Describe the situation of Runners A and B in Graph 3.

____

____

Describe the situation of Runners A and B in Graph 4.

____

____