Lesson 2.8: Physical Science – Forces and Motion

Weekly Focus: Reading Comprehension
Weekly Skill: Group Presentations

Lesson Summary: This week students will begin study in the areas of forces and motions. The group presentations are a way to ensure students understand the material. There is a follow-up activity that will help students apply what they have learned.

Materials Needed:

- Reading Comprehension and Jigsaw Group Presentations: **Unit 2.8 Handout 1**
- Application of information from group presentations: **Unit 2.8 Handout 2**
- Forces and Motion, **Unit 2.8 Handout 3** *(6-Way Paragraphs, Introductory Level, pages 94 – 95)*

Objectives: Students will be able to…

- Demonstrate an understanding of the terms force, gravity, friction, and motion
- Apply understanding of gravity, friction, and speed and velocity

College and Career Readiness Standards: RI, RST, WHST, SL

ACES Skills Addressed: EC, LS, ALS, CT, SM, N

Notes: Please review and be familiar with classroom routine notes for: reading for fluency strategies (**Routine 2**), summarizing techniques (**Routine 4**), and self-management skills (**Routine 1**). The notes will help with making a smooth transition to each activity.

GED 2014 Science Test Overview – For Teachers and Students

The GED Science Test will be 90 minutes long and include approximately 34 questions with a total score value of 40. The questions will have focus on three content areas: life science (~40%), physical science (~40%), and Earth and space science (~20%). Students may be asked to read, analyze, understand, and extract information from a scientific reading, a news brief, a diagram, graph, table, or other material with scientific data and concepts or ideas.

The online test may consist of multiple choice, drop down menu, and fill-in-the-blank questions. There will also be a short answer portion (suggested 10 minutes) where students may have to summarize, find evidence (supporting details), and reason or make a conclusion from the information (data) presented.

The work students are doing in class will help them with the GED Science Test. They are also learning skills that will help in many other areas of their lives.

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Lesson 2.8: Physical Science – Forces and Motion

Activities:

Warm-Up: K-W-L Chart	Time: 5 - 10 minutes

- As students enter the class, have the following written on the board or overhead: **"In physical science, a force is a push or pull upon an object resulting from the object's *interaction* with another object."** Have students create a **"KWL"** chart on a piece of notebook paper (below). This helps to activate students' prior knowledge by asking them what they already **K**now (column 1); students (collaborating as a classroom unit or within small groups) set goals specifying what they **W**ant to learn (column 2); and after reading students discuss what they have **L**earned (column 3).
- Students apply higher-order thinking strategies which help them construct meaning from what they read and help them monitor their progress toward their goals.

KWL Chart:

K - What (else) do I KNOW?	W - What do I WANT to know?	L - What did I LEARN?

Activity 1: Forces & Motion (Unit 2.8 Handout 1)	Time: 45- 50 minutes

1) Put students into 4 groups labeled A, B, C, D.
2) Distribute the appropriate reading **(Unit 2.8 Handout 1)** pages to each group (**A** = Forces 2 pages, **B** = Friction 2 pages, **C** = Gravity 2 pages, **D** = Motion 2 pages, and the last 2 pages to **all** students (vocabulary and note taking sections).
3) Ask each group of students to read their assigned sections silently and then summarize and share their findings within their group. Explain how they are reading to become experts of the material and after discussing it in their groups, they will then share their knowledge from their section with the other groups. The other groups will take notes on the information presented.
4) Tell students when they are done reading silently, they should turn their papers over and discuss and summarize what their section is about to others in their group. They should also discuss how they would like to present the materials to the other groups. Explain that the other groups will have to take notes, or summarize the information presented in order to understand it fully. Students should be reminded they need to present the information and not read from it directly.
5) After groups have read and discussed their section in groups, each group will present their section of the reading to the whole class. The other groups will take notes of the material presented on last page of **Unit 2.8 Handout 1**.
6) If there is extra time, or to challenge students, they can write a 3 – 5 sentence summary of all of the material presented, use Routine 4: Summarizing Techniques.
7) While students are reading, circulate to the groups and discuss with students that when reading for comprehension, there are many strategies to use: read the title to predict what the reading is about; look at the words in bold and their definitions within the context of the reading or with the

vocabulary sheet at the end of **Unit 2.8 Handout 1**; if there are images, look at them to get a better understanding; while reading remember to ask "What is this all about?" Circulate class while they are reading to make sure they understand the information presented and see if there are any questions.

