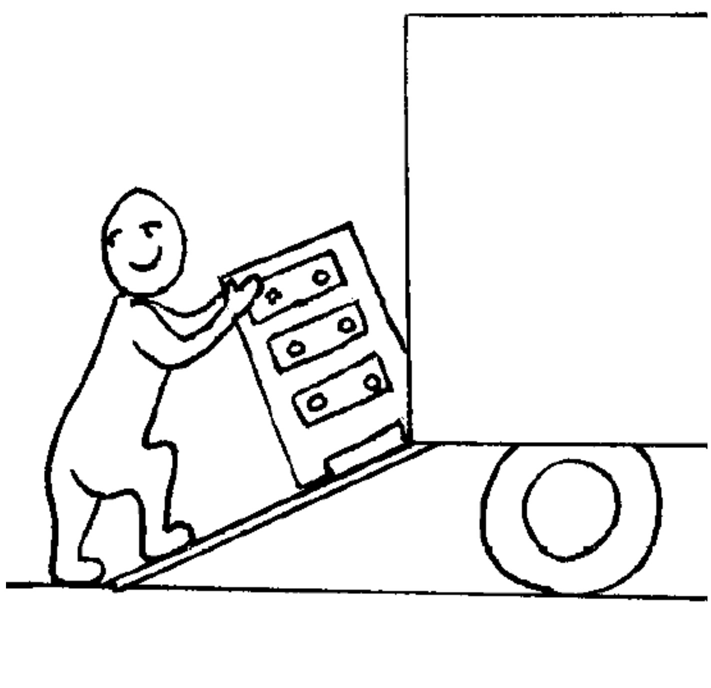
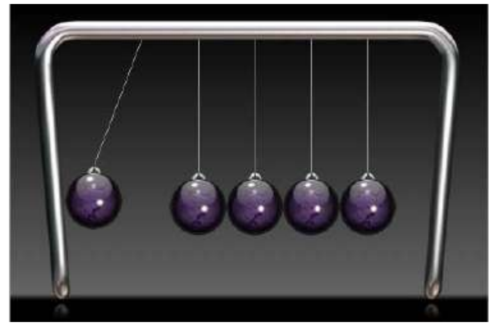
FORCE AND MOTION



MOTION

Types of motion



What is Goal 1?

Classify different types of motion (e.g., straight line, projectile, circular, vibrational)

Assignment

Print off or cut out three examples of something or someone in motion.

What are we going to do with it?

We will examine each image and begin to learn and define what it means to be in motion. We will then classify the type of motion exhibited in the picture as an examples of one or more of these: straight line, projectile, circular, vibrational.

SPEED

Force & Motion

Name _______________________

Speed Trials

Describe SPEED in your own words:
____
____
____
____
____
____
____
____
____
____
____

Problem: To calculate speed

Background Information: <u>**Motion**</u> is a change in position measured by distance and time.

<u>**Speed**</u> is the rate of change in position. Speed combines information about how far an object moves (distance) with how long it takes to move that distance (time).

Speed is the rate at which an object moves.

Speed = distance ÷ time

Distance and Time can also be calculated with these formulas:

Distance = speed X time

Time = distance ÷ speed

Materials:

Stopwatch	1m board	Wood blocks
Toy car	Calculator	

Procedure:

1. Use the wood blocks and the board to build a ramp
2. Put the toy car at the top of the ramp, with the front wheels behind the edge of the board.
3. On the signal, release the toy car so that it rolls down the ramp AND start the stopwatch.
4. Stop timing when the back wheels of the toy car leave the end of the ramp.
5. Record the data.
6. Repeat the procedure for a total of 5 times.
7. Average the data.

Data:

Trial	Distance (m)	Time (sec)	Speed (m/s)
1	1		
2	1		
3	1		
4	1		
5	1		
Average	*1*		

Questions:

1. Use your textbook to describe:
   a. Average speed

      ____

      ____

   b. Instantaneous speed

      ____

      ____

   c. Constant speed

      ____

      ____

2. How is instantaneous speed different from average speed?

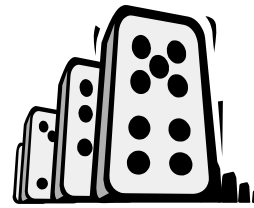
   ____

   ____

   ____

3. If you drive 200 miles in 3 hours before stopping for 30 minutes for lunch and gas. After lunch you travel 150 miles in an hour and a half. What was your average speed for the trip? Show your work.

Name____________________________



Domino Dash

Problem: To demonstrate the relationship between speed, time and distance.

Background Information:
__Average Speed__ is the rate of motion calculated by dividing the distance traveled by the amount of time it takes to travel that distance

$$\text{average speed} = \frac{\text{total distance traveled}}{\text{travel time}}$$

If you let *s* stand for the average speed, *d* stand for distance, and *t* stand for time, you can write this equation as follows.

$$s = \frac{d}{t}$$

Because average speed is calculated by dividing distance by time, its units always will be a distance unit divided by a time unit.

Materials:

1 box of 28 dominoes	Stopwatch	Meter stick
Calculator		

Procedure:
1. Set up all 28 dominoes with equal spacing between them. Set the dominoes in a straight line to cause a chain reaction when the first domino is pushed.
2. Measure the length of the domino row. Record this data in the table.
3. Use the stopwatch to measure the time it takes for the entire row of dominoes to fall after the first domino is pushed. Record the data.
4. Calculate the speed at which the dominoes fell. Record.

$$\text{average speed} = \frac{\text{total distance traveled}}{\text{travel time}}$$

5. Set up another row of a different length. Repeat steps 3 – 4.
6. Repeat for a total of 7 different trials.

M. Poarch – 2003
http://science-class.net

Data:

Speed of Falling Dominoes		
Length of domino row (cm)	***Time to fall (sec)***	***Average speed of falling dominoes (cm/sec)***

Data Analysis:
Make a line graph to show the relationship between the length of the domino row and the time it takes to fall. Put the length of the row on the X-axis and the time to fall on the Y-axis.

Title ____

Speed Challenge

Get Ready!

Step 1: Gather your materials!

Each team needs 2 timers, 1 meterstick, 1 roll of masking tape, and 1 marker.

Step 2: Create your "race" track!

Find a spot in the hallway and measure a 10 meter race track. Use three pieces of tape to mark the beginning, middle an end of your track. Mark each distance (0 m, 5 m, and 10 m) on the tape with the marker.

Step 3: Go for it!

Each team member will to peform the following tasks for each distance THREE times: hopping, walking backwards, walking (regular rate), and speed walking. Your team will need people with timers or stopwatches at the 5 meter and 10 meter points. Record the time it takes to perform each task.

NOTE: Speed walking is going as fast as you can **without** jogging or running.

Collect That Data:

Record your data from the experiement in the chart, then use the information to calculate the speed for each task and distance. Round answers to the nearest hundreth if needed. Label your answers.

Task	Distance	Time Trial 1	Time Trial 2	Time Trial 3	Average Time	Speed*
Hopping	5 m					
Hopping	10 m					
Walking backwards	5 m					
Walking backwards	10m					
Regular Walking	5 m					
Regular Walking	10m					
Speed Walking	5 m					
Speed Walking	10 m					

***Be sure to use your average time to calculate speed**

Think About It!

1. Which task and distance resulted in the fastest speed?

   Task = ____________ Distance = ____________ Speed = ____________

2. Which task and distance resulted in the slowest speed?

   Task = ____________ Distance = ____________ Speed = ____________

3. How far could you speed walk in 10 minutes based on your speed for the 10 meter trial? Show your work!

4. How long would it take you to hop 30 meters based on your speed for the 5 meter trial? Show your work!

5. How far could you travel walking backwards in 15 minutes based on your results for the 5 meter trial? Show your work!

6. How long would it take you to walk (regular rate) 1 kilometer (or 1,000 m) based on your speed for the 10 meter trial? Show your work!

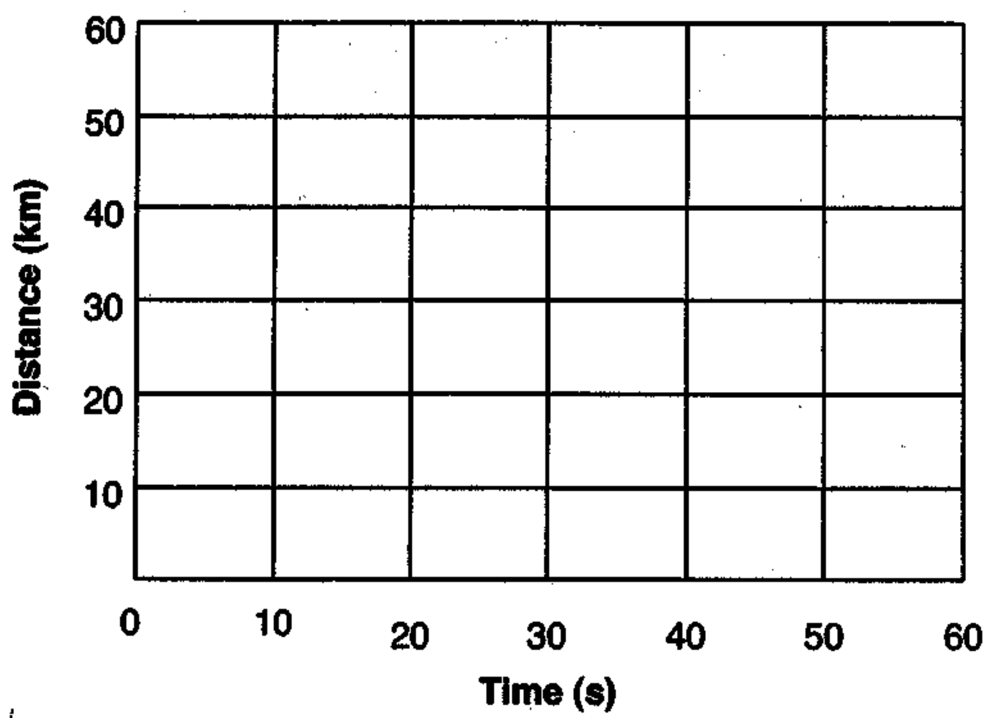
7. Are your results accurate? Why or why not?

GRAPHING DISTANCE VS. TIME

Name ____________________

Plot the following data on the graph and answer the questions below.

