

FORCE AND MOTION

a hands-on science unit for kids



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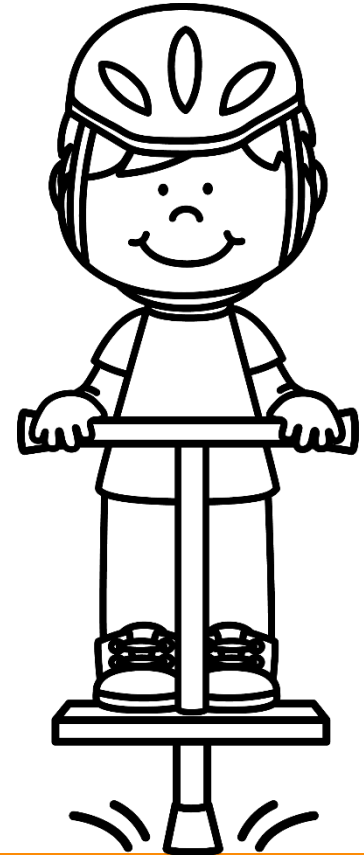
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VOCABULARY POSTERS

FORCE



Kate pushes the tetherball to make it move.

Force is the push or pull on an object. Force makes the object move or change direction.

ENERGY



Susie uses push off the ground to make the skateboard move.

Energy is the ability to do work. You need energy to make an object move.

MOTION



Motion occurs when an object or person moves from one place to another.

WORK



You do work when you push a friend on the swing. Your force causes the swing to move.

Work happens when a force is used to move an object.

FRICTION



Friction is a force caused when two objects rub against each other. Friction causes objects in motion to slow down.

PUSH



Push is a force that moves an object. Often, pushing moves it away from you.

PULL



Pull is a force that moves an object. Often, pulling moves it toward you.

STRAIGHT



The bee flew in a straight path.

Straight is a type of direction or path.

CIRCULAR



This Ferris wheel travels in a circular pattern around a central point.

Circular is a path or direction in the shape of a circle, around which an object can move.

ZIG-ZAG



Zig-zag is a type of direction or path an object can move with, back and forth, diagonal motion.

SLIDE



Slide is the movement of an object to smoothly glide or slip over a surface without rotating or turning.

ROLL



Roll is the movement of an object that turns over and over in a circular pattern.

VOCABULARY CARDS

WORK

ENERGY

LAR

FRICTION

PUSH

ZAG

MOTI

PULL

SLIDE

FOR

STRAIGH

ROLL

HANDS-ON LESSON PLANS & ACTIVITIES

MY PLAYGROUND LAB REPORT

Objective: Students will apply their knowledge of motion and energy by using the forces of "push" and "pull" to cause motion to an object or person on the playground. (*Note: This activity may not be applicable if your school or community does not include the playground equipment within the activity. I have included two versions of blank lab reports you can fill in to modify for your school, or, allow the kids to fill in as they explore the playground environment your school has.)

Introduction: Today YOU will be a motion scientist! Your mission will be to explore our playground and use the forces of "push" and "pull" to cause motion to an object or person on each piece of playground equipment. (You will want to review playground rules and procedures that fit your classroom at this time.) I recommend giving students a lab report, pencil, and a clipboard to secure the report as they navigate their way around the playground to complete the activity.

Activity: Students will decide which force they think is stronger (tetherball or a kickball).

*Suggested playground activities:

- (pulling oneself up to a bar)
- (pulling oneself across a rope)

MOTION ON THE PLAYGROUND!

Objective: Students will understand that a force, such as a push or a pull, puts objects and/or people into motion. This lesson uses playground pieces—a well known part of a child's world—to connect the concept of force and motion to their everyday lives.

Introduction: Invite students to think about different playground activities and their purpose. Then, ask students how these pieces result in motion to an object or a person. For example, "If I am on the see-saw and I want to go up, do I have to push my feet or pull my feet off the ground?" This type of dialog between the teacher and students will create critical thinking skills – students will begin to think through the process of how they are able to move on the swings, slide, and monkey bars, and how the tetherball moves around the pole, etc. – Most likely, how they move on the playground is something they have never thought of in a scientific way before. ☺

Activity: Study the playground map together and discuss each piece of playground equipment in order to build missing background knowledge. Sort and write the activities under the appropriate box, discussing the forces of "push" and "pull" as needed. This printable activity is great to use before the Playground Lab follows. You could also give students their own playground map to "cut and glue" the pictures onto the sorting mat!

