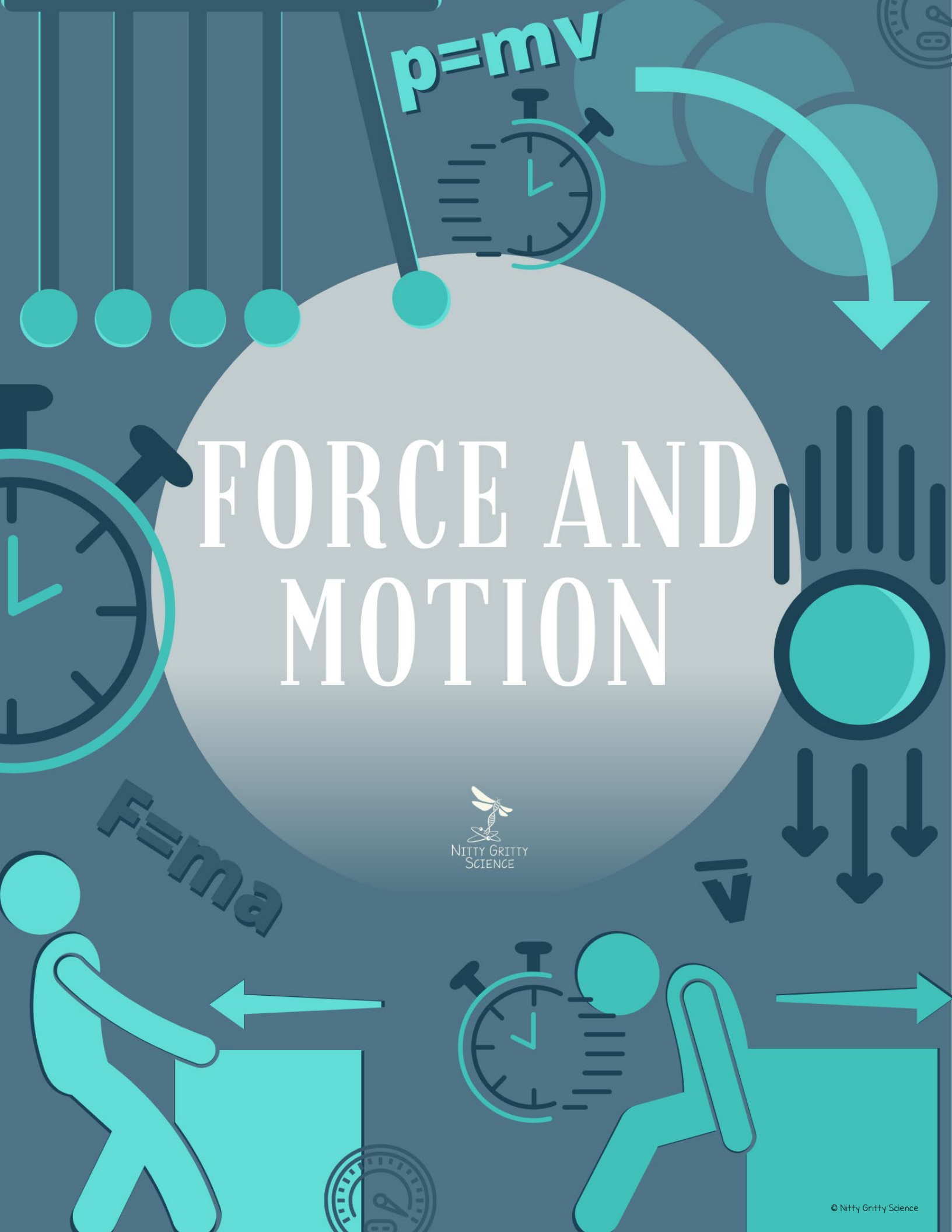

FORCE AND MOTION

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Table of Contents:
Force and Motion

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Introduction

If you are new to the idea of using a Science Interactive Notebook in your classroom, **stop by my Nitty Gritty Science shop and download my Intro to Science Interactive Notebooks tutorial for FREE!** In there you will find tips on how to begin with your students, what materials to have on hand and, most importantly, how it will enhance your students learning through reflection and creativity.

Focused Lessons with Differentiated Instruction

The lessons shared on the following pages cover National Science Standards and meet students' needs. I have given you the notes that I would give my students (Right Side - Input Side of Notebook) so you can understand what I'm having the students focus on when working on their creative assignments (Left Side - Output Side of Notebook). Each lesson focuses on a Question of the Day (QOD) represented in red in the top margin of each "Input" page with student giving an answer in red on "Output" page.

Left Side - Output

Instructions for each Output Side are included. This includes cut-outs, foldables or master copies where applicable. You may find that students work slowly at first, but once groups are organized and students know what is expected from them, not only will you see more energy focused on the final product, but also you will be shocked at the level of creativity certain students have in certain areas.

Mini-Assessments

Mini quizzes will be given for each section so you may monitor the student's level of understanding. For reproduction purposes, there are two quizzes to a page so you can cut them in half and save on some paper ☺

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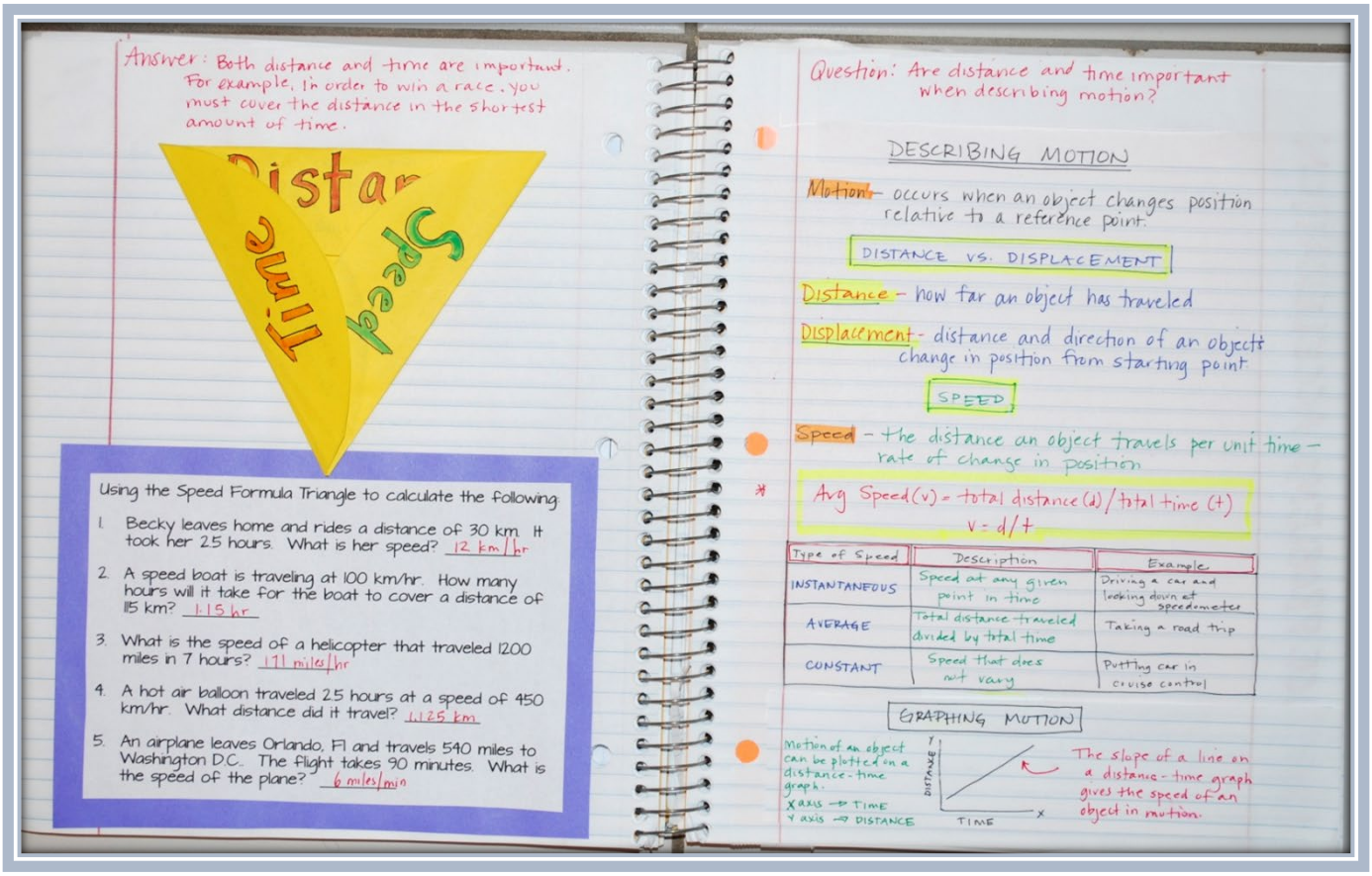
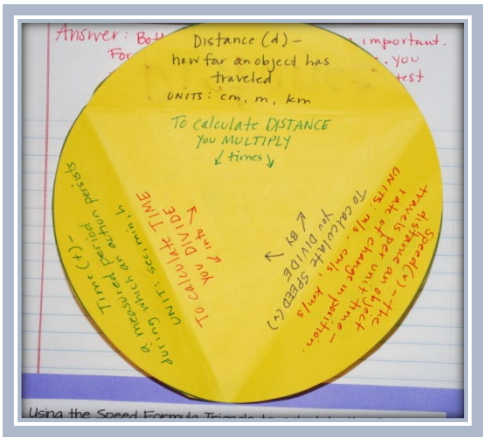
Section 1: Describing Motion