8) Have student groups take turns presenting while the other groups take notes using the note sheet. Have students KEEP THEIR PENCILS DOWN until the group finishes presenting. Then, ask the class, what did they say? After students supply sound bites that they remember from the presentation, have them write a few notes in their own words. If you do not instruct students to keep their pencils down, they may try to write down every word of the presenter instead of listening for the key points.

8) Remind students that they need to have a good foundational knowledge of forces and motion in order to answer some questions that may be on the GED 2014 test.

9) If there is extra time at the end of group presentations, have students read passage in pairs to promote reading fluency.

Break: 10 minutes

Activity 2: Application (Unit 2.8 Handout 2)	**Time: 40 – 50 minutes**

1) Distribute **Unit 2.8 Handout 2** to students.

2) Work through the application problems on these three pages together as a class. Do a couple of examples together on a worksheet, then let students try to finish that worksheet individually or in pairs. Finally, go over the answers for that worksheet as a class. Repeat the process with the remaining two worksheets.

Wrap-Up: Summarize	**Time: 5 minutes**

Have students turn to a partner (or write in their journals) about what they have learned today about Forces. They may want to discuss some of the areas that they would like to do further study on in the future. Their summary may include any wonderings they have about the subject.
Note: Use Routine 4

Extra Work/Homework: Unit 2.8 Handout 3	**Time: 30 minutes outside of class**

Students can read and answer questions from the **6-way Paragraphs** (Introductory Level # 47, pages 94-95) "Forces and Motion." This is an excellent opportunity for students to review today's material in an independent manner.

Differentiated Instruction/ELL Accommodation Suggestions	**Activity**
If some student groups finish early, they can turn their paper over and summarize the reading passage.	**Activity 1 Handout 1**
There may be a lot of new vocabulary and ideas for some students, be prepared to assist by circulating while they are reading and discussing on how to present the material.	**Activity 1 Handout 1**

Students may request to use calculators for Activity 2. If at all possible, have them try to do the speed and velocity problems without the use of a calculator. They may have to use a white board as "scratch paper" when taking the GED 2014 Science Module and not have access to a calculator.	**Activity 2 Handout 2**

Online Resources:

Discovery Education:

If students are able to have access to the Internet, there is an excellent video on Forces and Motion from Discovery Channel. If possible, try the link in class after students read and present their information on forces and motion. It is a great way to reinforce some of the main ideas in this area of physical science. (The video cannot be uploaded to YouTube, so you have to connect directly to Discovery Education via the URL (http://www.discoveryeducation.com/administrators/curricular-resources/science/#/Features)

Suggested Teacher Readings:

- GED Testing Service – GED Science Item Sample (to get an idea of what the test *may* be like)

  http://www.gedtestingservice.com/itemsamplerscience/

- Assessment Guide for Educators: A guide to the 2014 assessment content from GED Testing Service:

  http://www.riaepdc.org/Documents/ALALBAASSESSMENT%20GUIDE%20CHAPTER%203.pdf

- Minnesota is getting ready for the 2014 GED test! – website with updated information on the professional development in Minnesota regarding the 2014 GED.

  http://abe.mpls.k12.mn.us/ged_2014_2

Unit 2.8 Handout 1 – **Group A** (page 1 of 2)

Force and Motion

Brief #1: Forces

Focus

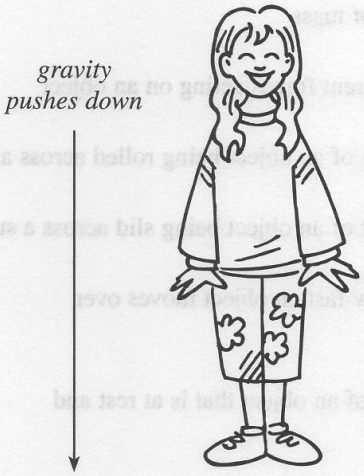
Forces act on all objects in the universe.

The universe in which we live is full of all different kinds of forces. **A force is a push or a pull.** There is the force of gravity. Gravity is a pulling force. And there is the force of magnetism, which can push or pull. Some forces are big, like the force that keeps the Earth in orbit around the sun. Some forces can be much smaller, like the force that keeps electrons orbiting the nucleus of an atom.

Some forces act only if the objects involved are touching each other. These are called contact forces. If you hit a tennis ball with a racket, the racket and the ball have come into contact with one another.