MOTION MANIA MISSION

Objective: Students will gain an understanding of force, energy, friction, and work as objects and critically think about the causes and effects of the motion created while "Mission" tasks.

Explanation for Teachers: This activity is very hands-on and can be used in SO many ways in the classroom. Students rotate in groups around the room to complete the mission cards. Students record their answers to the mission task cards in their notebooks. Alternate ways of coordinating this activity is to have all of the objects in one bag (having several "sets" of bags for the class), or simply completing all of the mission cards in one whole class one day. You could even kick start each day of the unit by completing one mission card at the beginning of your lesson. There are so many possibilities for this activity, so please feel free to adapt it to your individual classroom! ☺

Introduction: "Today you are going on a Motion Mission! Your job is to go around and complete the mission for each object. Follow the directions for each mission card in your Motion Mission Notebook. You will be using distance, time, speed, energy, and work. Good luck! ☺"

MOVIN' AND GROOVIN'

Objective: Students will practice following directions and understanding the directional words *right*, *left*, *backward*, and *forward*.

Introduction Ask the students if they know what direction objects can move in. Your students might come up with words like right, left, forward, backwards, side to side, diagonal, etc. Then, ask students what direction a car can move. Explain that cars generally move right, left, backward, and forward. Ask the students *"What makes a car move?"* Explain that a driver must exert force on the gas pedal of a car. This causes the engine of the car to start working and makes the car move. The driver must steer the car in the direction they want it to move. *"Today, we're going to practice the directions of right, left, forward, and backward by playing a game of bumper cars!"*

Activity: Now, explain the rules of the game. One partner is the "driver" and one partner is the "car." The "car" must put both hands out and touch the driver's hands all times. This is the car's bumper. The driver must give directions to the car. The car must move if the driver says "Move forward 5 steps."

RAMP ROLLIN'

RAMP ROLLIN'

Objective: Students will learn about energy and momentum as they create two ramps that are of different heights to make a hypothesis and draw a conclusion on which ramp will be more likely to roll the fastest.

Materials: 1 meter of energy with your students. Remember, energy is the ability to do work. In this case, the more work, such as moving a marble, the more energy is used. Be sure to use the energy wisely!

Objective: Students will learn about the concept of energy and draw a conclusion about the relationship between the height of the marble and the distance it travels.

Introduction: Review the concept of energy with your students. Remember, energy is the ability to do work. When an object has more energy, it can do more work, such as move faster. When an object has less energy, it will not move as fast or as efficient. Relate this activity to real-life situations for your students prior to the experiment. Ask students if they have ever went sledding. Discuss whether they think a sled would go faster down a big hill or a small hill. Your students will most likely state that a big hill makes their sled go faster. The sled has farther to travel down the big hill, so it gains more energy and speed than the smaller, lower hill. *Today, you are going to be motion scientists as you do an experiment about energy with ramps and marbles!*

When students complete the hypothesis part of their lab reports before the experiment as a whole group, or, if you have multiple sets of students, assign them to the following page to set up the experiment and begin the experiment.

Activity: Have students complete the hypothesis part of their lab reports before the experiment. You can do this experiment as a whole group, or, if you have multiple sets of materials, you can do this in groups. Follow the steps on the following page to set up the experiment. After the experiment is completed, students will complete the remaining portion of their lab report to discover that an object that travels from a higher point will gain more energy and speed than an object dropped from a lower point.

FRICTION FRENZY

FRICITION FRENZY

Objective: Students will participate in a science experiment to observe the effect of friction in order to understand how friction affects objects in motion.

Intervention:

Introduction: Review or introduce the concept of friction to your students. Friction is a force that can slow down objects in motion. Friction occurs when an object rubs against something. Relate the concept of friction to your student's everyday lives. For example, "If you put on ice skates, will you slide around easier on ice or on the sidewalk? Invite students to discuss this question with one another. You may also ask, "Why do we have slippery shoes?" The sidewalk is rougher than ice so it provides better traction. Invite students to think about how they can use friction to their advantage. For example, "How can you slow your speed down?"