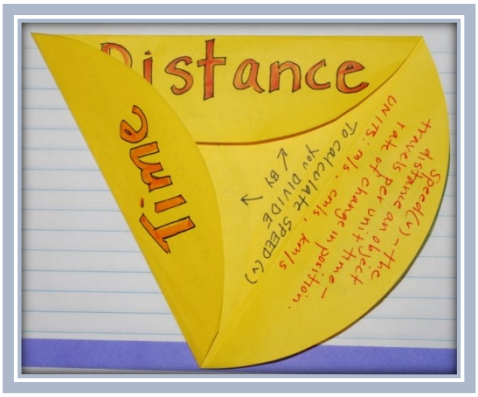


Instructions:

Students will create a Formula Triangle Foldable to help them calculate speed, distance and time in the following word problems. Each tab will need to have the definition of each term as well as directions on how to calculate each term.

The following contains directions for the foldable, speed word problems (1/2 page), and a mini-quiz for this section.





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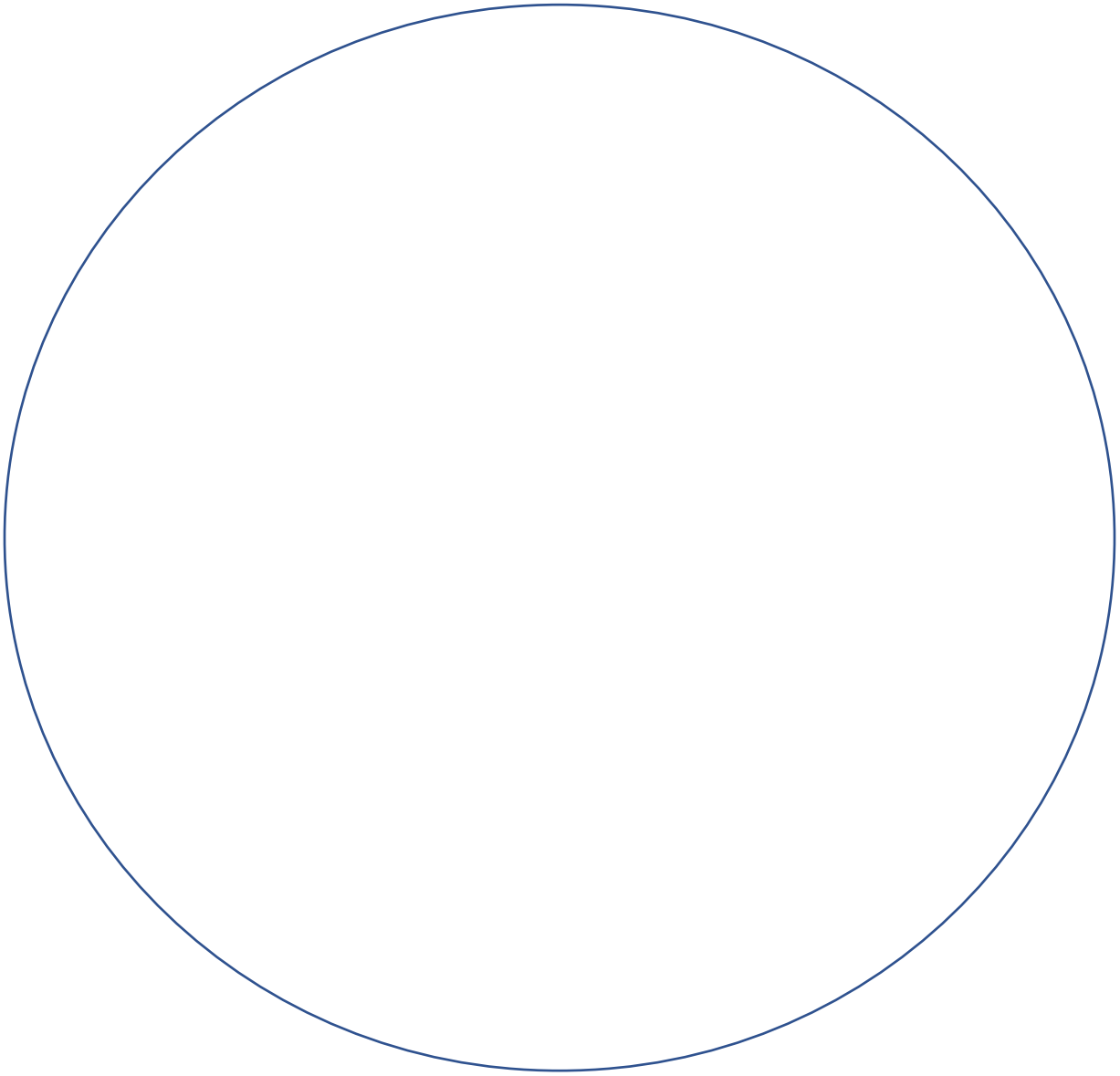
Formula Triangle Foldable



Step 1: Cut out the circle.

Step 2: Find center and lightly mark for reference.

Step 3: Pick any edge on the circle and fold it towards center – make a crease.

Step 4: Pick the opposite edge of the paper and fold towards the center overlapping edges and forming a cone shape – crease edge.

Step 5: Fold the final edge down towards the center forming an equilateral triangle. Glue into your Science Interactive Notebook and fill in the definitions.