Distance (km)	Time (s)
0	0
5	10
12	20
20	30
30	40
42	50
56	60



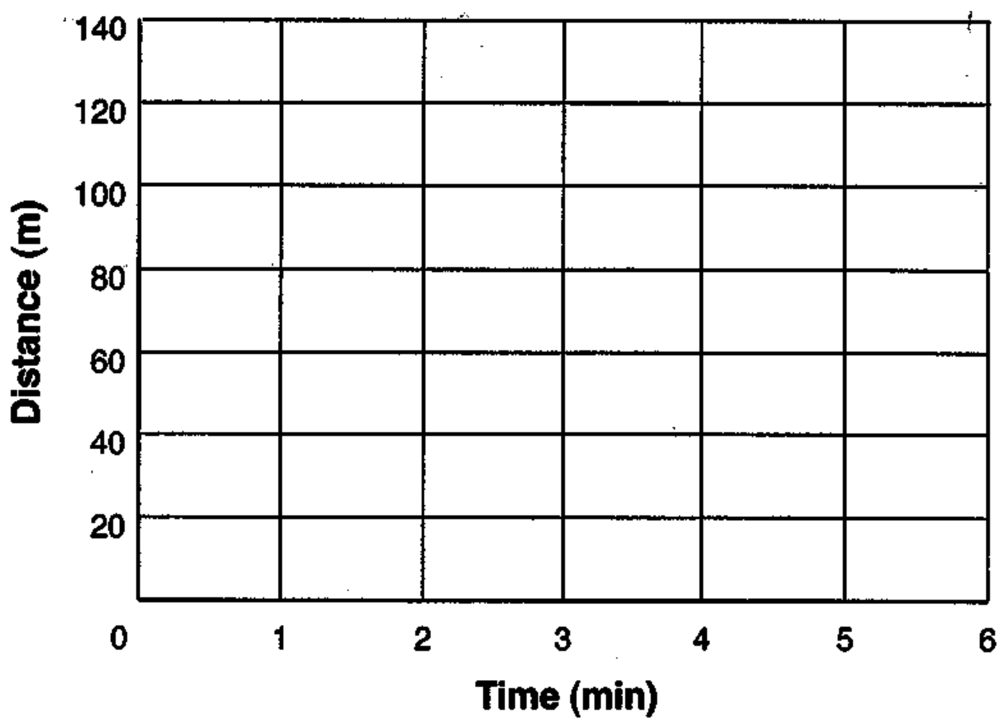
1. What is the average speed at t = 20 s? ____________________
2. What is the average speed at t= 30 s? ____________________
3. What is the acceleration between 20 s and 30 s? ____________________
4. What is the average speed at t = 40 s? ____________________
5. What is the average speed at t = 60 s? ____________________
6. What is the acceleration between 40 s and 60 s? ____________________
7. Is the object accelerating at a constant rate? ____________________

CALCULATING AVERAGE SPEED

Name ____________________

Graph the following data on the grid below and answer the questions at the bottom of the page.

Time (min)	Distance (m)
0	0
1	50
2	75
3	90
4	110
5	125



$$\text{Average Speed} = \frac{\text{Total Distance}}{\text{Total Time}}$$

1. What is the average speed after two minutes? ____________________
2. After three minutes? ____________________
3. After five minutes? ____________________
4. What is the average speed between two and four minutes? ____________________
5. What is the average speed between four and five minutes? ____________________

NAME________________________________

PROBLEM: To calculate the speed of a rolling marble.

BACKGROUND INFORMATION: ***Motion*** is a change in position in a certain amount of time. All motion is compared to a ***frame of reference***. The rate at which an object moves is its ***speed***. Speed can be calculated by this formula:

$$\text{Speed} = \frac{\textbf{Distance}}{\textbf{Time}}$$

$$\text{Speed} = \text{Distance} \div \text{Time}$$

Objects whose speed does not change are said to have ***constant speed***. ***Average speed*** is obtained by dividing total distance by total time.

MATERIALS:

Stopwatch or clock w/ second hand	ruler
Marble	Small block
Meter stick or measuring tape	Masking tape

PROCEDURE – PART 1:

1. On a level surface, make a ramp with the ruler and the block.
2. Roll the marble down the ramp.
3. Record the distance the marble rolls from the bottom of the ramp (ruler) across the floor in two seconds.
4. Repeat 4 more times.
5. Record the distance the marble rolls in three seconds.
6. Repeat 4 more times.
7. Record all data.

PROCEDURE – PART 2:

1. Using the same ramp, measure ½ meter straight across the floor to the bottom of the ramp.
2. Put a piece of masking tape at the ½ meter mark.
3. Roll the marble down the ramp.
4. Time how long it takes the marble to reach the ½ meter mark.
5. Repeat 4 more times.
6. Measure 1 meter straight across the floor to the bottom of the ramp.
7. Repeat steps 3 – 5.
8. Record all data.

DATA:

DISTANCE TRAVELED

Trial	2 Sec	Speed D/2s	3 Sec	Speed D/3s
1				
2				
3				
4				
5				
Mean				

TIME

Trial	½ meter	Speed ½ m/T	1 meter	Speed 1m/T
1				
2				
3				
4				
5				
Mean				

CLASS AVERAGES

Group	Speed @ 2 sec	Speed @ 3 sec	Speed @ ½ m	Speed @ 1 m
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
Mean				
Median				
Mode				
Range				

Create a graph to display the **most significant** data.

CONCLUSION:
Write a paragraph discussing the results of this activity. Explain what happened and why.

DETERMINING SPEED (VELOCITY)

Name ______________

Speed is a measure of how fast an object is moving or traveling. Velocity is a measure of how fast an object is traveling in a certain direction. Both speed and velocity include the distance traveled compared to the amount of time taken to cover this distance.

$$\text{speed} = \frac{\text{distance}}{\text{time}} \quad / \quad \text{velocity} = \frac{\text{distance}}{\text{time}} \text{ in a specific direction}$$

Answer the following questions.

1. What is the velocity of a car that traveled a total of 75 kilometers north in 1.5 hours?

   ____

2. What is the velocity of a plane that traveled 3,000 miles from New York to California in 5.0 hours? __________

3. John took 45 minutes to bicycle to his grandmother's house, a total of four kilometers. What was his velocity in km/hr? __________

4. It took 3.5 hours for a train to travel the distance between two cities at a velocity of 120 miles/hr. How many miles lie between the two cities? __________

5. How long would it take for a car to travel a distance of 200 kilometers if it is traveling at a velocity of 55 km/hr? __________

6. A car is traveling at 100 km/hr. How many hours will it take to cover a distance of 750 km? __________

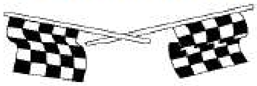
7. A plane traveled for about 2.5 hours at a velocity of 1200 km/hr. What distance did it travel? __________

8. A girl is pedaling her bicycle at a velocity of 0.10 km/min. How far will she travel in two hours? __________

9. An ant carries food at a speed of 1 cm/s. How long will it take the ant to carry a cookie crumb from the kitchen table to the ant hill, a distance of 50 m? Express your answer in seconds, minutes and hours. ________________________

10. The water in the Buffalo River flows at an average speed of 5 km/hr. If you and a friend decide to canoe down the river a distance of 16 kilometers, how many hours and minutes will it take? ________________________

Speed Machines



Name ___________________________

FORMULA : SPEED = Distance ÷ Time

Round answers to the nearest tenth (one decimal place)!

1. NASCAR fans love race day when they get a chance to cheer on their favorite team! If a driver was able to travel 600 miles in 3 hours, what was his average speed?

2. The fastest car on Earth, a British-made *Thrust SSC*, would win every NASCAR race in America. If it takes 0.5 hours (30 minutes) to travel 380 miles, what is its speed?

3. The fastest train on Earth, the *TGV* from France, can travel at faster speeds than trains in the United States. During a speed test, the train traveled 800 miles in 2.5 hours. What is its speed?

4. *Spirit of Australia*, a hydroplane boat, made speed records by traveling 239 miles in 0.75 hours (45 minutes). What is its record-breaking speed?

5. The fastest plane ever made, the *Lockheed SR71*, was able to travel 2200 miles per hour. Based on this speed, how far could it travel in:

a. 2 hours? b. 3 hours? c. 5 hours?

Challenge:
Which machine on this page is the fastest? ____________________

6. Fill in the boxes and use a calculator to determine how long it would take each machine to get to travel 60 miles. Use the speeds you calculated in miles per hour on the front of this worksheet. Round answers to the nearest tenth (one decimal place)!

60 miles	÷		=		X	60 minutes	=	
		↑ Speed (mph)						

A. Jeff Gordon's Car = _______ minutes

B. *Thrust SSC* Car = _______ minutes

C. *TGV* Train = _______ minutes

D. *Spirit of Australia* Boat = _______ minutes

E. *Lockheed SR71* Airplane = _______ minutes

Name ______________________________

Period ____________ Date ______________

AVERAGE SPEED PRACTICE A

1. When Belinda walks to school in the morning, it takes her 12 minutes to walk the 1 kilometer (km). When she walks home after school with her little sister, it takes twice as long. Does Belinda's speed increase or decrease when she walks with her sister?

2. Frank's car rolled 300 centimeters (cm) in 1.5 seconds (s).

   Noah's car rolled 360 cm in 2 s.

   Whose car ran on a steeper ramp?

3. A biker rode up a 20-km hill in 2 hours and down the hill in 0.5 hour without stopping. What was his average speed

   a. going up the hill?

   b. going down the hill?

   c. for the whole trip?

4. It took Ellie 4 hours to paddle her canoe 10 km upstream. After a leisurely 3-hour picnic, she paddled back home in 1 hour.

   a. How fast did Ellie paddle upstream?

   b. What was Ellie's average speed while she was paddling her canoe?

5. Mark's family drove 180 km to the beach at 90 km/h. They drove home at 60 km/h. What was their average driving speed for the time they were on the road?

6. Three girls raced their model cars down a 40-meter track. Their times are in the table. What was the average speed at which the cars rolled down the track?

	Δt (s)	d (m)
Jessica	10	40
Kristi	20	40
Laticia	8	40

7. Ben took off in a plane at 9:30 a.m. from Seattle and landed in Baltimore, 4030 km away, at 7:00 p.m. There was a 1.5-hour layover in Denver. (The time in Baltimore is 3 hours later than in Seattle.)

   a. What was Ben's average speed on his trip from Seattle to Baltimore?

   b. What was the plane's average speed while in the air?