MOTION MEMORY

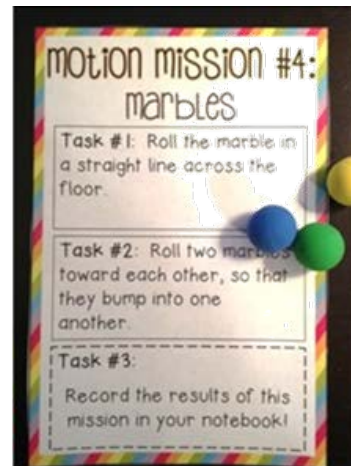
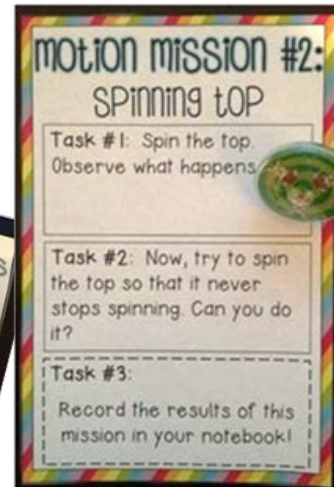
MEMORY

is game will encourage your students to think critically about what is on picture, because no definitions are provided – on purpose! (For students will flip over the card of the little boy skateboarding and have to decide whether the little boy used the force of push to move the skateboard, or representing the word "roll.") Because it is challenging, you may want to put all the cards face up during their first game, so they can watch. You could also do this as a whole class activity for the lesson, leading to a science center for independent practice and fun.

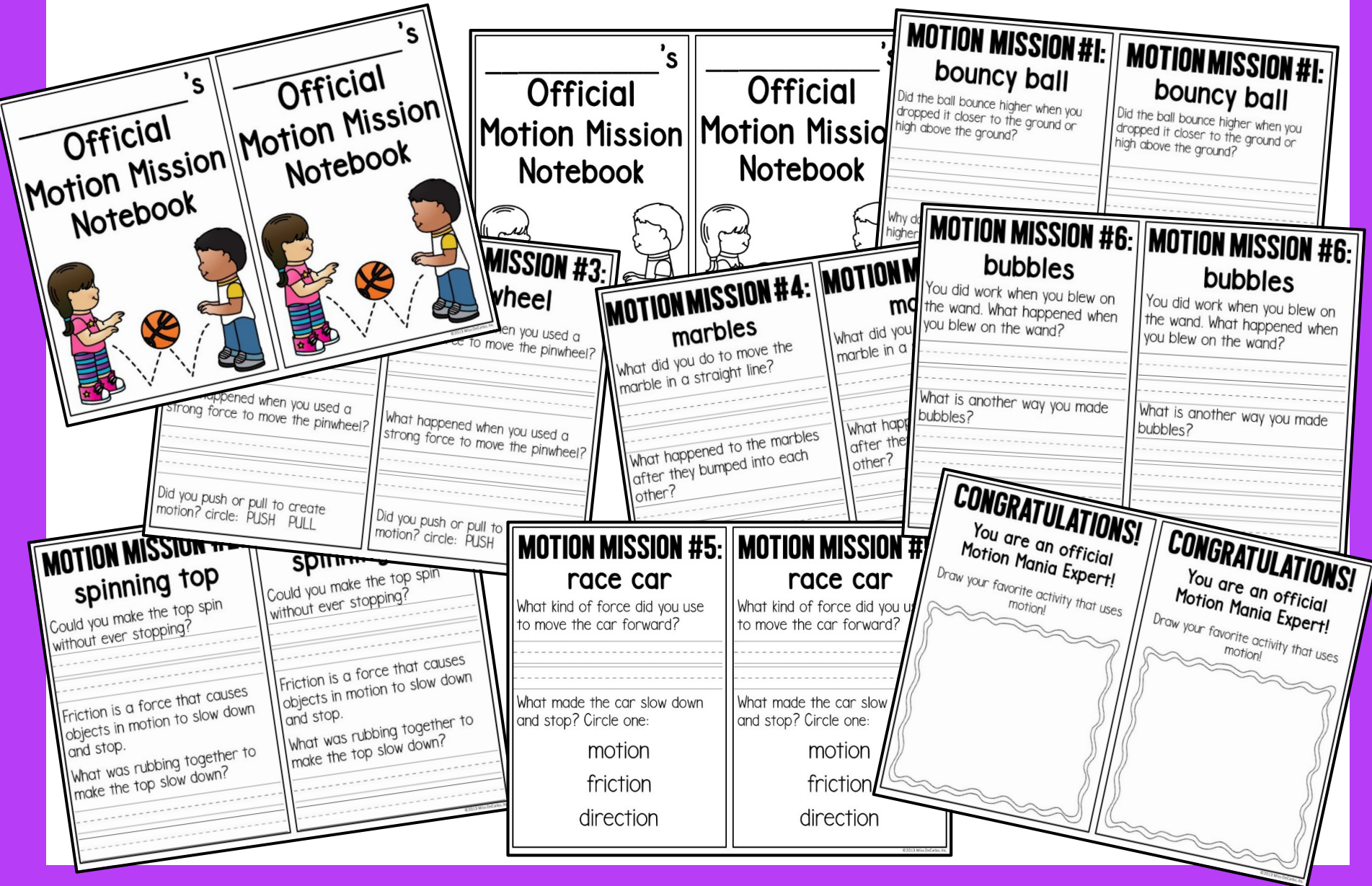
Students cut out the cards to play the game in a science center.