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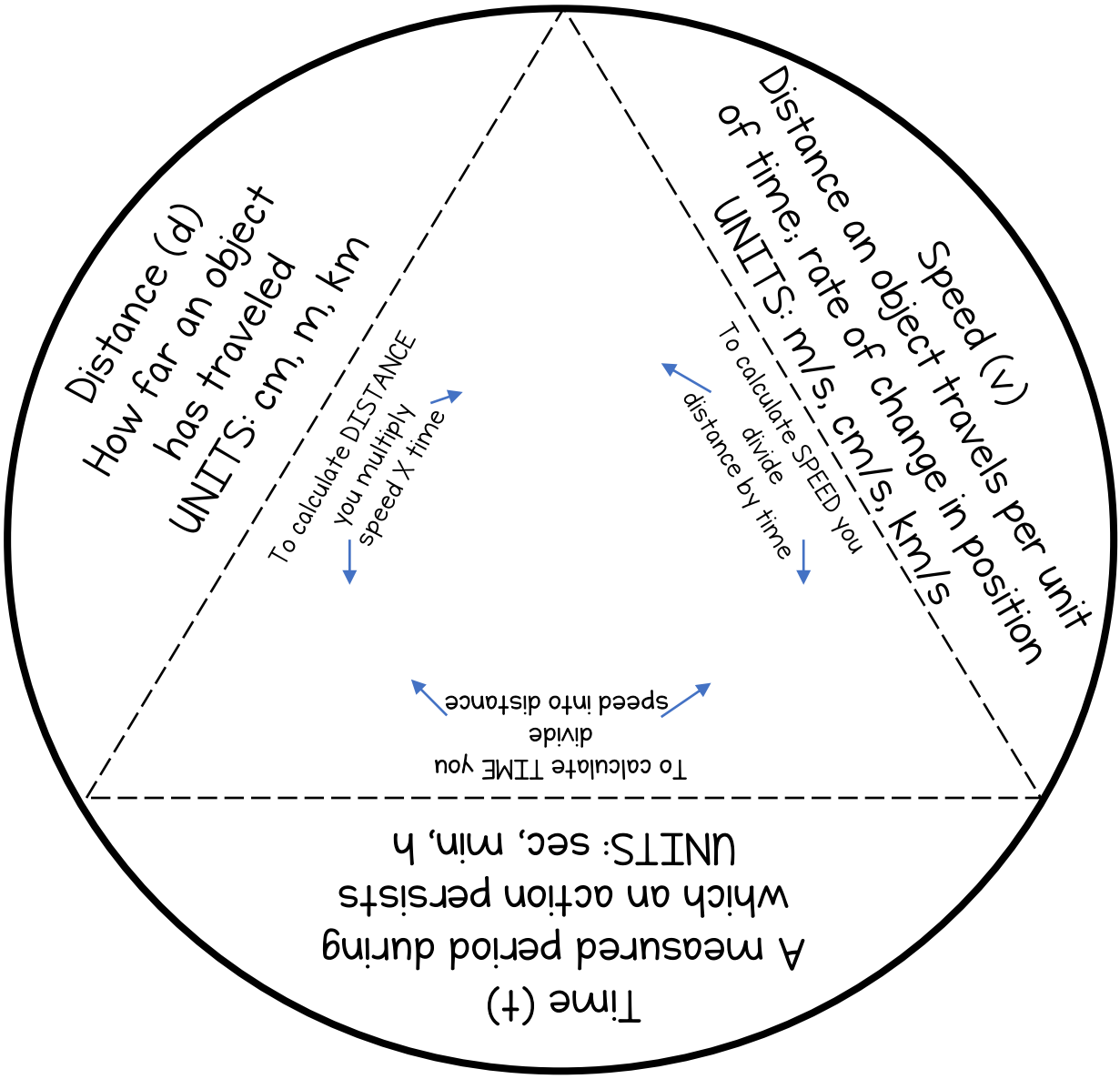
Formula Triangle Foldable



Step 1: Cut out the circle.

Step 2: Fold on dotted line forming an equilateral triangle.

Step 3: Label back of each fold as TIME, DISTANCE, and SPEED

Step 4: Glue your Formula Triangle into your Science Interactive Notebook and use it to help solve calculations.

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Paste this page in your Science Interactive Notebook and use the Speed Formula Triangle to calculate the following:

1. Becky leaves home and rides a distance of 30 km. It took her 2.5 hours. What is her speed? _____

2. A speed boat is traveling at 100 km/hr. How many hours will it take for the boat to cover a distance of 115 km? _____

3. What is the speed of a helicopter that traveled 1200 miles in 7 hours?
   _____

4. A hot air balloon traveled 2.5 hours at a speed of 450 km/hr. What distance did it travel? _____

5. An airplane leaves Orlando Fl and travels 540 miles to Washington D.C. The flight takes 90 minutes. What is the speed of the plane? _____

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Name _____ Date _____

Quiz: Describing Motion
Matching

_____ 1. Motion	a. speed that does not vary
_____2. Distance	b. when an object changes position
_____3. Displacement	c. speed at any given point in time
_____4. Instantaneous speed	d. how far an object has moved
_____5. Constant speed	e. distance and direction of an object's change in position

6. To skate 100 meters in 20 seconds, a skater must skate at a speed of _____.

7. If a runner maintains a constant speed of 12 miles/hour, how long will it take to complete a half marathon race of 13.1 miles? _____

8. If Johnny won a 300 meter race in 40 seconds, his speed would be _____.

Name _____ Date _____

Quiz: Describing Motion
Matching

_____ 1. Motion	a. speed that does not vary
_____2. Distance	b. when an object changes position
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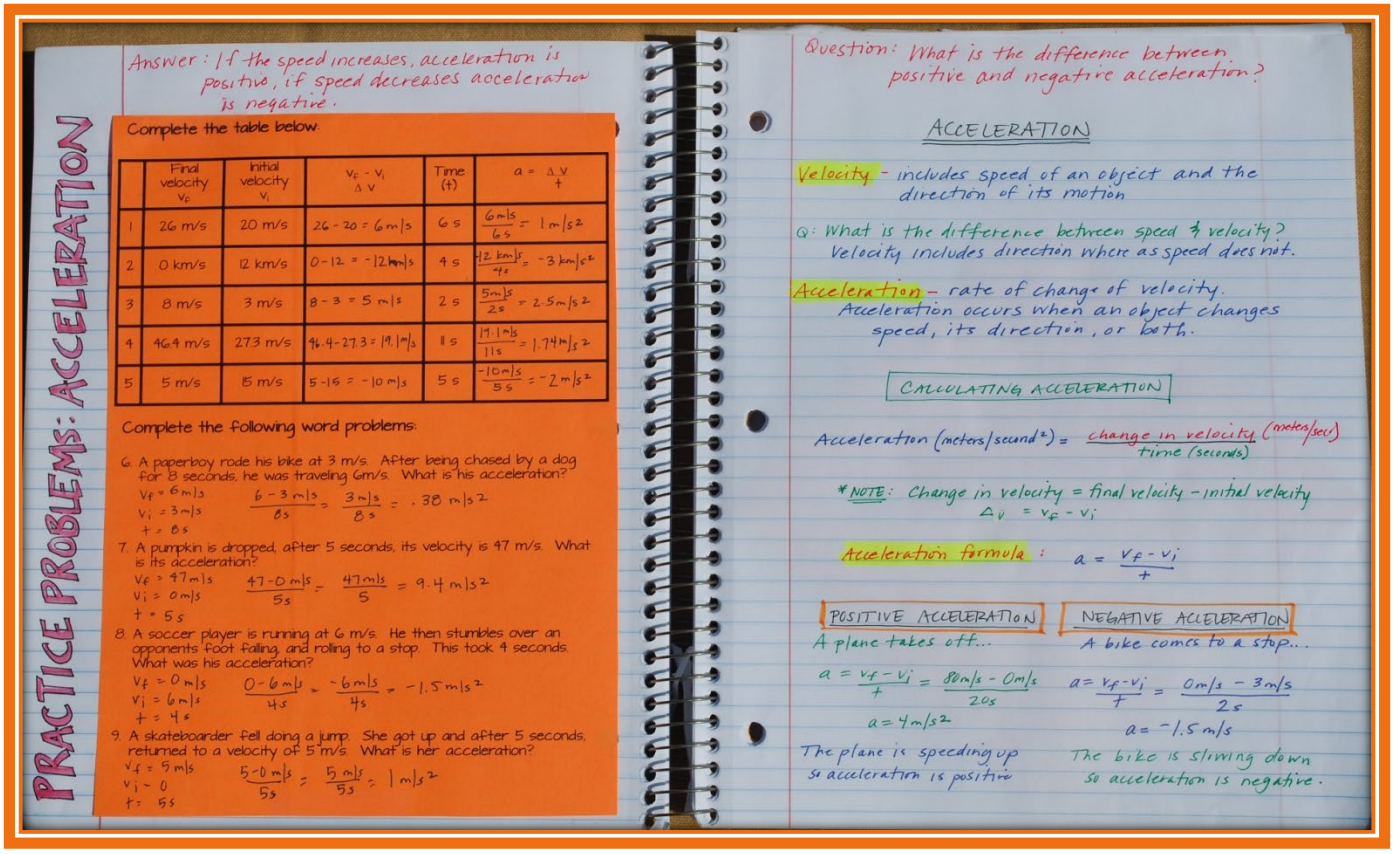
Section 2: Acceleration



Instructions:

For this section, all I can say is practice, practice, practice. Students will be practicing using the acceleration formula to calculate equations and word problems. The following contains Practice Problems: Acceleration, an Accelerations Master copy page, and a mini-quiz.