Vocabulary

1. force
2. net forces



But there are other forces that can act on objects without having to be in contact with them. These are called action-at-a-distance forces. For example, if you put two magnets close together, you will be able to feel the push or pull without the magnets having to touch. Force is always the result of the interactions of objects with one another, whether they are touching or not.

Forces have size and direction. The size of a force is measured in newtons. "N" is the abbreviation for "newton." One newton is equal to the amount of force it would take to move an object with a mass of one kilogram a distance of one meter every second.

A spring scale can be used to measure forces. An object is attached to one end of the spring scale. The spring stretches to show how much force is pulling down on the object.

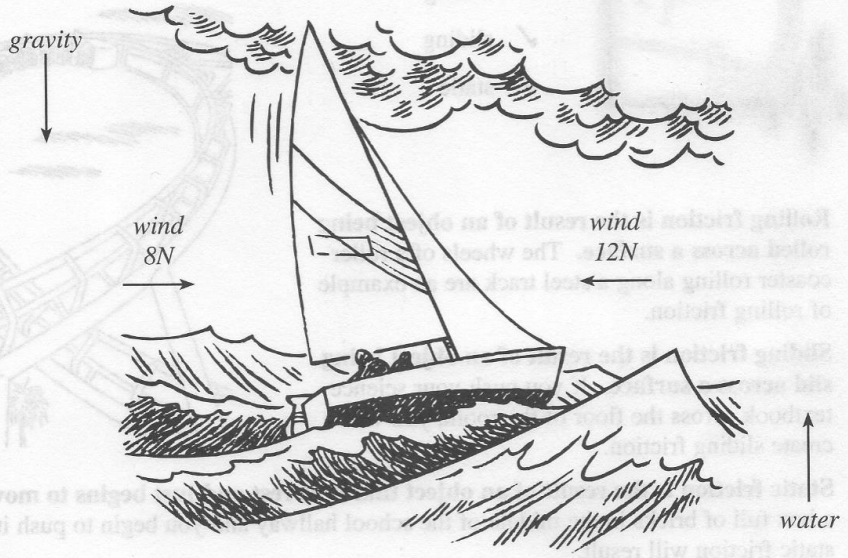
Unit 2.8 Handout 1 – **Group A** (page 2 of 2)

Force and Motion

Brief #1: Forces *(cont.)*

Net Forces

It is rare for there to be only one type of force acting on any object. Most of the time, many forces are acting on an object at a given time. **All of the different forces acting on an object are called net forces.**



In the illustration above, you can see all of the forces that are acting on the boat: the force of gravity is pushing down, the force of the water is pushing up, and the wind is blowing from east to west and from west to east.

If the boat moves west, it is because wind is blowing from the east. If the boat doesn't move at all, it means that there is no wind blowing from either direction or that the same amount of wind is blowing from each direction. When forces are unbalanced, an object at rest will move. But when forces are balanced, the motion of the object will not change.

If you take a look again at the picture above, you will see that there is a 12 N force pushing to the west and an 8 N force pushing to the east.

To figure out the net forces on the sailboat, you subtract the forces. The result is that there is 4 N force pushing to the west. The net force is 4 N to the west.

The net forces on any object can act to change the direction of an object or can slow an object down.

Unit 2.8 Handout 1 – **Group B** (page 1 of 2)

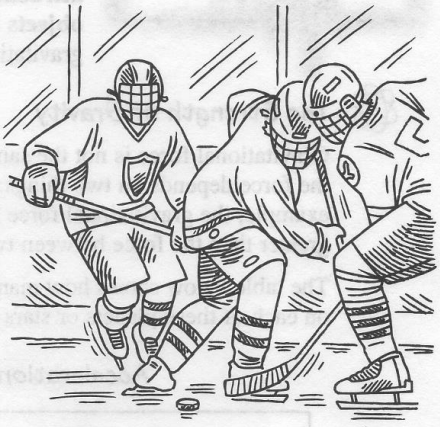
Force and Motion

Brief #2: Friction *(cont.)*

Friction in Everyday Life

Friction may sound like not such a great thing because it can slow things down or make them stop. But think for a minute what would happen in our everyday lives if friction were not a part of it! Imagine what would happen to the players in a basketball game if there was no friction between their feet and the court. The truth is that the shoes these players wear are specially designed with friction in mind.

A surface that is made of rubber has more friction because rubber easily bends. This friction created by contact between the rubber soles and the wooden court helps the basketball players stop and start more easily.



