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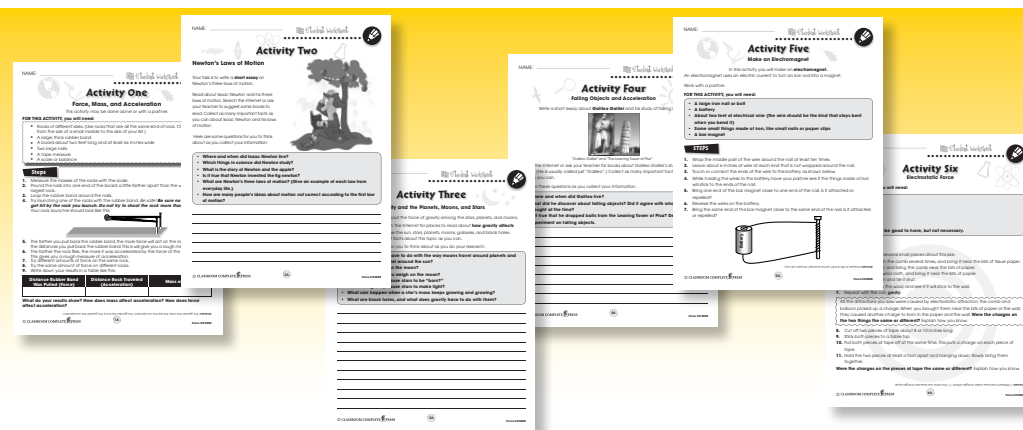
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Force and Mass

1. Circle the word True if the statement is true. Circle the word False if it is false.

- a) Only solid things have mass.
True False
- b) An unbalanced force is needed to change the direction of a thing's motion.
True False
- c) On Earth, gravity always acts in the direction we call "down."
True False
- d) When forces are balanced, the net force is zero.
True False
- e) Force is a kind of energy.
True False

2. Put a check mark (✓) next to the answer that is most correct.

- a) What do we know about an object that is speeding up?
- A The mass of the object is very small.
- B The net force acting on the object is zero.
- C An unbalanced force is acting on the object.
- D The force of friction is not acting on the object.
- b) What do we know about an object that is moving in a straight line at a steady speed?
- A The object is not acted on by a force.
- B The object will soon slow down and stop.
- C The forces acting on the object are balanced.
- D The forces acting on the object are all pushing from behind.
- c) All of these forces can act at a distance, except _____.
- A friction
- B gravity
- C magnetic force
- D electrostatic force



Force and Mass

In the last two sections we saw that we can add together forces to get the net force acting on something. If the net force is anything but zero, it is an unbalanced force. An unbalanced force changes the motion of the thing it acts on. An unbalanced force can make an object go faster or slower, or it changes the thing's direction.



Greater unbalanced forces cause greater changes in motion. This makes sense when you think about things on which you exert force. The harder you push on the pedals of a bicycle, the more it speeds up. The harder you throw a ball the faster it goes.

We need to know one other thing to know how much a force will change the motion of something. That thing is called mass. Mass is a measure of how much matter is in something. Matter is a science word that means about the same as the word "stuff."

The **more** mass a thing has the **less** a force will change its motion. A brick has more mass than an empty tin can. Suppose you kicked a can and a brick with the same force. The brick would speed up less than the can because it has more mass.

What is mass?

STOP



Force and Mass

1. Put a check mark (✓) next to the answer that is most correct.

- a) Which rock will speed up fastest?
- A a one-pound rock acted on by a one-pound force
- B a one-pound rock acted on by a two-pound force
- C a two-pound rock acted on by a one-pound force
- D a two-pound rock acted on by a two-pound force
- b) The Titanic was a very big ship that sank when it hit an iceberg. What was the main reason the captain of the Titanic couldn't stop the ship when he saw the iceberg?
- A The ship had a lot of mass.
- B The ship had too much force.
- C The ship was moving very fast.
- D The ship was acted on by an unbalanced force.
- c) When things are pushed by a force, they speed up. Which things speed up the most?
- A things with the least mass that are pushed with the smallest force
- B things with the least mass that are pushed with the biggest force
- C things with the most mass that are pushed with the smallest force
- D things with the most mass that are pushed with the biggest force

2. Write a word in each blank to complete the sentences. Two words will be left over.

balanced direction	unbalanced gravity	friction mass
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- a) _____ is a measure of the amount of stuff in something.
- b) When something is acted on by an unbalanced force, it will speed up, slow down, or change _____.
- c) A net force of zero is the same as a(n) _____ force.
- d) Falling objects speed up because they are acted on by an unbalanced force. The main part of this unbalanced force is _____.