Name ______________________

Period __________ Date ______________

AVERAGE SPEED PRACTICE B

8. A high school varsity hardball pitcher can throw his fastball 28.5 m in 0.75 s. A high school varsity softball pitcher can throw her fastball 12.0 m in 0.3 s. Which pitcher's ball travels faster?

9. A boat sailed out to an island at a speed of 18 km/h in 4 h and then immediately sailed back to port at 36 km/h in 2 h. What was its average speed for the trip?

10. Sweta entered a skate, row, and bike race. Her time and distance for each leg of the race are entered in the chart.

    a. What was Sweta's average speed for each leg?

    b. What was her average speed over the whole race?

	Δt (h)	d (km)	v (km/h)
Skate	1.25	20	
Row	0.75	6	
Bike	2.5	100	

11. Biff's dog loves to catch his tennis ball. It takes the ball 5 s to fly 60 m.

    a. How fast does Biff's dog have to run to catch it?

    b How fast is that in kilometers per hour?

12. Lily's family took a motor boat 24 km down a river for a picnic. It took them 1 h to get to the picnic spot. The ride back to the dock took an hour and a half.

    a. What was the boat's average speed going to the picnic?

    b. What was the boat's average speed coming home from the picnic?

    c. What was the boat's average speed for the whole boat ride to and from the picnic?

    d. What was the average speed at which the river flowed?

    e. What would the boat's average speed be on a lake?

13. What is the average speed of an arrow that takes 1.25 s to hit a target 75 m away?

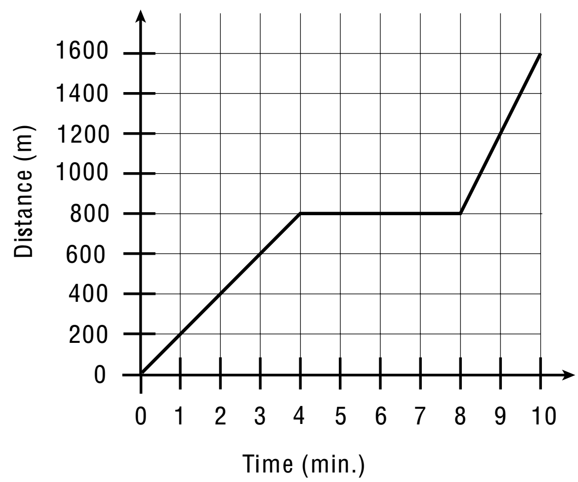
Name ______________________ Date __________________ Class ___________

Describing and Measuring Motion

Understanding Main Ideas

Use the following paragraph and graph to answer questions 1 through 5. Write your answers on a separate sheet of paper. Remember to include units in your answers.

On Saturday, Ashley rode her bicycle to visit Maria. Maria's house is directly east of Ashley's. The graph shows how far Ashley was from her house after each minute of her trip.



1. Ashley rode at a constant speed for the first 4 minutes of her trip. What was her constant speed?
2. What was her average speed for the entire trip?
3. What was her average velocity for the entire trip?
4. Ashley stopped to talk with another friend during her trip. How far was she from her house when she stopped?
5. Ashley's brother rode beside her for several minutes. During this time, was he moving relative to Ashley?

Building Vocabulary

From the list below, choose the term that best completes each sentence. Write your answers on the lines provided.

motion	International System of Units	foot
reference point	yard	meter
average	velocity	speed

6. Scientists around the world use the ______________________, a system of measurement based on the number ten.
7. An object is in ______________________ when its distance from a(n) ______________________ is changing.
8. Speed in a given direction is ______________________.
9. ______________________ can be calculated if you know the distance that an object travels in one unit of time.
10. The basic SI unit of length is the ______________________.

Speed and Velocity

Homework Practice Problems Name ________________

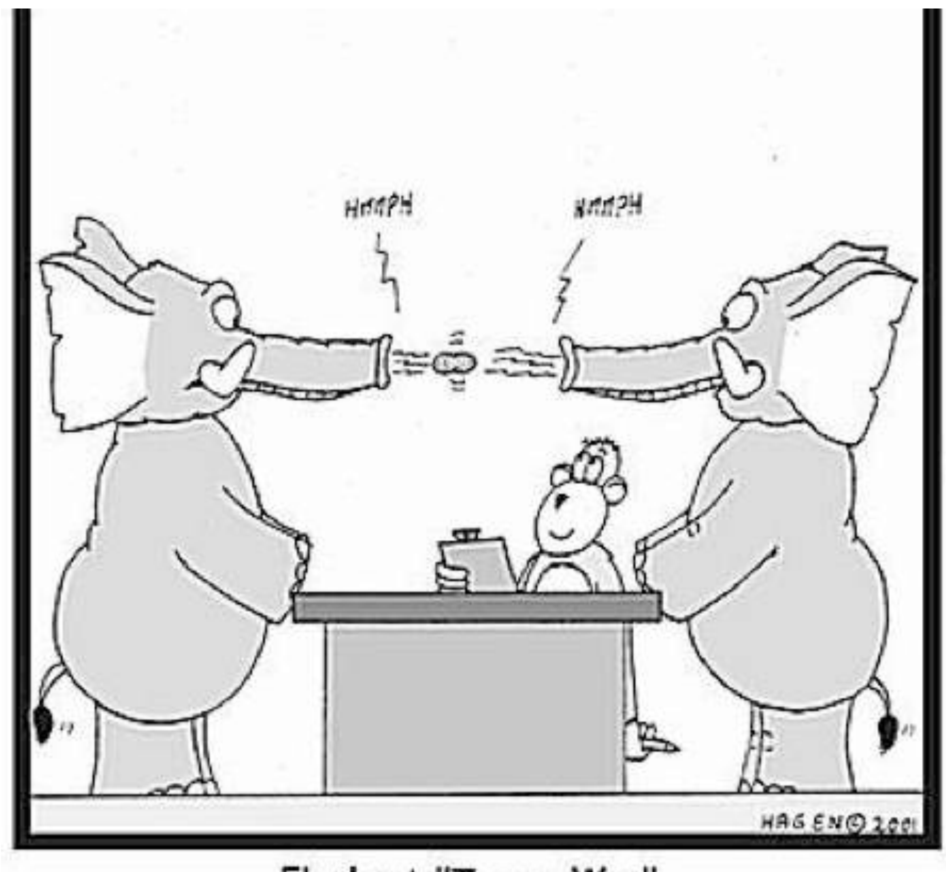
Solve each of the problems below to find the correct answer. Use the formula **speed= distance / time .** Use a calculator, but show how to solve each problem. Label your answers!!!!!! Circle your answer.

1. Calculate the speed of a dog running through a field if he is covering 23.7 meters in 54 seconds.

2. If a cross country runner covers a distance of 347 meters in 134 seconds what is her speed?

3. Calculate the velocity of a car that travels 556 kilometers northeast in 3.4 hours.

FORCES



Elephant "Tug-a-War"

Name____________________

Forces

When you ride a bike, your foot **pushes** against the pedal. The push makes the wheels of the bike move.

When you drop something, it is **pulled** to the ground by gravity.

A **PUSH** or a **PULL** is a **FORCE**. So, a good definition for ***force*** *is a push or pull in a particular direction.*

Forces affect how objects move. They may cause motion; they may also slow, stop, or change the direction of motion of an object that is already moving.

Give an example of a pushing force AND a pulling force at school:

____

____

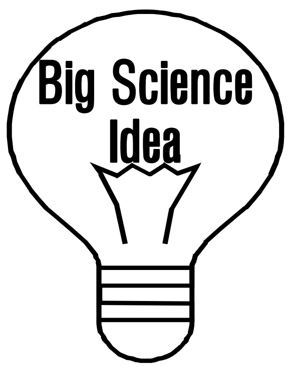
____

____

____

____

____



Forces can affect motion in several ways:

→ They can make objects <u>start moving</u>

→ They can make objects <u>move faster</u>

→ They can make objects <u>move slower</u>

→ They can make objects <u>stop moving</u>

→ They can make objects <u>change direction</u>

→ They can make objects **<u>change shape</u>**

Since force cause changes in the **speed** or **direction** of an object, we can say that forces cause changes in **velocity**, so....

Forces cause acceleration!

List 3 examples of acceleration:

____

____

____

____

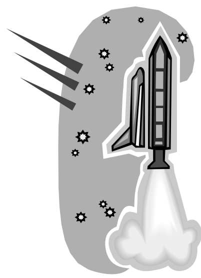
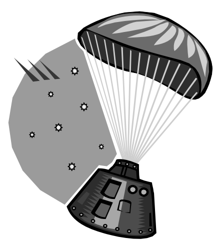
____

____

FORCE FACTS:

→ Forces are measured in Newtons (N)
→ Forces usually act in pairs
→ Forces act in a particular direction
→ Forces usually cannot be seen, but their effects can

Label the force in each picture as a push or pull. Then describe whether the force is causing a change in speed or direction or both.

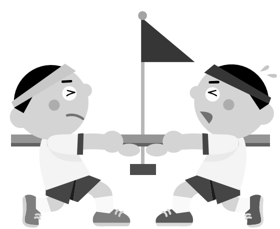
More than one force can act on an object at a time. The forces can push or pull in any direction. What happens to the object when the forces act depends on two things:

→ How strong the forces are
→ The direction of the forces

When more than one force acts on an object, the forces combine to form a **net force**. The combination of all the forces acting on an object is the net force.

Forces may work together or they may be opposite forces.

Two or more opposite forces are **balanced forces** if their effects cancel each other and they **do not cause a change in an object's motion**. If two forces of equal strength act on an object in opposite directions, the forces will cancel, resulting in a net force of zero and no movement.