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Practice Problems: Acceleration

Directions: Complete the table below.

	Final velocity v_f	Initial velocity v_i	$v_f - v_i$ Δv	Time (t)	$a = \frac{\Delta v}{t}$
1	26 m/s	20 m/s		6 s	
2	0 km/s	12 km/s		4 s	
3	8 m/s	3 m/s		2 s	
4	46.4 m/s	27.3 m/s		11 s	
5	5 m/s	15 m/s		5 s	

Complete the following word problems. Show your work.

6. A paperboy rode his bike at 3 m/s. After being chased by a dog for 8 seconds, he was traveling 6m/s. What is his acceleration?

7. A pumpkin is dropped, and after 5 seconds its velocity is 47 m/s. What is its acceleration?

6. A soccer player is running at 6 m/s. He then stumbles over an opponent's foot, falls and rolls to a stop. This took 4 seconds. What was his acceleration?

7. A skateboarder fell doing a jump. She got up and after 5 seconds returned to a velocity of 5 m/s. What was her acceleration?

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Practice Problems: Acceleration

Answer Key

	Final velocity v_f	Initial velocity v_i	$v_f - v_i$ Δv	Time (t)	$a = \frac{\Delta v}{t}$
1	26 m/s	20 m/s	26 - 20 = 6 m/s	6 s	6/6 = 1 m/s^2
2	0 km/s	12 km/s	0 - 12 = -12 m/s	4 s	-12/4 = -3 m/s^2
3	8 m/s	3 m/s	8 - 3 = 5 m/s	2 s	5/2 = 2.5 m/s^2
4	46.4 m/s	27.3 m/s	46.4 - 27.3 = 19.1 m/s	11 s	19.1/11 = 1.74 m/s^2
5	5 m/s	15 m/s	5 - 15 = -10 m/s	5 s	-10/5 = -2 m/s^2

Complete the following word problems. Show your work.

6. A paperboy rode his bike at 3 m/s. After being chased by a dog for 8 seconds, he was traveling 6m/s. What is his acceleration?

   .38 m/s^2

7. A pumpkin is dropped, and after 5 seconds its velocity is 47 m/s. What is its acceleration?

   9.4 m/s^2

6. A soccer player is running at 6 m/s. He then stumbles over an opponent's foot, falls and rolls to a stop. This took 4 seconds. What was his acceleration?

   -1.5 m/s^2

7. A skateboarder fell doing a jump. She got up and after 5 seconds returned to a velocity of 5 m/s. What was her acceleration?

   1 m/s^2

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Name _____Date _____

Quiz: Acceleration

1. What is the difference between speed and velocity?

_____

_____

2. Explain the difference between positive and negative acceleration.

_____

_____

3. A satellite's speed is 10,000 m/s. After 1 minute, it is 5000 m/s. What is the satellite's acceleration?

_____

_____

4. A runner increases her speed from 3.1 m/s to 3.5 m/s during the last 15 seconds of her run. What was her acceleration during her big push to the finish?

_____

_____

Name _____Date _____

Quiz: Acceleration

1. What is the difference between speed and velocity?

_____

_____

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_____

_____

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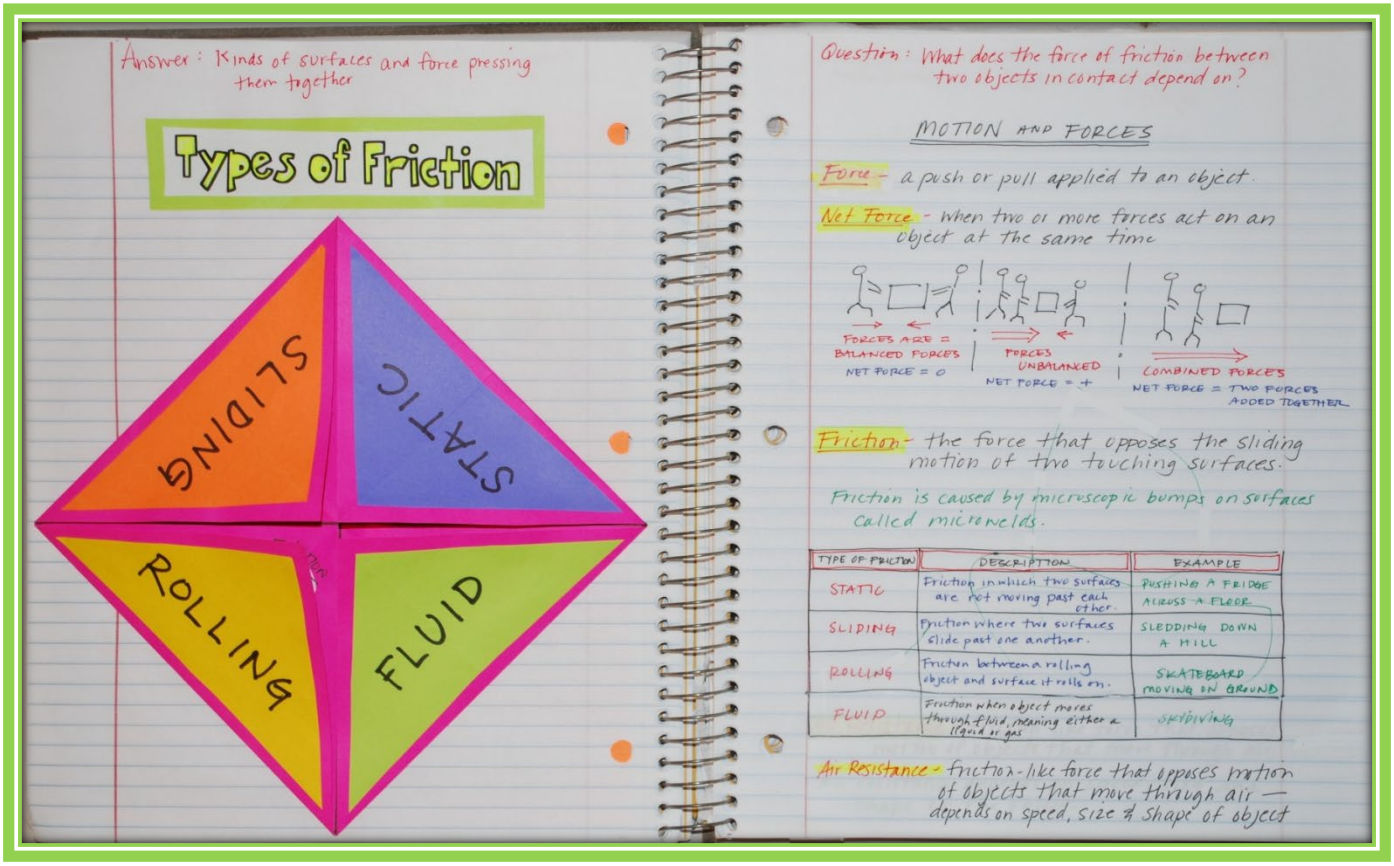
Section 3: Motion and Forces



Instructions:

Students will be creating and designing a Friction Four Point Envelope Foldable in which they will be comparing different types of friction. Each corner of the foldable will represent a different type of friction, and underneath each fold students will need to find an illustration that shows an example of the type of friction. Included for this section are directions on how to make the Four Point Envelope Fold, graphics for the Teacher's notebook so you don't have to go searching for examples, and of course a mini quiz.

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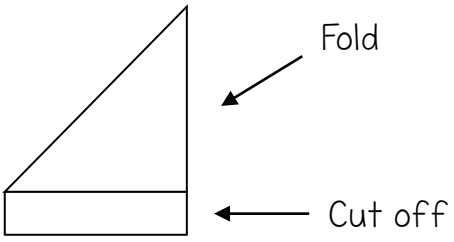
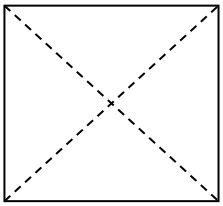
Friction Four Point Envelope Foldable

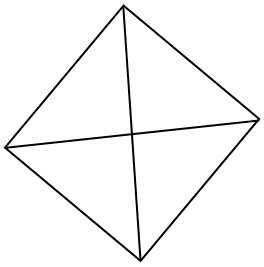
Step 1: Fold a sheet of paper into a "taco" forming a square. Cut off the excess strip of paper.