Students cut out the cards to play, or, cut and laminate the cards in a science center. Students take turns flipping two cards over. The partner with the most matches wins!

MOTION MISSION MANIA STATIONS



STUDENT-LED RESPONSE BOOKLETS



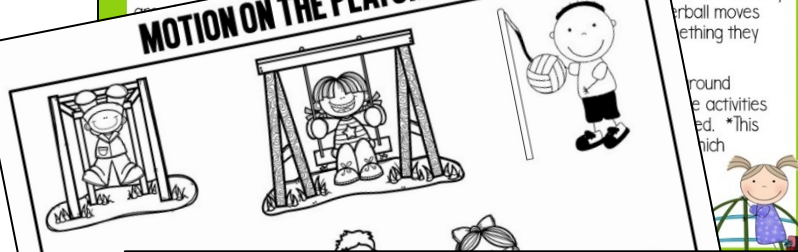
STUDENTS WILL USE THE PLAYGROUND TO UNDERSTAND PUSH AND PULL

MOTION ON THE PLAYGROUND!

Objective: Students will understand that a force, such as a push or a pull, puts objects and/or people into motion. This lesson uses playground pieces— a well known part of a child's world — to connect the concept of force and motion to their everyday lives.

Introduction: Invite students to think about different playground activities and their purpose. Then, ask students how these pieces result in motion of an object or a person. For example, "If I am on the see-saw and I push my feet off the ground?" and "If I am on the monkey bars and I pull myself up?" and students will create critical thinking about how they understand the concept of push and pull.

MOTION ON THE PLAYGROUND!



Name: _____ Date: _____

MOTION ON THE PLAYGROUND

Directions: Use the playground map to answer the following questions about motion. Use what you already know about playing on the playground equipment.

Which playground activities need a "push" to create motion?	Which playground activities need a "pull" to create motion?

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MY PLAYGROUND LAB REPORT

Objective: Students will apply their knowledge of motion and energy by using the forces of "push" and "pull" to cause motion to an object or person on the playground. (*Note: This activity may not be possible if your school or community does not include the playground equipment with the necessary pieces for this activity. You may use blank lab reports you can fill in to modify for your own playground.)

Introduction

playground equipment

person on the playground

and proceed to the playground

report, per the playground

Activity: Students will

decide which activities

need a push or pull to

create motion. (*Suggest

pulling a ball or a

pulling a ball or a

Name: _____ Date: _____

MY PLAYGROUND LAB REPORT

Directions: Today you are a scientist! Your mission is to explore the playground and use your energy to create motion! Circle if you used the force of "push" or "pull" (or both) to create motion.

Playground Mission: Use a force to make the swing move.	PUSH	PULL
Playground Mission: Use a force to set the see-saw in motion.	PUSH	PULL

Name: _____ Date: _____

MY PLAYGROUND LAB REPORT

Directions: Today you are a scientist! Your mission is to explore the playground and use your energy to create motion! Circle if you used the force of "push" or "pull" (or both) to create motion.

Playground Activity: _____	PUSH	PULL
Playground Activity: _____	PUSH	PULL
Playground Activity: _____	PUSH	PULL
Playground Activity: _____	PUSH	PULL

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EXPERIMENTS AND STUDENT LAB REPORTS

FRICITION FRENZY

Objective: Students will participate in a science experiment and observe the effect of friction in order to understand that friction is a force that acts on objects in motion.