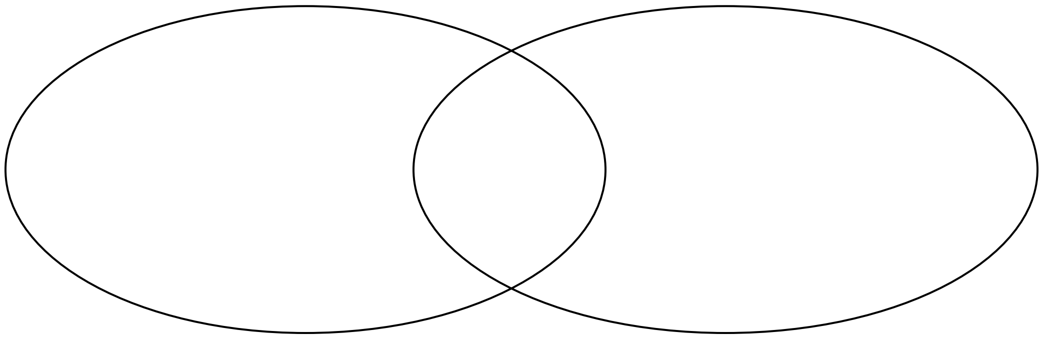
If the effects of the forces don't cancel each other, if one force is stronger than others, the forces are **unbalanced forces**. **Unbalanced forces cause a change in motion**; speed and/or direction.

When two forces act in the **same direction** on an object, the net force is equal to the **sum** of the two forces.

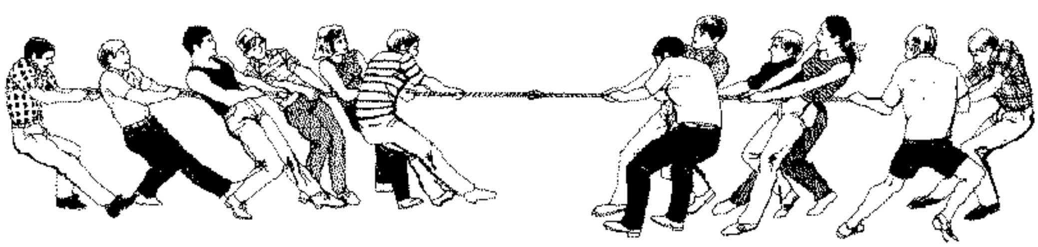
When two unequal forces act in **opposite directions** on an object, the net force is the **difference** of the two forces

Use the Venn Diagram to compare and contrast balanced and unbalanced forces.

Balanced Force   Unbalanced Force



Circle the best answer:



1. The forces shown above are Pushing / Pulling forces.

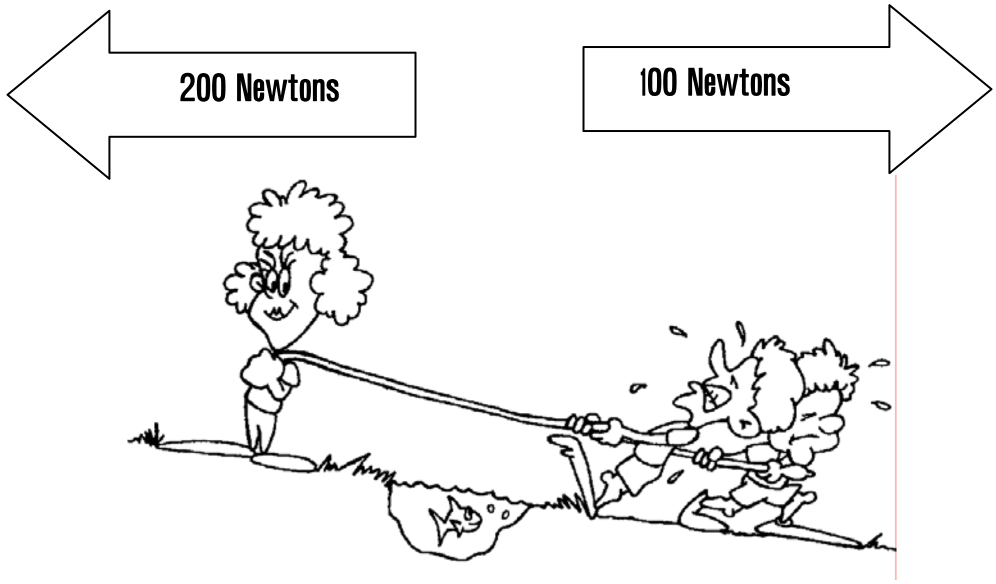
2. The forces shown above are Working Together / Opposite Forces.

3. The forces are Equal / Not Equal.

4. The forces Do / Do Not balance each other.

5. The resultant force is 1000 N to the Right / 1000 N to the left / Zero.

6. There Is / Is No motion.



7. The forces shown above are PUSHING / PULLING forces.

8. The forces shown above are WORKING TOGETHER / OPPOSITE FORCES.

9. The forces are EQUAL / NOT EQUAL.

10. The forces DO / DO NOT balance each other.

11. The stronger force is pulling to the RIGHT / LEFT.

12. The weaker force is pulling to the RIGHT / LEFT.

13. Motion is to the RIGHT / LEFT.

Use your textbook to answer the following questions. Circle the best answer.

14. When you look out your window and see a skateboarder in front of your house, and two minutes later you look up and see her several houses away, you can use this information to describe her ___.

a. speed
b. velocity
c. change in position
d. acceleration

15. It takes 1.0 h to drive 20 km through a city during rush hour. Your ___ speed is 20 km/h.

a. constant
b. average
c. instantaneous
d. accelerating

16. If an object starts to accelerate, ___.

a. a balanced force is acting on it
b. gravity is acting on it
c. velocity is acting on it
d. an unbalanced force is acting on it

17. The tendency to resist a change in an object's motion is ___.

a. inertia
b. an unbalanced force
c. a balanced force
d. work

18. When forces are balanced, the total force ___.

a. is greater than the sum of the forces
b. is zero
c. is negative
d. is equal to the largest force

19. Newton's first law of motion explains ___.

a. inertia
b. force
c. balanced forces
d. unbalanced forces

20. The reaction force occurs ___ the action force.

a. before
b. after
c. at the same time as
d. either a or b

21. A soccer ball takes 20 s to roll 10 m. What is the average speed of the soccer ball?

a. 200 m/s
b. 5 m/s
c. 2 m/s
d. 0.5 m/s

22. When an object is at rest, what is its speed?

a. 2 m/s
b. 3 m/s
c. 1 m/s
d. 0 m/s

23. Which describes how velocity changes with time?

a. acceleration
b. average speed
c. gravity
d. inertia

24. A person in a head-on car collision who is not wearing a seat belt continues to move forward at the original speed of the car because of ___.

a. friction
b. inertia
c. gravity
d. weight

25. What is the term for speed at any instant in time?

a. instantaneous speed
b. variable speed
c. constant speed
d. average speed

26. Newton's first law of motion states that an object stays at rest unless a(n) ___ acts on it.

a. balanced force
b. unbalanced force
c. gravitational force
d. strong force

27. Which one of the following objects has the greatest inertia?

a. baseball
b. bowling ball
c. pencil
d. toothpick

28. A force is which one of these?

a. a push
b. a pull
c. a push or pull
d. none of these

29. Force is measured in which units?

a. kilograms
b. degrees
c. newtons
d. m/s^2

30. A force is exerted on a box and an equal and opposite force is exerted by the box. What explains this?

a. conservation of energy
b. Newton's first law of motion
c. Newton's second law of motion
d. Newton's third law of motion

Applied Force

Frictional Force

Gravitational Force

Air Resistance Force

Spring Force

Tension Force

MOTION:

FORCE(S):

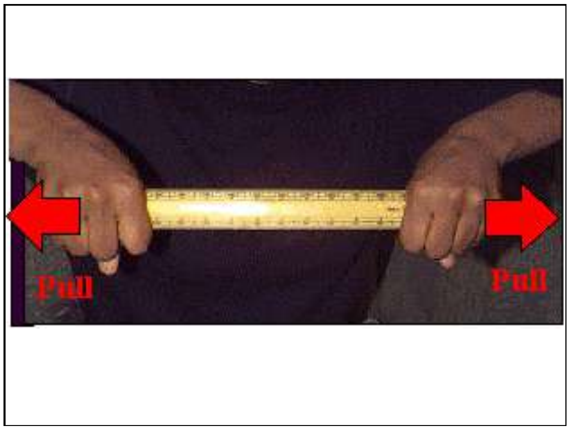
WHY:

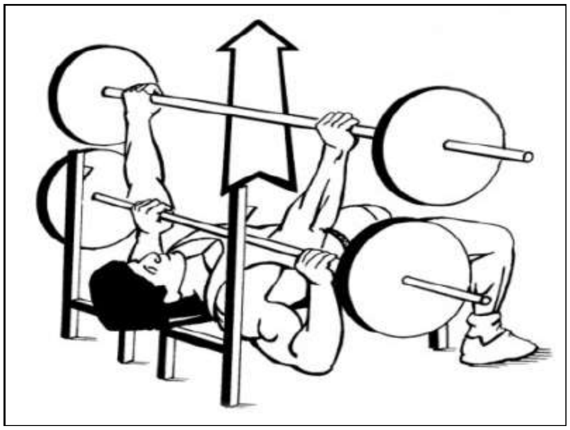
MOTION:

FORCE(S):

WHY:


New!
orthotic


Pull
Pull




WATCH
FOR
ICE

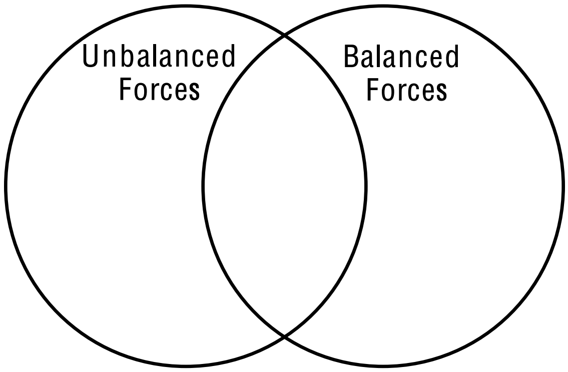
The Nature of Force

Understanding Main Ideas

Write the phrases listed below in the Venn diagram. Write the characteristics shared by unbalanced and balanced forces in the area of overlap.

change an object's motion	push or pull
do not change an object's motion	have direction
net force = 0	net force not = 0

1.



Answer the following question in the space below.

2. Describe how to combine unequal forces acting in opposite directions.

____

____

____

Building Vocabulary

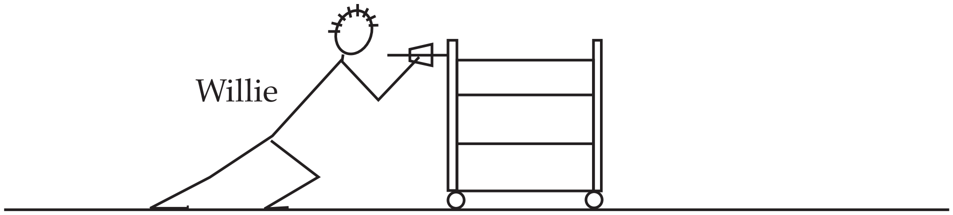
Match each term with its definition by writing the letter of the correct definition in the right column on the line beside the term in the left column.