Step 2: Open the square and fold in the opposite direction in order to find the center.



Step 3: Fold all four corners toward the center forming a small square. Glue to your Science Interactive Notebook.



Step 4: Label all four corners with the different types of friction.

Step 5: Under each tab, write the definition of each type of friction in your own words.

Step 6: Find an illustration or draw an example of each type of friction and glue under the appropriate tab.

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TYPES OF FRICTION

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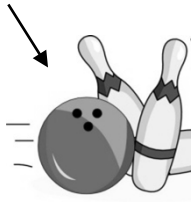
Name _____ Date _____
Quiz: Motion and Forces

Label each type of friction:



1_____ 2. _____ 3. _____ 4. _____

5. When two or more forces act on an object at the same time it's called a

_____.

6. A friction-like force that opposes motion of objects moving through the air is called

_____.

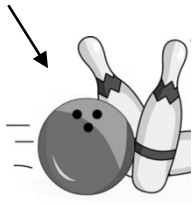
7. Friction is caused by microscopic bumps on surfaces called

_____.

Name _____ Date _____
Quiz: Motion and Forces

Label each type of friction:



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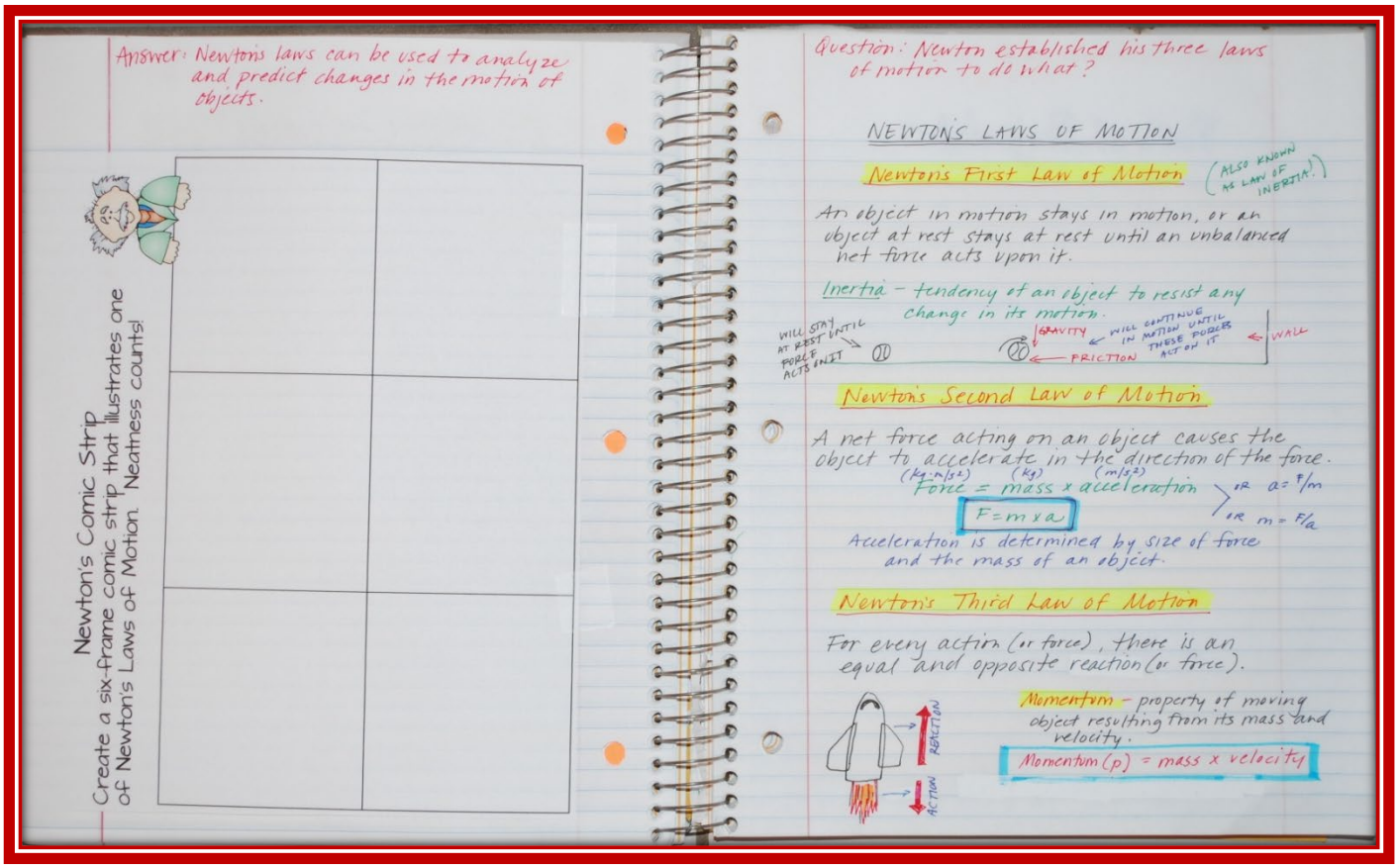
Section 4: Newton's Laws of Motion



Instructions:

First of all, I have to apologize for not having a cartoon drawn - I tried, but I thought my horrible artistry just made the page look messy, so you'll have to bear with a blank page ☺ Students are going to draw a six-frame comic strip illustrating one of Newton's laws. You are going to be amazed when you check notebooks and see some of the artistry your students are capable of. I would definitely let my students know that the page for the Science Interactive Notebook is for final copies ONLY, so do a rough draft on scrap paper - neatness counts! Have them use lots of color and use the space given in each square.

Following pages include comic strip template and mini-quiz.

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Newton's Comic Strip

Create a six-frame comic strip that illustrates one of Newton's Laws of Motion. Neatness counts!

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Name_____ Date _____

Quiz: Newton's Laws of Motion

_____ 1. As an ice skater pushes harder with his leg muscle, he begins to move faster. This is an example of

a. Newton's 1st Law b. Newton's 2nd Law c. Newton's 3rd Law

_____ 2. When you paddle a canoe, the canoe goes forward. This is an example of

a. Newton's 1st Law b. Newton's 2nd Law c. Newton's 3rd Law

_____ 3. The law of inertia is another name for

a. Newton's 1st Law b. Newton's 2nd Law c. Newton's 3rd Law

_____ 4. The equation F = m x a represents

a. Newton's 1st Law b. Newton's 2nd Law c. Newton's 3rd Law

_____ 5. According to ___ an object at rest will stay at rest unless acted upon by a force.

a. Newton's 1st Law b. Newton's 2nd Law c. Newton's 3rd Law

Name_____ Date _____

Quiz: Newton's Laws of Motion

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a. Newton's 1st Law b. Newton's 2nd Law c. Newton's 3rd Law

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a. Newton's 1st Law b. Newton's 2nd Law c. Newton's 3rd Law