Introduction: Review or introduce the concept of friction to your students. *Force that can slow down objects in motion. Friction occurs when two surfaces rub against each other.* Relate the concept of friction to your student's everyday life. *If you put on ice skates, will you slide around easier on ice or on concrete? If you put on sneakers, will you slide around easier on ice or on concrete?* Have students to discuss this question with one another. *You will slide faster on ice than on concrete because the sidewalk is rough. Your skates will slide faster on ice because there is less for your skates to rub against than the sidewalk. The same would be true if you had a sled. A snowy hill is better than a hill of sand because there is less friction slowing you down. The same would be true if you had a sled. A snowy hill is better than a hill of sand because there is less friction slowing you down.*

Activity: Have students complete the first part of their lab report. Follow the directions in the pictures on the following pages. After students should complete the remaining half of their lab reports. Have fun!

FRICITION FRENZY

You Will Need:

- *4-5 pieces of construction paper, taped together to create a long "ramp" or "road"
- *4-5 pieces of course sandpaper, taped together to create a long "ramp" or "road"
- *2 toy cars (different colored cars work best)
- *a low box, books, or DVDs to create some height for the cars to slide down. A low box works best when a low box is used, or only a few books are stacked.
- *tape
- *foam blocks

FRICITION FRENZY



Setting up: Tape the sandpaper sheets together to create a long "ramp" or "road" for the cars. Do the same for the construction paper.



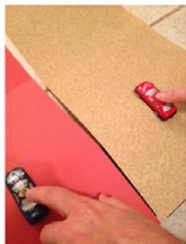
Tape both ends of the ramps to a low box or stack of books, like in the picture, to create a low ramp. The construction paper turn the cars.



Set the cars at the top of the "roads."

FRICITION FRENZY

Set the cars at the very end of the ramp - right before they are ready to fall off. Instruct students to **LIGHTLY** tap the cars until they "fall" off the ramp and slide down the two roads. Students should not give the cars a push. Allow them to practice first.



Now, watch them go! As long as students do not push the cars, the car on the sandpaper will slide down the road slower than the car on the paper. Eventually, the cars will reach the bottom. The car on the paper will win because it had less friction than the sandpaper car. The sandpaper car was slowed down by friction.

MY FRICITION FRENZY LAB REPORT

1. Make a hypothesis. Do you think the car on the construction paper road or the sandpaper road will win? Circle your hypothesis.

2. Why?

3. Now, test out your hypothesis. With your teacher's help, complete the racing experiment. Then answer the questions on the back of this lab report.



The car rubbed against the sandpaper more than the car on the construction paper, which is smoother. The sandpaper caused the car to slow down, so it did not move as far as the other car. The construction paper car won the race because it had less friction rubbing against it and was able to glide smoothly across the road! Well done, scientist!

CRITICAL THINKING MOTION GAMES!

MOTION MEMORY

Objective: Students will play a memory game to reinforce words associated with the direction or path.

Introduction: This game will encourage you to use your critical thinking skills to match the words with the directions.

MOTION DIRECTION MEMORY GAME

Teachers: Use these cards as a science game to review the directions and paths of motion. Cut out the cards to play, or, cut and laminate the cards for durability and place in a science center. The partner with the most matches wins!

MOTION DIRECTIONS

MOTION DIRECTIONS

slide

roll

drive

straight

MOTION DIRECTION MEMORY GAME: PAGE 2

pull

up

right

left

GPS DIRECTIONS

Directions: Read and follow the GPS directions to help Tommy get to the theme park. Use your pencil to draw the path and direction Tommy takes on his trip. *Teachers, have students rotate the paper as they "drive" so they are looking in the direction they are moving.

1. Head straight until you get to the end of the road.
2. Make a left turn.
3. Turn left again.
4. Continue straight.
5. Turn right.
6. Drive straight.
7. Make a right turn.
8. At the end of the road, turn left.
9. Turn left again.
10. Continue straight.
11. You have reached the theme park.
12. If you get lost, ask for help.

Name _____

Date _____

MOVE THAT CAR!

Directions: Using your pencil to draw the car's path, follow the directions on the GPS to help the car get to the theme park. Be careful!



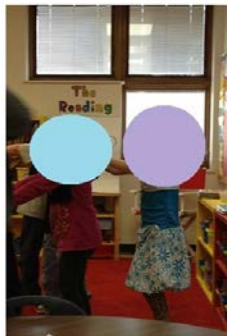
GPS DIRECTIONS

Objective: Students will practice following the GPS directions to practice the directions of left and right as they use their maps and pencils to draw the path Tommy takes to get to the amusement park.