____	**3.** newton	**a.**	the SI unit for force
____	**4.** force	**b.**	sum of all forces acting on an object
____	**5.** unbalanced forces	**c.**	push or pull
____	**6.** balanced forces	**d.**	can change an object's motion
____	**7.** net force	**e.**	will not change an object's motion

Name ______________________

Period __________ Date ______________

FORCES ON CARTS A

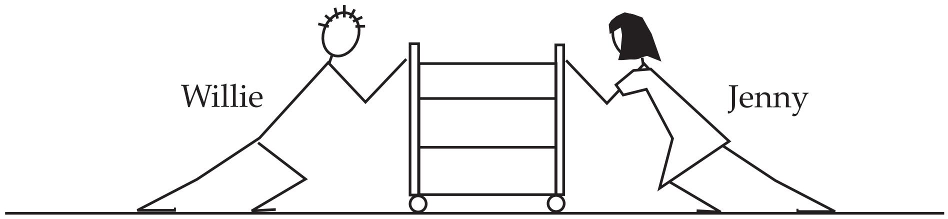


1. Willie's class found that the cart will move when pushed with 50 newtons of force. When Willie pushed on the cart with 10 newtons of force, why didn't the cart move?

____

____

____



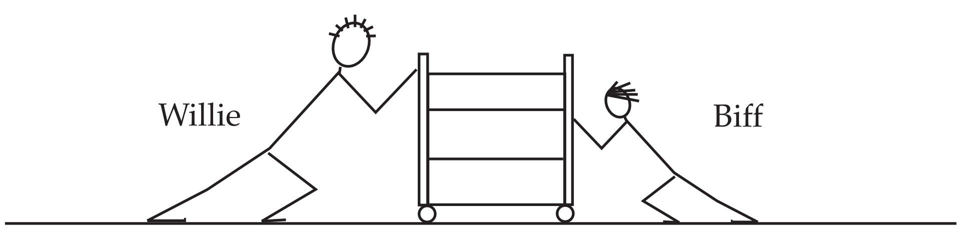
2. Willie pushed on the cart with 500 newtons of force. Jenny pushed on the other side of the cart. The cart didn't move. How much force did Jenny apply? __________

   Why do you think so?

____

____

____



3. Willie and Biff pushed on the cart and it didn't move. Biff pushed with 400 newtons of force. How much force did Willie apply?

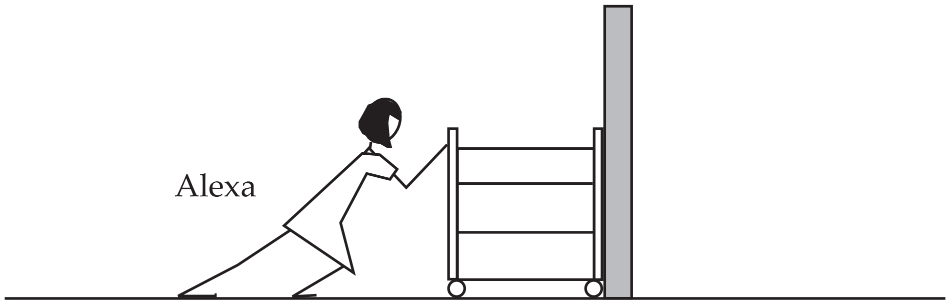
____

____

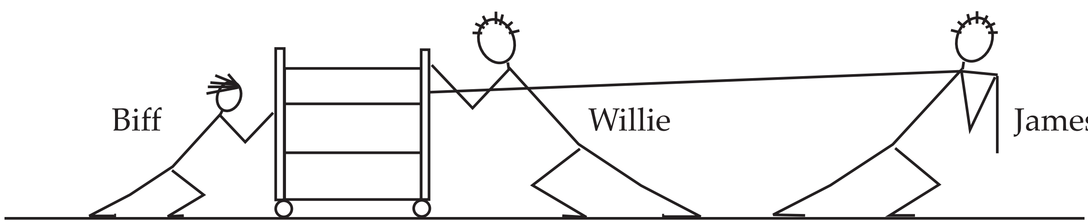
Name ______________________

Period ____________ Date ______________

FORCES ON CARTS B



4. Alexa pushed on a cart against the wall with 500 newtons of force. The cart didn't move. How do you explain what happened?

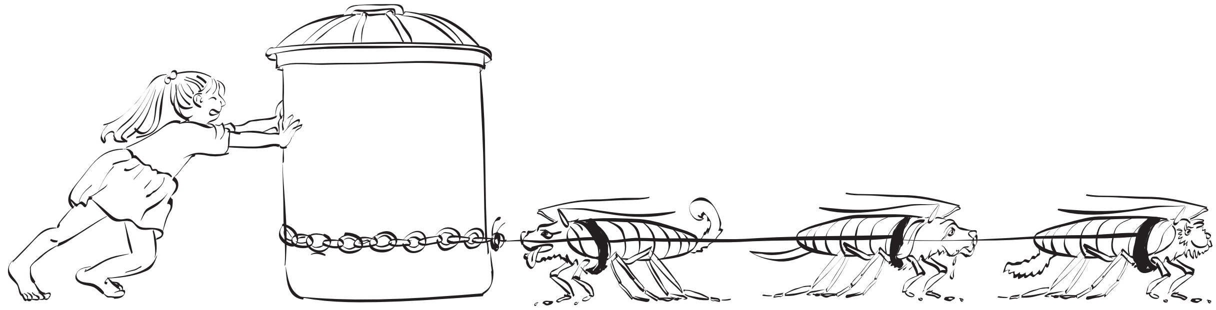


5. Willie pushed on the cart with 1000 newtons of force. James pulled on a rope attached to the cart with 500 newtons of force. Biff pushed on the cart with 400 newtons. What will happen to the cart and why?

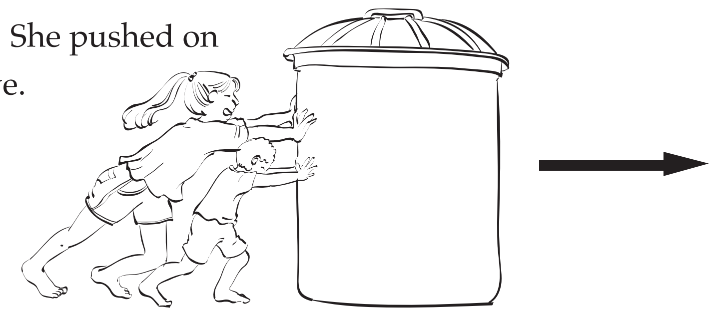
Name ______________________________

Period ____________ Date ______________

RESPONSE SHEET—FORCE



Gloria wanted to move her compost bin. She hitched her roach-hound team to one side of the bin. She pushed on the other side. She couldn't get it to move. Gloria said,



Billie and I moved that compost bin last week. I thought the hounds and I could move it this week.

How would you expain the two different outcomes to Gloria?

Gloria can push with 500 newtons (N). Billie can push with 200 N. Each hound can pull with 100 N.

____

____

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____

Force Vocabulary **Name ______________________________**

Force-

Balanced force-

Unbalanced force-

Net force-

Newton-

Types of Forces:

Applied force: Force applied by person or object.
Example:

Frictional force: Force from 2 surfaces rubbing against each other.
Example:

Gravitational force: Force pulls 2 objects together.
Example:

Air resistance force: Acts opposite of gravity. Fluid friction on an object that moves through air.
Example:

Spring force: Force of a compressed or expanded spring on an object.
Example:

Tension force: Force when object is pulled in separate directions.
Example:

Name ______________________________

Period ____________ Date ________________

RESPONSE SHEET—GRAVITY

Donna said,

I think a falling apple would accelerate more slowly on the Moon than on Earth because the force of gravity is less.

Anita said,

I think a falling apple would accelerate faster on the Moon than on Earth because there is no air on the Moon.

Who do you think has a better idea? Explain your reasons.

Friction and Gravity

Understanding Main Ideas

Answer the following questions on another sheet of paper.

1. What are the two factors that affect the friction force between two surfaces?
2. What is one way you could reduce the friction between two surfaces?
3. The acceleration due to gravity of all objects in free fall is the same. Why, then, do some objects fall through the air at a different rate than others?
4. How does mass differ from weight?
5. What two factors affect the gravitational force between two objects?

Building Vocabulary Skills

Match each term with its definition by writing the letter of the correct definition in the right column on the line beside the term in the left column.

____ **6.** friction

____ **7.** rolling friction

____ **8.** sliding friction

____ **9.** fluid friction

____ **10.** weight

____ **11.** free fall

____ **12.** gravity

____ **13.** terminal velocity

____ **14.** air resistance

a. the force that accelerates objects towards Earth

b. the kind of friction that exists between oil and a door hinge

c. the force that one surface exerts on another when they rub against each other

d. the kind of friction that slows a falling object

e. the state that exists when the only force acting on an object is gravity

f. the kind of friction that results when you rub sandpaper against wood

g. the kind of friction that results when a wheel turns on a surface

h. a measure of the force of gravity on an object

i. a falling object reaches this when forces of gravity and air resistance are balanced

NEWTON'S LAWS

Describing Motion: Newton's Laws

1st Law of Motion
Law of Inertia

____
____
____
____
____
____

2nd Law of Motion
Law of Acceleration

____
____
____
____
____
____

3rd Law of Motion
Law of Action - Reaction

____
____
____
____
____
____

Name_______________________________

Purpose: To demonstrate the First Law of Motion

Background Information: A **force** is a push or a pull. When you drop something it falls to the floor or ground. The force of **gravity** pulls objects toward the center of the earth. When objects are not moving they are said to be at **rest**. A book on the table, cars in the parking lot or a chair on the floor are at rest if they are not moving.
People have understood these phenomena for a long time but Isaac Newton was able to understand the mathematics behind them and so he developed the three basic laws of motion in the late 1600's. We are studying the first law. Part of the first law of motion says:

Objects at rest stay at rest unless pushed or pulled by a force and objects that are moving stay moving unless stopped by a force.