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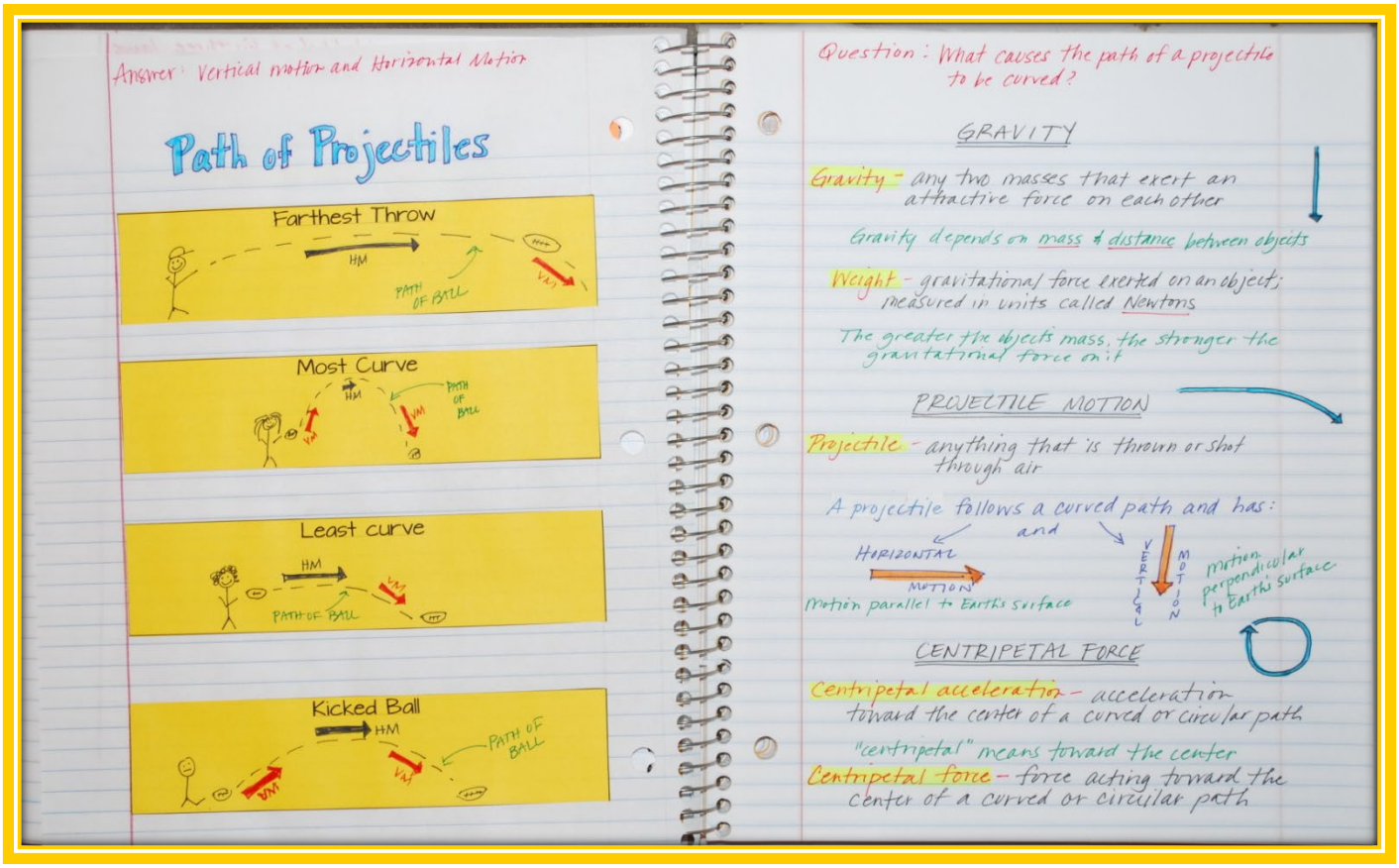
Section 5: Gravity



Instructions

To help students with this section on Gravity and Path of Projectiles, you're going to borrow some footballs from the PE department and take your kiddos outside so they can see gravity at work!

Students will take the worksheet outside with them and draw the path of projectiles for each task given to each group member, but you can have them label everything when they return to the classroom.

Included for this section is the Path of Projectile template and mini-quiz.

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Path of Projectiles

Directions: Using a football, each member of your group will perform one of the tasks below. You will then record what happened to the ball by drawing the scene from start to finish.

Cut and paste each scene into your Interactive Science Notebook. For each drawing you need to label the HORIZONTAL VELOCITY, VERTICAL VELOCITY and PATH OF BALL.

Throw as Far as Possible

Throw with Most Curve

Throw with Least Curve

Kick the Ball

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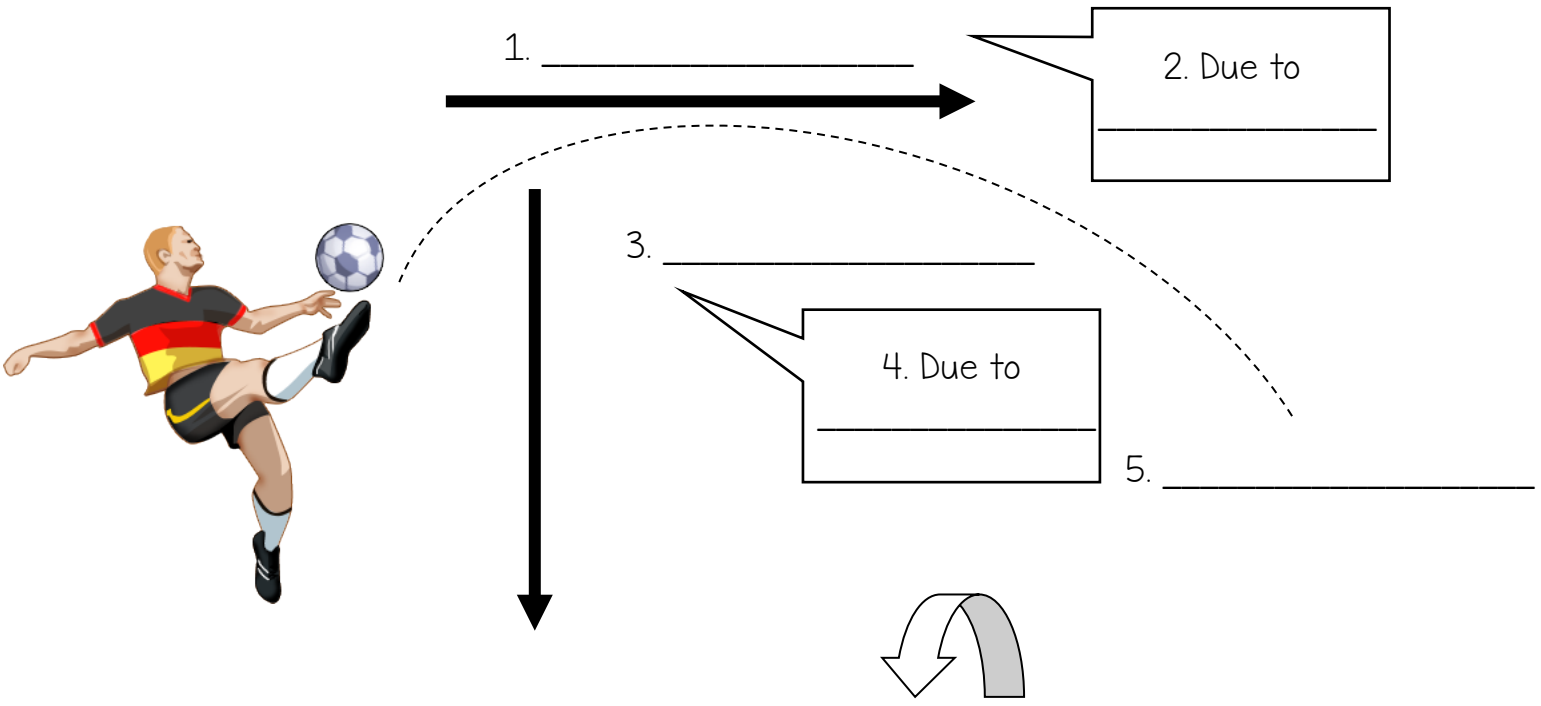
Name _____ Date _____