Activity: (You will want to model this lesson as you complete it for younger and/or older students. Teach them how to draw their line and then turn the paper so that they are looking at the "road" or "path" in the same way that the car would be - similar to looking at a map while driving.) Explain to the students, "Today we are going to help Tommy get to the amusement park! We're going to practice knowing our left and right by following the GPS directions and using our pencil to draw where Tommy will turn and move his car. Here we go!" (This would be a great time to show students that their left hand is a correct "L" to help them remember the difference between left and right.) When the car moves, the directions "left" and "right" help to describe the movement of objects or people.)

Activity: Read #1 on the GPS and follow the directions by drawing a straight line until your pencil reaches the end of the "road." Turn your paper 90 degrees to the left so that you are now looking at the paper vertically. Read #2 on the GPS and follow the directions by drawing a line to the left with your pencil to tell Tommy to turn left with his car. Continue to follow the directions until you reach the park!

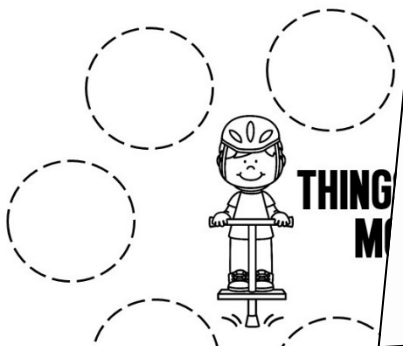
MOVIN' AND GROOVIN'



NO-PREP STUDENT PRINTABLES, POEMS, AND SONGS!

Name _____ Date _____

Directions: What are some things in your classroom or school that move? Draw or write your ideas in the bubbles.



THING M

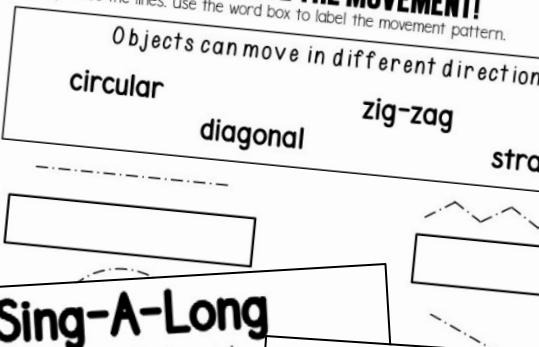
Name _____ Date _____

TRACE THE MOVEMENT!

Directions: Trace the lines. Use the word box to label the movement pattern.

Objects can move in different directions

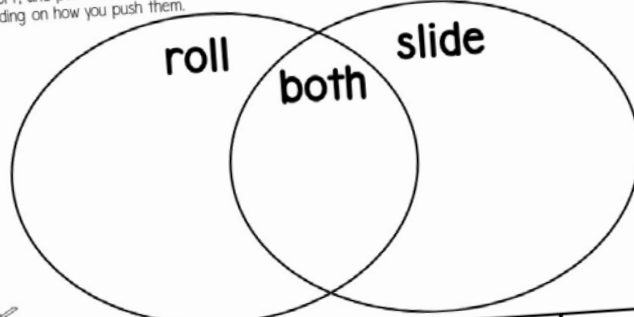

circular diagonal zig-zag straight




Name _____ Date _____

ROLL OR SLIDE?

Directions: Study the objects. If you pushed the object across a table, would the object roll or slide? Cut, sort, and paste the objects onto the Venn Diagram. *Challenge: TWO objects could do both, depending on how you push them.





Motion Sing-A-Long
(Tune: Mary Had a Little Lamb)



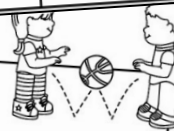
Motion happens every day
When we work, when we play
Push and pull are forces used
To make an object move.

Motion happens every day
When we work, when we play
Energy is what we use
To make an object move.



All About Motion

My Illustration:



Motion is created when I move from place to place
Like a spaceship flying high and fast,
into outer space.

Push and pull are forces that need energy to work.
I need energy to move in gym or even lift my fork!

Circular, straight, and zig-zag are some paths an object can take.
Friction can cause things to slow and then the path can break!

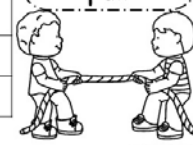
Motion is important. We use it all the time.
Your eyes and lungs are moving while you read this little rhyme!

SEARCH!
words in the word list!