Of course, the opposite would be true with the sport of ice hockey. Ice skates are designed to reduce friction upon contact with the ice. As the blade of the skate moves across the ice, the friction created causes it to heat up. This little bit of heat melts the ice directly beneath the skate, and the water acts as a lubricant. This reduces friction and allows the skates to slide easier. The water refreezes as soon as the blade of the skate is no longer in contact with it.

You know if you rub your palms together that they will heat up a little bit. This is the result of friction. Sometimes the friction between two objects can cause so much heat that a fire can start. After any kind of motorized machine has been running for a while, it will give off a certain amount of heat. The heat is a result of all of the parts of the machine rubbing together and creating friction.

For this reason, many mechanized devices have to use lubricants to reduce friction. Cars, buses, and trucks use oil. Grease is used to lubricate the gears in other types of machines. There is a whole branch of science called *tribology* that studies the connection between friction and lubricant.

Fast Fact

The coefficient of friction means how easily one object moves over another object.

high coefficient = higher friction

low coefficient = lower friction

Unit 2.8 Handout 1 – **Group B** (page 2 of 2)

Force and Motion

Brief #2: Friction

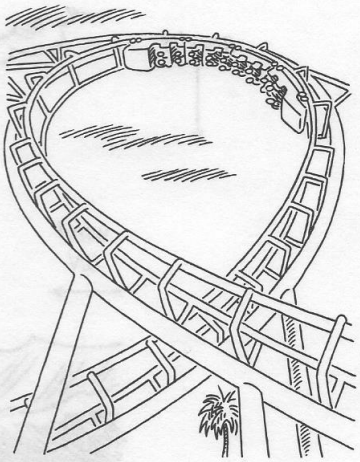
Focus

Friction is a contact force that resists movement.

If you have ever rollerskated, ridden a bike, or rolled a bowling ball down an alley, you have seen friction in action. **Friction is a force that is the result of objects pressing tightly against each other. The force of friction slows things down.**

There are three different types of friction:

- ✓ rolling
- ✓ sliding
- ✓ static



Rolling friction is the result of an object being rolled across a surface. The wheels of a roller coaster rolling along a steel track are an example of rolling friction.

Sliding friction is the result of an object being slid across a surface. If you push your science textbook across the floor of the room, you will create sliding friction.

Static friction is the result of an object that is at rest and just begins to move. If there is a box full of bricks in the middle of the school hallway and you begin to push it forward, static friction will result.

How much friction is present depends on two things:

- ✓ the material each object and surface is made of
- ✓ how tightly the object and the surface pressed together

Let's go back to our example of sliding friction. Your textbook may slide quite easily across the floor of your classroom, especially if the surface of the book and the floor are smooth. But what might happen if you put a brick on top of your book and then tried to slide it? If you guessed that the book would not slide as easily, you are correct. The more tightly together the objects are pressed, the greater the friction will be. Rougher surfaces also create greater friction.

Vocabulary

1. friction
2. rolling friction
3. sliding friction
4. static friction

Unit 2.8 Handout 1 – **Group C** (page 1 of 2)

Force and Motion

Brief #3: Gravity

Focus

Gravity is a pulling force that affects everything in the universe.

What do you think would happen in the game of baseball if there were no gravity? When a batter hit the ball, it would keep on going and going and going, never falling to the ground.

Gravity is a pulling force. Gravity pulls everything on Earth towards the ground. You can't smell, taste, or touch gravity, but you can see its affects everywhere. Earth is not the only place where this force exists. **Gravitational force is a force of attraction between all matter and objects in the universe.** The gravitational force is present in everything from atoms to galaxies.

Vocabulary

1. *gravitational force*

The Strength of Gravity

Gravitational force is not the same everywhere on Earth or in the universe. The strength of the force depends on two things: the mass of the objects and the distance between them. For example, the gravitational force between two large objects only one foot apart is much greater than the force between two small objects 10,000 miles apart.

The table below shows how many meters per second (m/s^2) an object would fall to the center on each of these planets or stars in our solar system.

Acceleration Due to Gravitational Force

Planet/Star	Gravitational Acceleration (m/s_2)
Sun	274.13
Mercury	3.59
Venus	8.87
Earth's moon	1.62
Mars	3.77
Saturn	11.08
Uranus	10.67
Neptune	14.07
Pluto	0.42

An apple would fall to Earth at a rate of 9.8 meters per second.

An apple would fall to Jupiter at a rate of 25.95 meters per second.