Quiz: Gravity

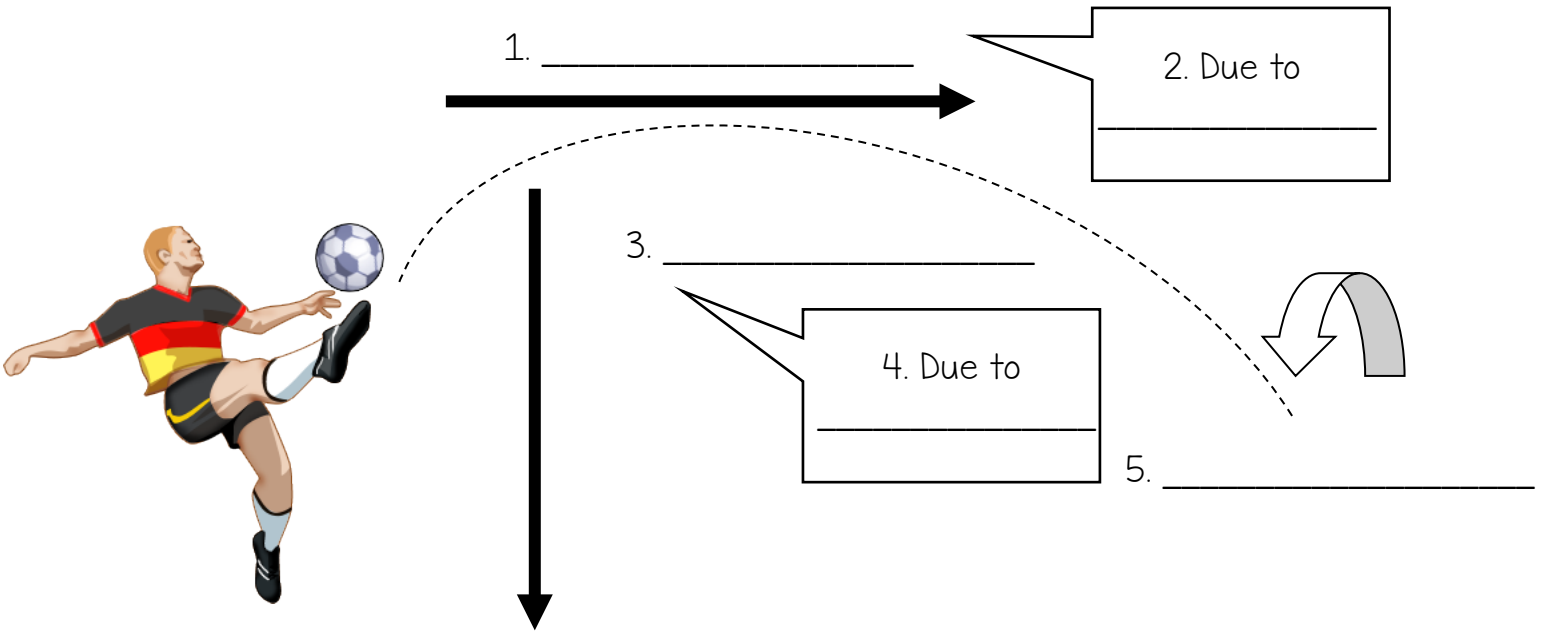
Label the following diagram.



Name _____ Date _____

Quiz: Gravity

Label the following diagram.



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Answer Key

Formula Triangle Calculations:

1. 12 km 2. 1.15 hr 3. 171 miles/hr 4. 1.125 km 5. 6 miles/min

Quiz: Describing Motion

1. B 2. D 3. E 4. C 5. A 6. 5 m/s 7. 1.09 hours 8. 7.5 m/s

Quiz: Acceleration

1. Velocity includes distance and direction, where speed just includes distance per unit time.

2. If speed increases, acceleration is positive; if speed decreases, acceleration is negative.

3. $-83.3\ m/s^2$ (make sure students convert 1 min to 60 sec)

4. $.02\ m/s^2$

Quiz: Motion and Forces

1. Sliding 2. Static 3. Fluid 4. Rolling 5. Net Forces
6. Air Resistance 7. Microwelds

Quiz: Newton's Laws of Motion

1. B 2. C 3. A 4. B 5. A

Quiz: Gravity

1. Horizontal velocity 2. Inertia 3. Vertical velocity 4. Gravity
5. Path of Ball

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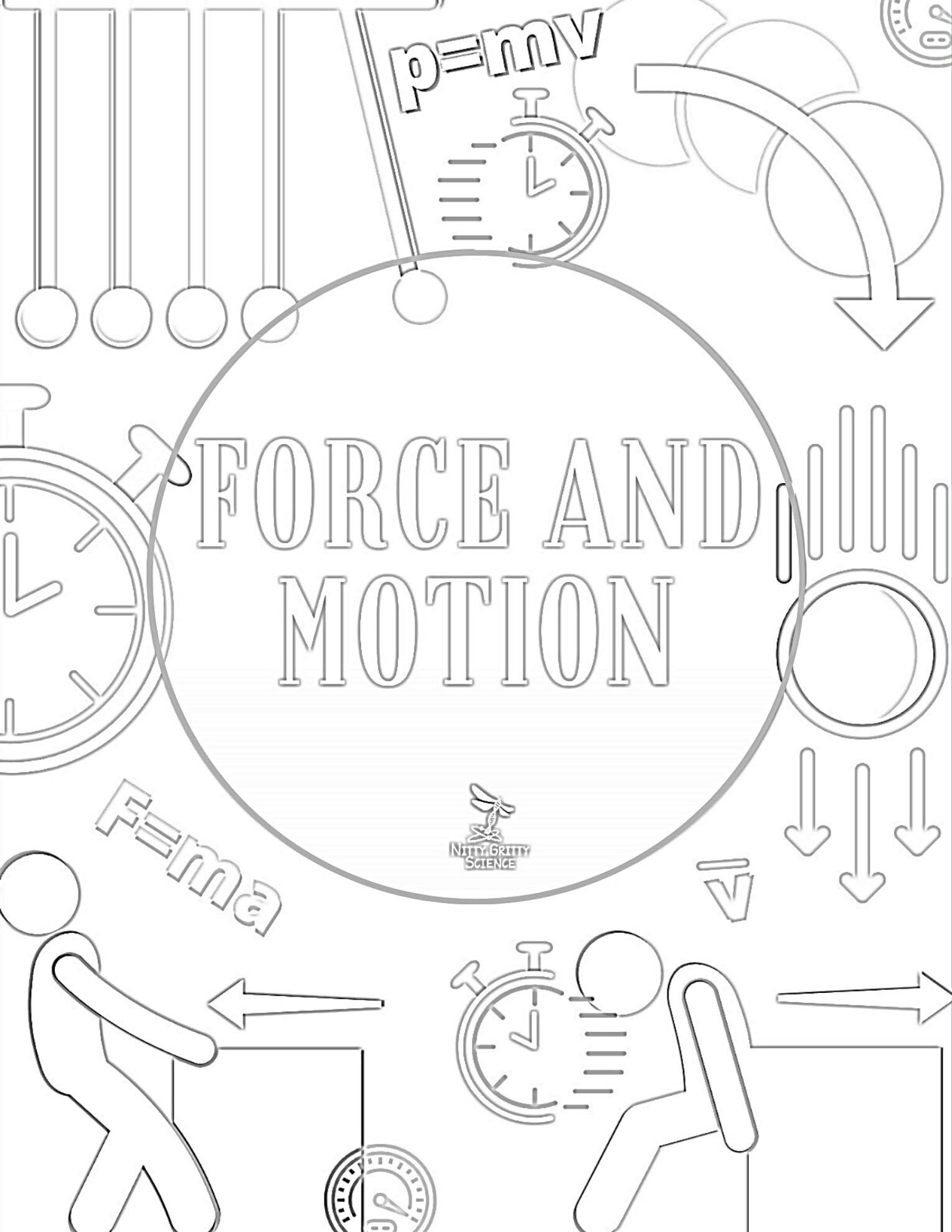
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FORCE AND MOTION
F=ma
NITTY GRITTY SCIENCE
v

Question: Are distance and time important when describing motion?

DESCRIBING MOTION

Motion – occurs when an object changes position relative to a reference point

DISTANCE VS. DISPLACEMENT

Distance – how far an object has traveled

Displacement – distance and direction of an objects change in position from starting point

SPEED

Speed - the distance an object travels per unit time; rate of change of position

Avg Speed (v) = total distance (d)/total time (t)
v = d/t

Type of Speed	Description	Example
INSTANTANEOUS	Speed at any given point in time	Driving a car and looking down at the speedometer
AVERAGE	Total distance traveled divided by total time	Taking a road trip
CONSTANT	Speed that does not vary	Putting a car in cruise control

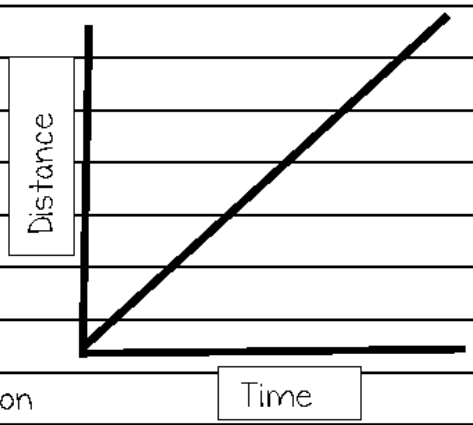
GRAPHING MOTION

Motion of an object can be plotted on a distance-time graph

X-axis → TIME

Y-axis → DISTANCE

The slope of a line on a distance-time graph gives the speed of an object in motion



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Question: What is the difference between positive and negative acceleration?