Force and Mass

Answer the questions in complete sentences.

3. A force acts on an object and makes it move faster. How does the size of the force affect how much the object speeds up?

4. A force acts on an object and makes it move faster. How does the mass of the object affect how much the object speeds up?

Extension & Application

5. This man is about to shoot an arrow almost straight up into the air. Think about the **forces** on the arrow, the **mass** of the arrow, and how they will **affect the motion** of the arrow during its flight. In your notebook, answer these questions about the different parts of the arrow's flight.



- a) How will the motion of the arrow change when the man lets go of the bow string? (Will it accelerate, decelerate, or move at a steady speed?)
- b) How will the mass of the arrow affect its change in motion?
- c) What is the main force acting on the arrow just after the man lets go of the bow string?
- d) In which direction does the force act?
- e) How will the motion of the arrow change after it leaves the bow?
- f) What is the main force acting on the arrow after it leaves the bow?
- g) What other force is acting on the arrow?
- h) What are the directions of these two forces?
- i) How will the motion of the arrow change after it reaches its highest point?
- j) What will be the main force acting on the arrow after the high point?
- k) What other force will be acting on the arrow after this point?
- l) What are the directions of these two forces?



Activity One

The Force of Friction

Learn about the force of friction between different surfaces.

FOR THIS ACTIVITY, you will need:

- A wooden board about two feet long and six or more inches wide
- A yard stick, meter stick, or measuring tape
- Tape
- Sandpaper
- Several of the following:

A block of wood	A sheet of paper	A brick
An ice cube	A piece of glass	A flat stone

Something made of plastic. Any other flat objects with different kinds of surfaces that are small enough to fit on the board

STEPS:

1. On a blank piece of paper, make a table with three columns like this:

Surface 1	Surface 2	Height of Board

2. Place any one of the objects on the board, near one end.
3. Slowly raise the end of the board nearest the object until the objects starts to slide down the board.
4. Measure the height to which you raised the board.
5. Write the results in the table. For example if you tried the stone first, you would write "wood" (for the board), "stone", and the height of the board when the stone started to slide.
It is important to understand that the **higher** you must raise the board to make the objects move, the **greater** is the force of friction between the object and the board.
6. Try as many combinations as you can. Try taping different materials to the board, like paper, carpet, or sandpaper. You could also tape different materials to the brick or block of wood. Try smoothing the surface of the board or the block of wood with the sand paper to see if that makes a difference.

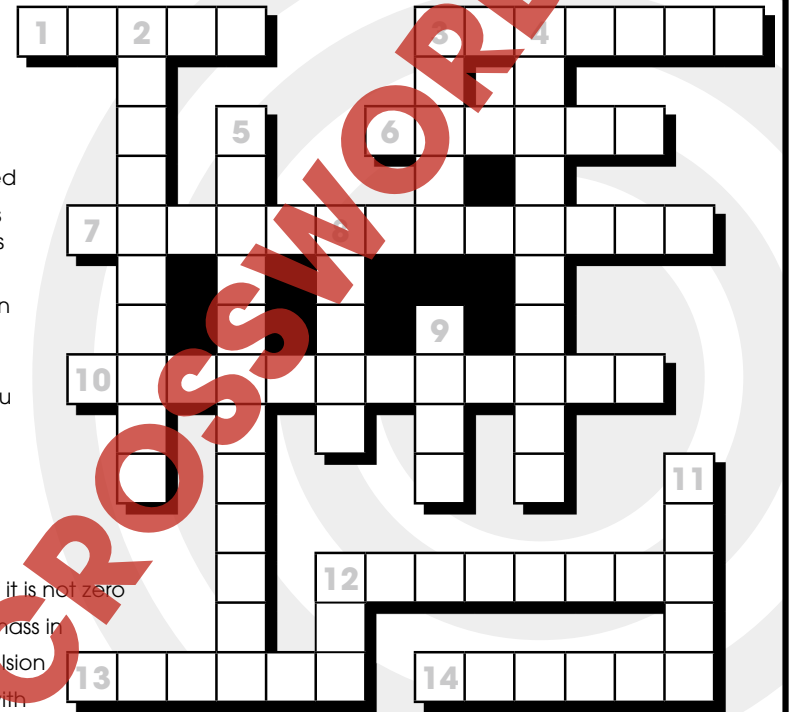
Write a list of things you learned about surfaces and the force of friction.