Unit 2.8 Handout 1 – **Group C** (page 2 of 2)

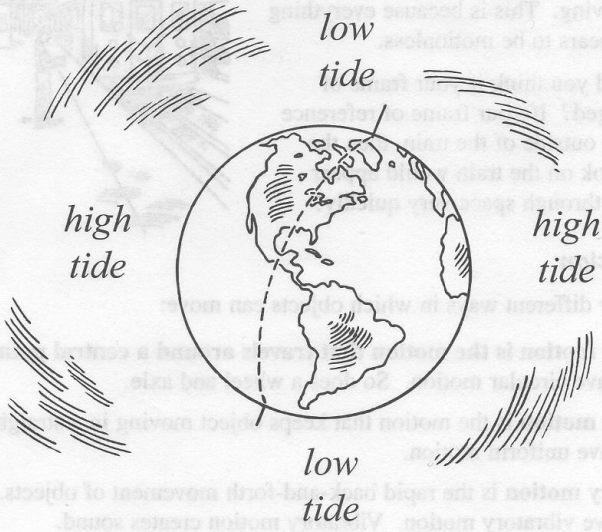
Force and Motion

Brief #3: Gravity *(cont.)*

Tides

The gravitational force on our planet has a huge impact on our oceans. If you have ever observed the ocean where it meets the shore at different times of day you may have noticed that the tides are not always the same. Tides are the rising and falling of the ocean level in the ocean due to gravitational forces between the Earth, sun, and moon.

As the Earth spins on its axis, one part of it faces the moon. Because this portion of the Earth is the closest, the gravitational force is the strongest. Water in the oceans on that moon-facing part of the Earth is drawn towards the moon. This creates a high tide. On the opposite side of the Earth, the water also rises as a high tide as a kind of counterbalance. The parts of the planet that are not experiencing high tide have a low tide.



Unit 2.8 Handout 1 – **Group D** (page 1 of 2)

Force and Motion

Brief #4: Motion

Focus

Motion depends on a frame of reference.

How did you get to school today? Did you get a ride in a car or bus? Perhaps you rode your bike or walked to school. No matter how you got here, at some point you were in motion.

Right at this moment you are probably sitting behind your desk. Are you moving? You may say "No," but the truth is that you are moving very quickly. Because the Earth is spinning on its axis and revolving around the sun, you actually never stop moving.

Vocabulary

1. circular motion
2. uniform motion
3. vibratory motion
4. speed
5. velocity
6. acceleration

Motion and Relativity

In order to describe any type of motion, you need to use a frame of reference. A frame of reference is an object that allows you to compare motion.

For example, let's say that you are sitting in a seat on a train and reading a book. If you use your seat and book as a frame of reference, you could say that, relative to your seat and book, you are not moving. This is because everything around you appears to be motionless.

But what would you think if your frame of reference changed? If your frame of reference was the ground outside of the train, then the seat and the book on the train would appear to be whizzing through space very quickly!

Types of Motion

There are many different ways in which objects can move:

- ✓ **Circular motion is the motion that travels around a central point.** Planets and moons have circular motion. So does a wheel and axle.
- ✓ **Uniform motion** is the motion that keeps object moving in a straight line. Trains and planes have uniform motion.
- ✓ **Vibratory motion** is the rapid back-and-forth movement of objects. The strings on a guitar have vibratory motion. Vibratory motion creates sound.

Unit 2.8 Handout 1 – **Group D** (page 2 of 2)

Force and Motion

Brief #4: Motion *(cont.)*

Describing Motion

Any kind of motion can be described by calculating its speed, velocity, and acceleration.

✓ **Speed**

Speed is a measure of how fast an object moves over a given amount of time. For example, if you travel 200 kilometers in 5 hours, it means that you have traveled at an average speed of 40 kilometers per hour.

The formula for calculating average speed is by dividing the distance traveled by the time you would need to move that distance:

$$\text{average speed} = \frac{\text{distance}}{\text{time}} = 200 \div 5 = 40 \text{ km/h}$$

Let's say that you can ride your bike 5 miles in 20 minutes. To calculate how many miles you could ride in one hour, use the same formula:

$$\text{Average speed} = \frac{\text{distance}}{\text{time}} = \frac{5 \text{ miles}}{20 \text{ minutes}} \times \frac{60 \text{ minutes}}{1 \text{ hour}} = 15 \text{ mph}$$

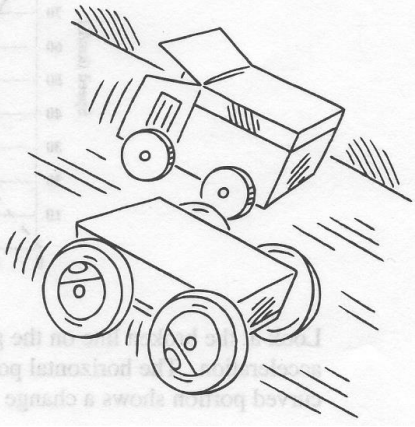
Instantaneous speed is the speed of any object at any moment. The speedometer on a car measures instantaneous speed.