Part 1 -

Materials: 2-liter soda bottle filled with water, piece of wax paper

Procedure:

1. Examine the picture to the right.
2. Predict what you think will happen.

____

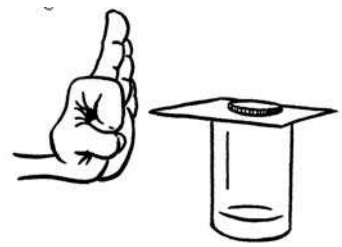
3. Set your bottle on the wax paper. Quickly pull the paper from under the bottle using a steady, straight motion.

Questions to Ponder:

1. What force acted on the paper? _________________
2. What force acted on the bottle? __________________
3. In this investigation what was at rest? _____________
4. In this investigation what was in motion? _______________

Part 2 -

Materials: Beaker, penny and index card



Procedure:
1. Lay an index card on the top of the beaker.
2. Place a penny on the card, centered over the beaker.
3. With a flick of your finger, give the card a quick thump.

Questions to Ponder:
1. What force acted on the card? ______________________

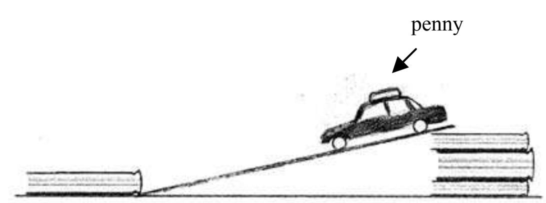
2. What force acted on the penny? _______________________

3. In this investigation what was at rest? ____________________

4. In this investigation what was in motion? ___________________

<u>Activity 3 -</u>

Materials: 3 books, penny, toy car, ramp



Procedure:
1. Place two books on top of each other and place the ramp on the books.
2. Place the other book at the end of the ramp.
3. Place the penny on top of the car and place it at the top of the ramp.
4. Let the car go down the ramp and observe the car and the penny.

Questions to Ponder:
1. What force acted on the car? ______________________

2. What force kept the penny on top of the car? ____________________

3. After the car stopped what happened to the penny? ________________

4. Why did the car stop? _______________________________________

5. Why did the penny keep going after the car stopped?

____

RERUN (Check your Science Handbook):

Recall –

____

____

____

Explain –

____

____

____

Results –

____

____

____

Uncertainties –

____

____

____

New –

____

____

____

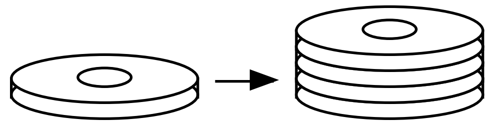
Name___________________________

Newton's First Law of Motion

What is Newton's First Law of Motion?

Part A: Wacky Washers

To prepare for this experiment, stack 4 washers one on top of the other so that you form a tower of washers. Place the stack of washers on top of your textbook or on the floor so that you have a smooth, slick surface.



Aim one washer at the <u>bottom</u> of the stack of four washers and give it a good hard flick with your finger or hand. What happens?

Flick a stack of two washers into a stack of four washers. What happens?

Flick a stack of four washers into a stack of four washers. What happens?

Explain your observations in terms of Newton's 1st Law.

Part B: Tricky Tricks

Now that you are an expert at Newton's First Law of Motion, try these tricks. Without inertia, they would not be possible!

Set up the situation shown in the top diagram. The goal is to remove the circle by pulling on the string, but the penny must remain in place on top of the clothespin. Can you do it? Keep trying until you are able to do it!

Try the experiment again using the plain circle (no string). Can you flick the circle out from under the penny and keep the penny on the end of the clothespin? Keep trying until you are able to do it!

Balance the penny on a circle (string or no string) on the tip of you finger as shown in the second diagram. Try to remove the paper circle to leave the penny balanced on your finger. Can you do it?

How does this activity relate to the "pull the tablecloth" trick used by magicians?

Name___________________________

Newton's Second Law of Motion

What is Newton's Second Law of Motion?

Newton's Race

Step 1: Set up a ramp using meter sticks and several books. Place one end of the ramp on the books and line up the other end with a piece of masking tape on the floor.

Step 2: Place the vehicle at the top of your meterstick and roll it down the ramp. Use a meter stick to measure how far the vehicle rolls. Repeat this step for Trials 2 & 3.

Step 3: Add five washers to the vehicle and repeat the process from Step 2. Record your measurements in the chart. Be sure all the washers remain on the vehicle! Repeat this step for Trials 2 & 3.

Step 4: Add ten washers to the vehicle and repeat the process from Step 2. Record your measurements in the chart. Be sure all the washers remain on the vehicle! Repeat this step for Trials 2 & 3.

# of Washers	Distance (cm)			Average Distance
	Trial 1	Trial 2	Trial 3	
0				
5				
10				

How does increasing mass (adding more washers) affect the force of objects in motion (the distance the vehicle rolls)? Explain your answer using data from the chart.

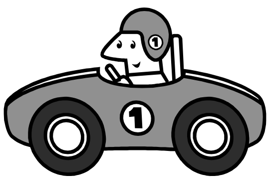
What would happen if you added fifteen washers to the car? Predict how far the car would roll.

Explain the results of your experiment in terms of Newton's 2nd Law.

Name______________________

Newton's Laws

Have you ever been riding in a car when the driver stopped suddenly? How did your body move as the car came to a stop? Did it feel like your body was moving forward? When you felt this happening you experienced Newton's first law of motion. Newton's



first law of motion says that an object in motion will stay in motion and an object at rest will stay at rest unless acted on by an unbalanced force. In the car your body was in motion, traveling at the same speed as the car. When the car stopped, your body stayed in motion. If you were not wearing a seatbelt and you were traveling very fast, your body could continue to move forward through the windshield!

This idea is called inertia.

Explain why your body feels like it is being pushed back when the car starts back up again:

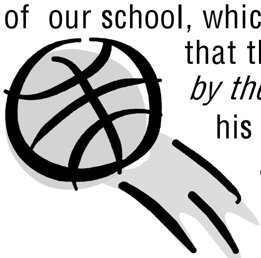
____

____

____

____

If a ping pong ball and a basketball were both dropped at the same time from the roof of our school, which would hit the ground with a greater force? Common sense tells us



that the basketball ball would. *The difference in forces would be caused by the different masses of the balls*. Newton stated this relationship in his second law, the force of an object is equal to its mass times its acceleration.

List two other situations where Newton's 2nd Law may apply.

____

____

____

____

Name______________________________

Force & Acceleration

Problem: To observe the cause of changes in motion.

Define force:

____

____

Materials:

60 cm string	Toy car	Paper clip
Weights	Stop watch	Triple beam balance

Procedure:

1. Tie one end of the string to the paper clip. Tie the other end to the toy car.
2. Place your car on the table and hang the paper-clip hook over the edge of the table.
3. You have been given several different weights. Use the triple beam balance to find the mass of each weight. Record this information.
4. Predict how the car will move as the different weights are hung from the paper-clip hook and allowed to fall to the floor. Record your predictions in the data section.
5. Conduct your investigation, and then record your observations.
6. Explain how you conducted your investigation (what did you do?)

____

____

____

____

____

____

____

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____

____

Data:

Mass of weight (g)	Predictions	Observations

Data Analysis:

For each weight, draw a diagram showing ALL of the forces acting on it as it falls to the floor.

Make a line graph to show the relationship between the **mass of the weight** and the **speed** at which it falls.

Title: ____

REMEMBER:
The independent variable goes on the X-axis.
The dependent variable goes on the Y-axis.

Before you plot your graph – **THINK**! What did you change, what did you measure?

Questions:

1. Describe the forces that caused acceleration in this investigation.

2. Identify the forces that:
    a. Bring a baseball to rest as it rolls across a field –
    b. Launch a rocket –

3. Explain why this investigation is experimental, rather than descriptive research.

4. What was the independent variable in this investigation?

5. What was the dependent variable in this investigation?

FORCE AND ACCELERATION

Name ____________________

A force is a push or a pull. To calculate force, we use the following formula,

$F = ma$ where F = force in newtons
m = mass in kg
a = acceleration in m/sec^2

Example: With what force will a rubber ball hit the ground if it has a mass of 0.25 kg?

Answer: $F = (0.25\ kg)(9.8\ m/s^2)$
$F = 2.45\ N$

Solve the following problems.

1. With what force will a car hit a tree if the car has a mass of 3,000 kg and it is accelerating at a rate of 2 m/s^2?

   Answer: ____________

2. A 10 kg bowling ball would require what force to accelerate it down an alleyway at a rate of 3 m/s^2?

   Answer: ____________

3. What is the mass of a falling rock if it hits the ground with a force of 147 newtons?

   Answer: ____________

4. What is the acceleration of a softball if it has a mass of 0.50 kg and hits the catcher's glove with a force of 25 newtons?

   Answer: ____________

5. What is the mass of a truck if it is accelerating at a rate of 5 m/s^2 and hits a parked car with a force of 14,000 newtons?

   Answer: ____________

Name ______________________ Date ________________ Class __________

Forces ▪ *Review and Reinforce*

Newton's First and Second Laws

Understanding Main Ideas

Answer the following question in the space provided.

1. Newton's second law of motion describes the relationship among force, mass, and acceleration. Write the equation.

____

Write the letter of the correct answer on the line at the left.

____ **2.** If you increase the force on an object, its acceleration
- **a.** decreases.
- **b.** stays the same.
- **c.** also increases.
- **d.** stops.

____ **3.** If you increase the mass on an object, its acceleration
- **a.** decreases.
- **b.** stays the same.
- **c.** also increases.
- **d.** stops.

____ **4.** How much force is needed to accelerate a 3 kg skateboard at 5 m/s^2?
- **a.** 8 N
- **b.** 0.6 N
- **c.** 1.6 N
- **d.** 15 N

____ **5.** A resistance to a change in motion is
- **a.** acceleration
- **b.** inertia
- **c.** gravity
- **d.** velocity

____ **6.** The amount of inertia an object has depends on its
- **a.** speed
- **b.** volume
- **c.** mass
- **d.** length

Forces

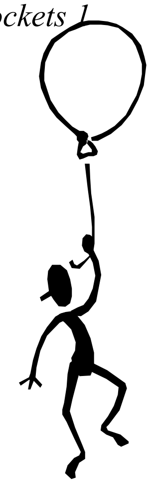
Building Vocabulary Skills

Answer the following question in the space provided.