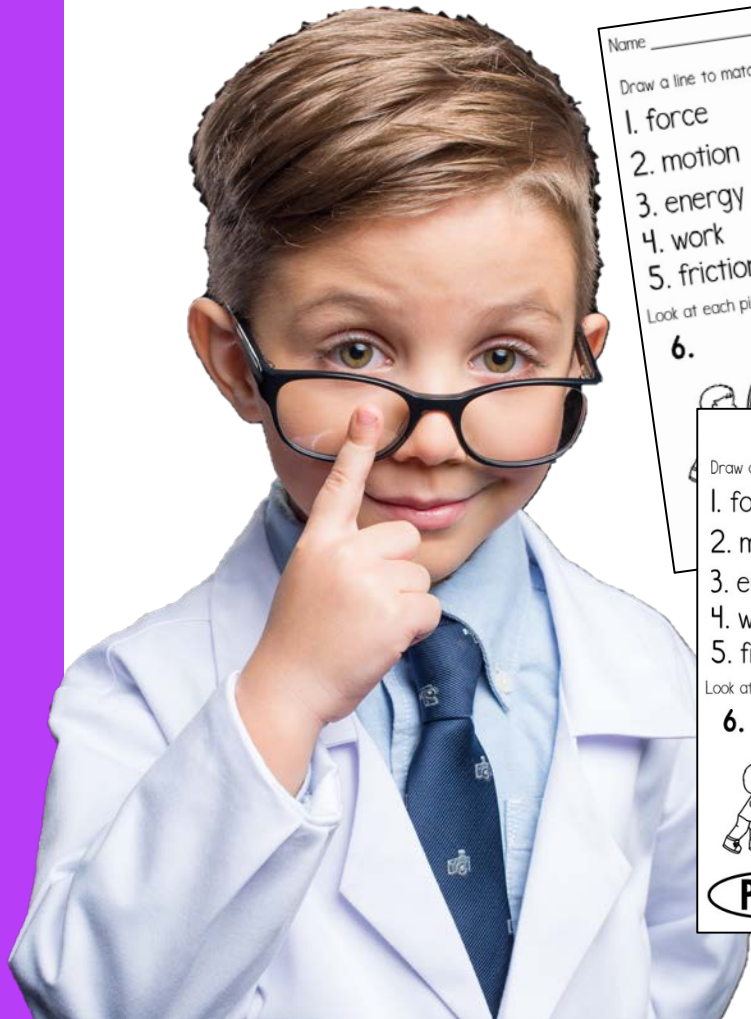
y	e
u	p
j	t
k	r
k	o
l	l
b	l
n	m
x	v
c	r

Word List

motion
force
energy
zig-zag
push
roll
slide
pull



FORCE & MOTION ASSESSMENT AND TEACHER ANSWER GUIDE




Name _____ Date _____


MOTION TUNE-UP TEST

Draw a line to match each vocabulary word to its definition.

1. force	when an object moves from one place to another
2. motion	a force caused when two objects rub against each other
3. energy	the push or pull on an object to make it move
4. work	the ability to do work
5. friction	when a force used to move an object moves another object

Look at each picture. Will a PUSH or a PULL best put the object into motion? Circle the force.

6. 


7. 


MOTION TUNE-UP TEST TEACHER ANSWER SHEET


Draw a line to match each vocabulary word to its definition.

1. force	when an object moves from one place to another
2. motion	a force caused when two objects rub against each other
3. energy	the push or pull on an object to make it move
4. work	the ability to do work
5. friction	when a force used to move an object moves another object

Look at each picture. Will a PUSH or a PULL best put the object into motion? Circle the force.

6.  **PUSH** **PULL**

7.  **PUSH** **PULL**

8.  **PUSH** **PULL**


MOTION TUNE-UP TEST (PAGE 2)


9. Would a marble roll faster and further on sand or on ice? Circle.

sand ice

10. Why?

11. Tommy rolls a marble down each ramp. Which ramp will make the marble roll faster? Circle the ramp.

 Ramp A

 Ramp B


MOTION TUNE-UP TEST (PAGE 2)


and further on sand or on ice? Circle.

sand ice

in the marble and the ice. Ice is smooth and slippery, against it as much as sand, which would slow it down is according to your students' development and age.)


in each ramp. Which ramp will make the marble roll faster?


 Ramp A

 Ramp B

ing down Ramp A because the ramp is taller and r because it has more energy. The marble on Ramp B ould take longer to gain energy down the ramp. (Again, development.)

Draw a circular path. 15. Draw a zig-zag path.







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