ACCELERATION

Velocity – includes speed of an object and the direction of its motion

Q: What is the difference between speed & velocity?

Velocity includes direction, whereas speed does not.

Acceleration – rate of chance of velocity

Acceleration occurs when an object changes speed, its direction, or both.

CALCULATING ACCELERATION

$$\text{Acceleration (meters/second}^2) = \frac{\text{change in velocity (m/s)}}{\text{Time (seconds)}}$$

* NOTE: Change in velocity = final velocity – initial velocity

$$\Delta v = v_f - v_i$$

Acceleration formula: $$a = \frac{v_f - v_i}{t}$$

POSITIVE ACCELERATION	NEGATIVE ACCELERATION
A plane takes off…	A bike comes to a stop…
$a = \frac{Vf - Vi}{t} = \frac{80m/s - 0m/s}{20s}$	$a = \frac{Vf - Vi}{t} = \frac{0m/s - 3m/s}{2s}$
$a = 4m/s^2$	$a = -1.5m/s$
The plane is speeding up, so acceleration is positive	The bike is slowing down so, acceleration is negative

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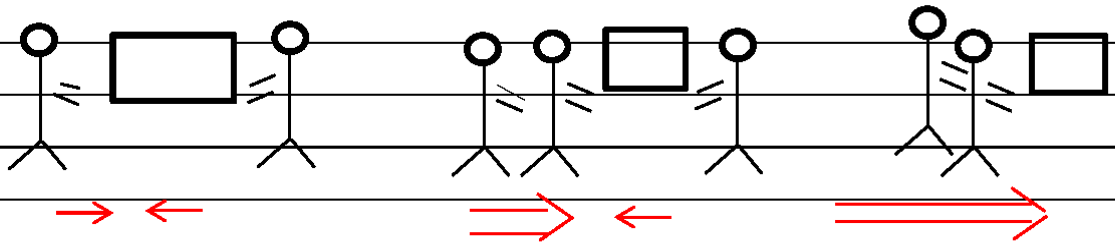
Question: What does the force of friction between two objects in contact depend on?

MOTION AND FORCES

Force – a push or pull applied to an object

Net Force – When two or more forces act on an object at the same time



FORCES ARE EQUAL	FORCES	COMBINED FORCES
BALANCED FORCES	UNBALANCED	NET FORCE = TWO
NET FORCE = 0	NET FORCE = +	FORCES ADDED TOGETHER

Friction – the force that opposes the sliding motion of two touching surfaces

Friction is caused by microscopic bumps on surfaces called microwelds.

TYPE OF FRICTION	DESCRIPTION	EXAMPLE
STATIC	Friction in which two surfaces are not moving past each other	pushing a fridge across a floor
SLIDING	Friction where two surfaces slide past one another	sledding down a hill
ROLLING	Friction between a rolling object and surface it rolls on	skateboard moving on ground
FLUID	Friction when an object moves through fluid, meaning either a liquid or gas	skydiving

Air Resistance – Friction-like force that opposes motion of objects that move through the air – depends on the speed, size, & shape of object

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Question: Newton established his three laws of motion to do what?

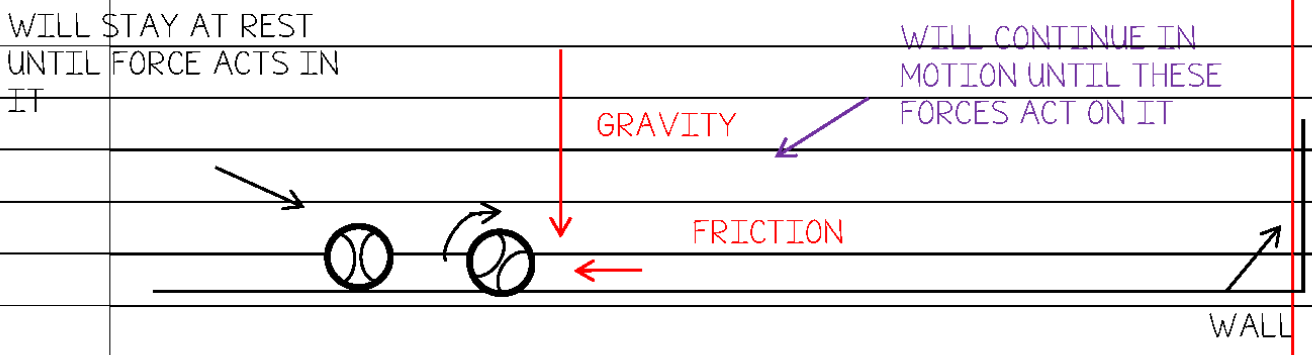
NEWTON'S LAWS OF MOTION

Newton's First Law of Motion

(also known as Law of Inertia)

An object in motion stays in motion, or an object at rest stays at rest until an unbalanced net force acts upon it.

Inertia – tendency of an object to resist any change in its motion.



Newton's Second Law of Motion

A net force acting on an object causes the object to accelerate in the direction of the force.

$(Kg * m/s^2)$ (kg) (m/s^2)

Force = mass x acceleration

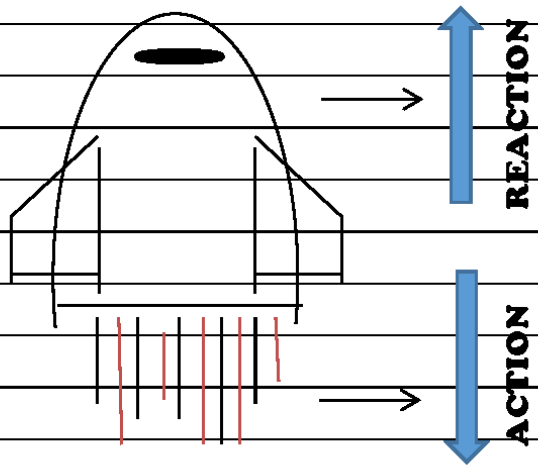
$F = m \times a$

Acceleration is determined by size of force and the mass of an object.

Newton's Third Law of Motion

For every action (or force), there is an equal and opposite reaction (or force).

Momentum – property of moving object resulting from its mass and velocity



Momentum (p) = mass x velocity

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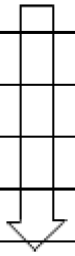
Question: What causes the path of a projectile to be curved?

GRAVITY

Gravity – any two masses that exert an attractive force on each other

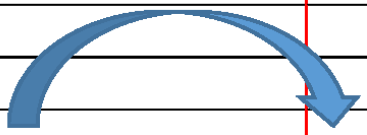


Gravity depends on mass and distance between objects

Weight – gravitational force exerted on an object; measured in units called Newtons (N)

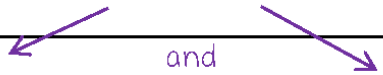
The greater the object's mass, the stronger the gravitational force on it

PROJECTILE MOTION



Projectile – anything that is thrown or shot through the air

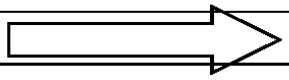
A projectile follows a curved path and has:



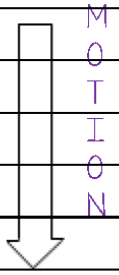
and

HORIZONTAL MOTION

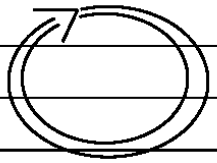
Motion parallel to Earth's surface



VERTICAL MOTION



Motion perpendicular to Earth's Surface



CENTRIPETAL FORCE

Centripetal acceleration – acceleration toward the center of a curved or circular path

"centripetal" means toward the center

Centripetal force – force acting toward the center of a curved or circular path

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