7. Define the term *inertia.*

____

____



Name______________________________

Balloon Rockets

Background information: A rocket's movement depends on ***Newton's Third Law of Motion – For every action there is an equal and opposite reaction***. When a rocket blows out gas at high speed in one direction (action force), the rocket is pushed in the opposite direction (reaction force). In other words, when there is a force on one thing in one direction, another force is acting on something else in another direction. The gas pushes against the rocket and the rocket pushes back just as hard against the gas.

Problem: To observe Newton's Third Law of Motion

Materials:

Long, thin balloon	5 meters of string	Straw
Tape		

Procedure:
1. Blow up the balloon, but do not tie it. Use the clothespin to clamp it shut.
2. Open the clothespin. What happened? Record your observations.
3. Blow up the balloon and clamp it shut with the clothespin again.
4. Thread the string through the drinking straw. Tape the long side of the balloon along the length of the straw.
5. Have two people hold the ends of the string. Make sure the string is stretched tight.
6. Slide the balloon-straw system down the string until the clamped end reaches the end of the string held by a person.
7. Release the clothespin. Record your observations.
8. Blow up the balloon half-way and repeat steps 5 and 6.

Data:

Observations of completely inflated balloon

____

____

____

____

____

Observations of partially inflated balloon

Questions:

1. What is the action force in this investigation?
2. What is the reaction force in this investigation?
3. What is the action force acting on in this investigation?
4. What is the reaction force acting on in this investigation?
5. What happened when the amount of force (amount of air in the balloon) was changed?
6. Explain your answer to number 5 using Newton's 3rd Law.
7. Think about a real rocket launching at NASA. What are the action and reaction forces in the launch? What are the forces acting upon?

Imagine a rocket is being launched from the earth. Hot gases are pushed out from the bottom of the rocket as the rocket is pushed upward. The force of the gases pushing against the surface of the earth is equal and opposite to the force with which the rocket moves upward. The motion of the rocket can be explained by Newton's third law, for every action there is an equal and opposite reaction. In other words, *when one object exerts a force on another object, the second object exerts a force of equal strength in the opposite direction on the first object*.

Fill in the table:

Law	Description/Definition	Everyday Example
1st Law of Motion		
2nd Law of Motion		
3rd Law of Motion		

Name ______________________ Date ________________ Class ___________

Forces ▪ *Review and Reinforce*

Newton's Third Law

Understanding Main Ideas

Answer the following questions in the spaces provided.

1. What does it mean to say that momentum is *conserved?*

____

____

2. How does the diagram at the right illustrate Newton's third law of motion? In your answer, compare the force of the foot kicking the soccer ball with the force of the soccer ball on the foot.

____

____

____

____

3. Could an elephant have the same momentum as a golf ball? Explain.

____

____

4. What is the momentum of a 20-kg dog running at a speed of 8 m/s?

____

5. Suppose you have two toy cars. Each has a mass of 0.04 kg. The cars have tape on their bumpers that will cause them to couple together. One car is stopped on the track. The other car, traveling at a velocity of 4 m/s, hits the first car. What is the momentum of the coupled cars?

____

____

Building Vocabulary

Answer the following questions in the spaces provided.

6. What is momentum?

____

____

7. Describe the law of conservation of momentum.

____

____

____

Forces

Math Skills

For the problems below, show your calculations. If you need more space, use another sheet of paper. Write the answers for the problems on the lines below.

Newton's Second Law of Motion

1. Force = 65 kg × 3 m/s^2 = ____________________

2. A 250-kg trailer is being pulled by a truck. The force causes the trailer to accelerate at 4 m/s^2. What is the net force that causes this acceleration?

Answer: ____________________

Weight and Mass

3. Weight = 45 kg × 9.8 m/s^2 = ____________________

4. What is the weight of a rock that has a mass of 7 kg?

Answer: ____________________

Momentum

5. Momentum = 5 kg × 6.5 m/s = ____________________

6. A baseball travels at 7 m/s, while a basketball moves at 3 m/s. The mass of the baseball is 0.14 kg and the mass of the basketball is 0.5 kg. Which has the greater momentum?

____

____

____

Thinking About Newton's Third Law of Motion

Everyday Examples

Newton's third law of motion can be seen in action in many places. In the space provided, describe how this concept explains the following events.

1. An untied inflated balloon zooms around the classroom when released.

____

____

____

____

2. A squid squirts through the water without using its fins or tentacles.

____

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____

3. A salmon swims upstream.

____

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____

4. A hummingbird stays motionless in the air while flapping its wings.

____

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____

Energy Sources

In designing your vehicle, you will need to apply Newton's third law of motion. List three different ways to propel your vehicle. The first one is done for you.

1. An inflated balloon

2. ____

3. ____

WHICH LAW?

We're told that Sir Isaac Newton discovered some things about motion when an apple dropped on his head. Whatever "force" was behind his discoveries, we have benefited from his discoveries.
Here are his three laws of motion. You should be familiar with them. Fill in the missing words in each of the three laws. Then tell which law fits each example below.

Which law? First, Second, or Third?

_____ 1. A frog leaping upward off his lily pad is pulled downward by gravity and lands on another lily pad instead of continuing on in a straight line.

_____ 2. As the fuel in a rocket ignites, the force of the gas expansion and explosion pushes out the back of the rocket and pushes the rocket forward.

_____ 3. When you are standing up in a subway train, and the train suddenly stops, your body continues to go forward.

_____ 4. After you start up your motorbike, as you give it more gas, it goes faster.

_____ 5. A pitched baseball goes faster than one that is gently thrown.

_____ 6. A swimmer pushes water back with her arms, but her body moves forward.

_____ 7. As an ice skater pushes harder with his leg muscles, he begins to move faster.

_____ 8. When Bobby, age 5, and his dad are skipping pebbles on the pond, the pebbles that Bobby's dad throws go farther and faster than his.

_____ 9. When you paddle a canoe, the canoe goes forward.

_____ 10. A little girl who has been pulling a sled behind her in the snow is crying because when she stopped to tie her hat on, the sled kept moving and hit her in the back of her legs.

NEWTON'S FIRST LAW OF MOTION:
An object at _______ stays at _______ or an object that is ___________ at a _______ in a straight _______ keeps moving at that _______ unless another _______ acts on it.

NEWTON'S SECOND LAW OF MOTION:
The amount of _______ needed to make an object change its _______ depends on the _______ of the object and the _______ required.

NEWTON'S THIRD LAW OF MOTION:
For every _______ (or force), there is an _______ and _______ action (or force).

Name

Name_________________________________

MOTION STATIONS

Instructions: There are seven (7) stations in the classroom. Each station is an investigation on force and motion. There is a task card at each station with an explanation of the investigation. Read the task card carefully, and then do the activity.

Stay at the station until you are given the signal to move by your teacher.

STATION # 1 ~ VELOCITY

BACKGROUND INFORMATION. **Speed** is a way to describe motion. It describes how much time it takes to travel a distance.

Average Speed is calculated by dividing distance by time.
Speed = distance ÷ time

Distance can be calculated by multiplying speed and time

Velocity is speed AND direction. Velocity changes when speed changes, when direction changes, or both.

DATA:

Time to Walk 5 Meters (sec)					
Trial 1	**Trial 2**	**Trial 3**	**Trial 4**	**Trial 5**	**Average Time**

My average speed is (show your calculations): ______________________________

REMEMBER YOUR UNITS!

STATION # 2 ~ 1ST LAW OF MOTION – INERTIA

BACKGROUND INFORMATION: The **law of inertia** states that an object at rest tends to remain at rest and an object in motion tends to remain in motion (in a straight line) unless the object is acted upon by an unbalanced force.
For example - Inertia is experienced daily by passengers in cars. As the brakes are applied to the car, it slows down. However, by the law of inertia, the people continue to move forward in a straight line. Inertia is also experienced by an object that is NOT moving. The object will continue to remain stationary as long as there are no unbalanced forces acting upon it.

DATA:

Mass		Force needed to move the cart (N)
Cart		
Cart + 1 weight		
Cart + 2 weights		
Cart + 3 weights		

How does increasing mass affect the amount of force needed to put an object in motion?

____

____

STATION # 3 ~ 2ND LAW OF MOTION – MASS & ACCELERATION

BACKGROUND INFORMATION: The relationship of force and mass to acceleration is shown in Newton's second law, the **law of acceleration**. The law is shown as

force = mass X acceleration

This means that *as the mass of an object increases, more force must be applied to the object to make the object move or to stop the object from m*oving. It is the reason why a car loaded with people accelerates more slowly than when it is nearly empty when the driver presses the gas pedal equally.

DATA:

# of Washers	Trial 1	Trial 2	Trial 3	Average Distance (cm)
0				
1				
2				
3				

How does increasing mass affect the motion of objects? Explain your answer **using data from your experiment.**

____

____

____

STATION # 4 ~ 3RD LAW OF MOTION – ACTION – REACTION

BACKGROUND INFORMATION: The **law of action and reaction** states that whenever an object exerts a force (action) on a second object, the second object exerts and *equal and opposite force* (reaction) on the first. For example, when a jet engine is started or when a rocket is fired, rapidly expanding gases exert a force on them while they exert equal but opposite forces on the gases. The gases move backward and the jet or rocket moves forward or upward.

DATA:

# of marbles pushed	#of marbles that move
1	
2	
3	
4	

What pattern do you see?

____

____

STATION # 5 ~ GRAVITY

BACKGROUND INFORMATION: One force that affects everything on Earth is **gravity**. Gravity is a force that acts at a distance and pulls objects toward each other. The amount of matter in an object is called its **mass**. The force of gravity depends on the amount of mass a body has. The **weight** of an object is the *measurement of the force of gravity on that object*. You weigh something on a scale, according to the force that the Earth pulls it down. So the weight is actually the force of gravity on that object.

If you drop an object, it will speed up because of acceleration due to gravity. Interestingly, mass does not have anything to do with acceleration due to gravity. *Heavy objects fall just as fast as lighter objects*. Air friction will slow some objects down, but if we didn't have any air, all objects would fall at the same speed.

DATA:

Time for Helicopter to Fall (sec)				
	Trial 1	**Trial 2**	**Trial 3**	**Average**
Helicopter				
Helicopter + 1 paper clip				
Helicopter + 2 paper clips				
Helicopter + 3 paper clips				

Did the mass of the paper helicopter make any significant difference in the time it took to fall? Why or why not?