Crossword Puzzle!

Across

1. If it's not the north pole it must be the _____ pole
3. It's what makes you fall
6. What scientists call "stuff"
7. The kind of force between electrical charges
10. The kind of motion with increasing speed
12. This kind of charge is marked with a minus sign
13. It can pick up an iron nail
14. The force of Earth's gravity pulling on you is your _____



Down

2. What a net force is if it is not zero
3. What you measure mass in
4. The opposite of repulsion
5. The kind of motion with decreasing speed
8. Push away
9. Something all matter has
11. Gravity can _____ a force at a distance
12. Combining all the forces acting on something gives the _____ force



Comprehension Quiz

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Part A

Circle the word True if the statement is true. Circle the word False if it is false.

1. A force is a push or a pull.
True False
2. Air resistance is a force that acts at a distance.
True False
3. Gravity repels, but it does not attract.
True False
4. Friction is a contact force.
True False
5. Combining the forces acting on an object gives the net force.
True False
6. The more mass a thing has, the more a force will change its motion.
True False
7. The north pole of a magnet will be attracted to the south pole of another magnet.
True False

Part B

Put a check mark (✓) next to the answer that is most correct.

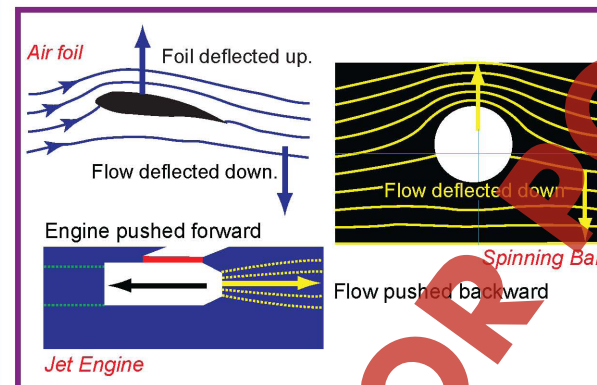
1. Which of these is a force?
 A energy
 B friction
 C mass
 D work
2. Which is the force of attraction between the masses of any two objects?
 A gravity
 B friction
 C air resistance
 D magnetic force
3. Which is true of any object acted on by an unbalanced force?
 A It is not moving.
 B Its net force is zero.
 C Its motion is changing.
 D It is moving at a steady speed.

SUBTOTAL: /10

Isaac Newton

First law of motion:

An object at rest remains at rest, and an object in motion continues to move in a straight line with a constant speed unless an unbalanced force acts upon it.



Second law of motion:

The acceleration of an object equals the net force on that object divided by its mass.
 $a = F/m$ or $F = ma$



Third law of motion:

For every action force there is an equal reaction force in the opposite direction.



NAME: _____

After You Read 



Force and Mass

Answer the questions in complete sentences.

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- What is the main force acting on the arrow after it leaves the bow?
- What other force is acting on the arrow?
- What are the directions of these two forces?
- How will the motion of the arrow change after it reaches its highest point?
- What will be the main force acting on the arrow after the high point?
- What other force will be acting on the arrow after this point?
- What are the directions of these two forces?

3.
The greater the force, the more the object will speed up.

4.
The greater the mass, the less the object will speed up.

5.
a) accelerate
b) the greater the mass the less it will accelerate
c) force of the bowstring
d) upward
e) decelerate
f) gravity
g) air resistance
h) direction for both are down
i) accelerate
j) gravity
k) air resistance
l) gravity - down, air resistance - up

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Answers will vary
12.
Answers will vary.

1.
Mass does not affect air resistance.
2.
Surface increases air resistance.

3.
a) No
b) No
c) No
(Helium balloons are acted on by the buoyant force of air.)

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2.
The greater the speed of rising or sinking, the greater the net force. Closest to being balanced on the egg

5.
Yes, weight is different in the water. Buoyant force is weight in air minus weight in water.

14.
7.
Magnet has more force

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Across:

- south
- gravity
- matter
- electrostatic
- acceleration
- negative
- magnet

Down:

- unbalanced
- grams
- attraction
- deceleration
- repel
- mass
- exert
- net

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