____

____

STATION # 6 ~ MEASURING FORCE

BACKGROUND INFORMATION: Forces are pushes or pulls. If forces are **unbalanced**, they make objects move or stop moving.
Forces are measured in **Newtons** (**N**).
A newton is the amount of force necessary to accelerate one kilogram of mass at a rate of one meter per second squared.
Weight is the downward force of gravity on an object. It is properly measured in newtons (N).

DATA:

WEIGHT (G)	**FORCE NEEDED TO MOVE (N)**

What relationship do you see between weight and force?

____

____

STATION # 7 ~ FRICTION

BACKGROUND INFORMATION: Friction is a force that resists the motion of an object. That means that friction slows objects down. Friction results from the close contact of two surfaces that are sliding across each other. When you slam on your brakes and your car skids to a stop with locked wheels, it is the force of friction that brings it to a stop. Friction resists the car's motion.
Friction is caused by irregularities (bumps and holes) in the surface of objects that are touching.

DATA:

Force needed to lift block ________________________________

Surface	Force needed to move block (N)

What is the relationship between the type of surface and the mount of force needed to move across the surface?

____

____

WORK

CALCULATING WORK

Name ______________

Work has a special meaning in science. It is the product of the force applied to an object and the distance the object moves. The unit of work is the joule (J).

W = Force x Distance	
W = F x d	Force = newtons
	Distance = meters

Solve the following problems.

1. A book weighing 1.0 newton is lifted 2 meters. How much work was done?

   Answer: ____________

2. A force of 15 newtons is used to push a box along the floor a distance of 3 meters. How much work was done?

   Answer: ____________

3. It took 50 joules to push a chair 5 meters across the floor. With what force was the chair pushed?

   Answer: ____________

4. A force of 100 newtons was necessary to lift a rock. A total of 150 joules of work was done. How far was the rock lifted?

   Answer: ____________

5. It took 500 newtons of force to push a car 4 meters. How much work was done?

   Answer: ____________

6. A young man exerted a force of 9,000 newtons on a stalled car but was unable to move it. How much work was done?

   Answer: ____________

Work & Simple Machines

Name________________________________

Work

Problem: To investigate the scientific definition of work.

Background information: WORK is done when a force causes an object to move in the direction of the force. For work to be done, two things must occur. First, you must apply a force to an object. Second, the object must move in the same direction as the force you apply. **If there is no motion, there is no work**. This is very different from the way we use the word work in everyday life.
Work can be calculated with this formula:

Work = Force X Distance

W = F d

The units of force are **Newtons** and the units of distance are **meters**.
The answer is in **Newton-Meters**. These units are referred to as **Joules**.

Materials:

5 Different Objects	Spring Scale	Meter Stick

Procedure:

1. Attach one of the objects to the spring scale.
2. Slowly lift or pull the object straight up. Record how much force you used to pull or lift the object (Newtons).
3. Use the meter stick to measure the distance you moved the object. Record the distance in meters.
4. Find out how much work you did by using the formula, **work = force x distance** the object moved. Record your answer.
5. Repeat steps 2-5 with the other objects.

Data:

Calculations of work			
Object	**Force (N)**	**Distance (cm)**	**Work (J)**

Questions:

1. Using a force of 50 N, you push a cart 10-m across a classroom floor. How much work did you do?
2. What is a Joule?
3. Were you doing work when you were holding the books? Explain your answer.
4. Were you doing work when you were lifting object with the spring scale? Explain your answer.
5. In Greek mythology, Atlas held the world on his shoulders. Did he do any work? Explain your answer.

Name________________________________

Work

Problem: To investigate the scientific definition of work.

Background information: WORK is done when a force causes an object to move in the direction of the force. For work to be done, two things must occur. First, you must apply a force to an object. Second, the object must move in the same direction as the force you apply. **If there is no motion, there is no work**. This is very different from the way we use the word work in everyday life.
Work can be calculated with this formula:

Work = Force X Distance

W = F d

The units of force are **Newtons** and the units of distance are **meters**.
The answer is in **Newton-Meters**. These units are referred to as **Joules**.

Materials:

4 Books	Spring Scale	Meter Stick
3 Different Objects		

Procedure:

1. Stand and hold your arms out in front of you at waist level, palms up.
2. Have your partner stack two books on your hands, one on each hand.
3. Lift the books to about shoulder level, then lower them.
4. Now try raising them overhead. When your hands are overhead, are you working harder than when you raised them to shoulder level? Describe your observations.
5. Lower the books again. Have your partner put two more books on each of your hands, so you're holding four books. Try to raise them to shoulder level. Are you pushing harder (using more force) than when you were holding only two books? Describe your observations.
6. Hold the four books at shoulder level until your arms get tired. Are you exerting force? Do you think you are doing work in these situations? What is the work being done on? Describe your observations.
7. Attach one of the objects to the spring scale.
8. Slowly lift or pull the object straight up. Record how much force you used to pull or lift the object (Newtons).

9. Use the meter stick to measure the distance you moved the object. Record the distance in meters.
10. Find out how much work you did by using the formula, **work = force x distance** the object moved. Record your answer.
11. Repeat steps 2-5 with the other objects.

Data:

Observations of step 4:

Observations of step 5:

Observations of step 6:

Calculations of work			
Object	Force (N)	Distance (cm)	Work (J)

Questions:

1. Using a force of 50 N, you push a cart 10-m across a classroom floor. How much work did you do?
2. What is a Joule?
3. Were you doing work when you were holding the books? Explain your answer.
4. Were you doing work when you were lifting object with the spring scale? Explain your answer.
5. In Greek mythology, Atlas held the world on his shoulders. Did he do any work? Explain your answer.

Physics Internet Scavenger Hunt

Name ________________________________

For each site below, log follow the link(s) and begin your hunt for information! Once you are done, you can go back and explore any of the sites in greater detail! Enjoy!

Amusement Park Physics (www.sciencespot.net > Kid Zone > Physics: Motion & Forces)

1. Which horses on a carousel are moving the fastest: the ones on the inside or the ones on the outside? Explain your choice.

2. Which Law of Motion explains what happens during a ride on the bumper cars? Give an example.

3. Where do riders have a feeling of "weightlessness" on a pendulum-type ride? At what point on the pendulum-type rides do riders feel the highest g-forces?

4. Explain the "weightless water" trick. Hint: Go to the Free Fall section.

5. Out of the 270 million people who visit amusement parks annually, how many require a trip to the emergency room?

Simple Machines (www.sciencespot.net > Kid Zone > Physics: Simple Machines)

A. List 6 types of simple machines.

B. What is the definition of a compound machine?

Speed Machines (www.sciencespot.net > Kid Zone > Physics: Motion & Forces)

A. How long can the SR-71 operate (at top speed) before it needs refueling?

B. Who devised the unit of power called the horsepower?

C. What type of vehicle is the Spirit of America? _______________ What is its top speed? ____________

Rube Goldberg (www.sciencespot.net > Kid Zone > Physics: Simple Machines)

A. Complete: Rube Goldberg lived from ________ to __________ and was a Pulitzer Prize winning _____________, ________________, and ________________.

B. How many steps were involved in Rube Goldberg's pencil sharpener? __________

Physics Classroom: Newton's Law (www.sciencespot.net > Kid Zone > Physics: Motion & Forces)

A. Give an example of Newton's 1st Law of Motion.

B. What formula is used to show Newton's 2nd Law of Motion?

C. In Newton's 3rd Law, how many forces always act at once? Give an example of how this works.

The Soundry (www.sciencespot.net > Kid Zone > Physics: Light & Sound)

A. What medium does sound travel the fastest through?

B. What are the 3 parts of the ear? Draw & label a sketch of the ear.

C. Go to the Doppler Effect Applet. Experiment! What do you notice about the sound of the jet as it gets closer to the person? How does the jet speed affect the sound?

Funderstanding (www.sciencespot.net > Kid Zone > Physics: Motion & Forces)

Work together as a group to make the roller coaster work. What is the coaster's top speed? __________
Sketch your coaster here:

Get your teacher's initials to show that you have successfully completed the coaster. _____

Shockwave Physics (www.sciencespot.net > Kid Zone > Physics: Light & Sound)

1. Go to RGB Lighting. Click the red button to turn on the red light. What do you observe about the color of the shadow and the color of the background?

2. Turn off the red light and then click the blue button to turn on the blue light. What do you observe about the color of the shadow and the color of the background?

3. Leave the blue light on and click to turn on the red light. What do you observe about the color of the shadows and the color of the background?

4. Leave the blue and red lights on and click to turn on the green light. What do you observe about the color of the shadows and the color of the background?

Sixth Grade Science
Force and Motion Goals

Grading Criteria: Understands Concepts and Principles of Motion

Goal #1 Students will classify different types of motion.

Goal #2 Students will use the speed equation and be able to contrast velocity and speed.

Grading Criteria: Understands Concepts and Principles of Force

Goal #3 Students will identify and describe the types of forces acting on an object, including: frictional force, gravitational force, tension force, air resistance force, applied force, spring force.

Grading Criteria: Understands Newton's Laws of Motion

Goal #4 Students will explain and apply Newton's first law

Goal #5 Students will explain and apply Newton's second law

Goal #6 Students will explain and apply Newton's third law

Grading Criteria: Understands Concepts and Principles of Work

Goal # 7 Students will solve for work in the equation work = force X distance and will recognize that force and distance must act in the same direction to produce work.

Sport Science (www.sciencespot.net > Kid Zone > Physics: Motion & Forces)

A. Where would you have the best chance for hitting a home run: Denver, Colorado or San Diego, California? Why?

B. How much force does it take to break a hockey stick?

C. Who is credited for developing the chain drive (chain and cog system) for bicycles?

Sandlot Science (www.sciencespot.net > Kid Zone > Physics: Light & Sound)
Click as follows Home >Optical Illusions>Optical Illusions>Distortions>Breathing Square.

A. What appears to be happening?

B. Click on the red shapes to change their size. What do you observe about the blue object?

Click "Moon Illusions" and then Demonstration from the menu on the left, then click on the picture of the moon. Use the mouse to move the moon in the sky. What do you observe? What causes this illusion?

Click "Typography" in the left hand menu and then choose "Which is an ambigram?"
A. What is an ambigram?

B. Which words in the table are ambigrams?

Which of the websites did you find most interesting? Why?

List three things you learned about physics through this activity:

1.

2.

3.

Which website(s) do you want to further explore? Why?