✓ **Velocity**

Velocity is the measurement of the speed and the direction of an object. For example, you may ride your bike 20 mph west to get to the grocery store and then ride back home at 20 mph east.

✓ **Acceleration**

Acceleration is a measurement of how velocity changes over time. For example, as you ride your bike to the grocery store at a rate of 20 mph west, you may need to apply the brakes at some point during your trip or speed up at other points. These would be examples of acceleration.



Unit 2.8 Handout 1 – **All Groups** (page 1 of 2)

Force and Motion

Vocabulary

1. **acceleration**—a measurement of how velocity changes over time
2. **circular motion**—motion that travels around a central point
3. **force**—a push or a pull
4. **friction**—a force that is the result of objects pressing tightly against each other
5. **inertia**—the tendency of an object to resist a change in its motion
6. **momentum**—the motion of mass
7. **net forces**—all of the different forces acting on an object
8. **rolling friction**—the result of an object being rolled across a surface
9. **sliding friction**—the result of an object being slid across a surface
10. **speed**—the measure of how fast an object moves over a given amount of time
11. **static friction**—the result of an object that is at rest and just begins to move
12. **uniform motion**—motion that travels in a straight line
13. **velocity**—the measurement of the speed and direction of an object
14. **vibratory motion**—the rapid back-and-forth motion of objects

Unit 2.8 Handout 1 – **All Groups** (page 2 of 2)

Take notes during the group presentations to make sure you fully understand the material presented. Make sure you can define it (*What is _____?*) and understand how it is important in our daily lives.

Forces:

_____

_____

_____

_____

Friction:

_____

_____

_____

_____

Gravity:

_____

_____

_____

_____

Motion:

_____

_____

_____

_____

Unit 2.8 Handout 2 **Application of Friction, Gravity, and Speed & Velocity** (3 pages total)

Name _____ Date _____

Friction

Friction is a force that acts to slow down moving objects. If friction could be completely removed, then moving objects would continue to move. Friction is a force that opposes the movement of objects sliding over or past each other. Friction can be increased or decreased depending on what needs to be accomplished. Use the terms in the word box to complete the chart.

a canoe glides down a river	rubbing two sticks together starts a fire
grease a bicycle chain	grate cheese
butter a cake pan	pedal your bicycle
oil a door hinge	build a house of cards
lotion helps remove a tight gold ring	smooth wood with sandpaper
a dolphin glides through the water	walk across a wood floor in socks
press on a car's brakes	skate across the ice
swan dive into a pool	walk across the road
slide down a snowy hill	slide down a grassy hill
walk across a wood floor in shoes	rub your hands together to warm them

Friction Is Used	Friction Is Reduced

Name _____ Date _____

Effects of Gravity

In our daily lives, we use the effects of gravity or overcome the effects of gravity. Study the illustrations and tell how gravity is used to perform the activity. Also tell how gravity must be overcome.

1

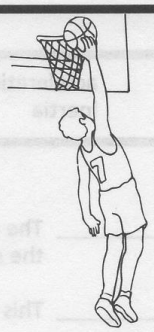
Use gravity: _____

_____

Overcome gravity: _____

_____

2



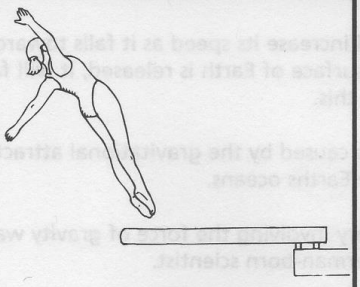
Use gravity: _____

_____

Overcome gravity: _____

_____

3



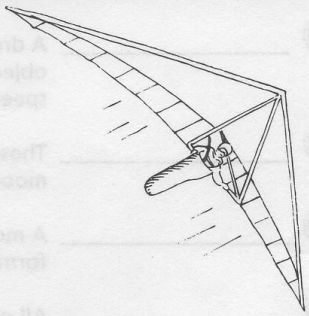
Use gravity: _____

_____

Overcome gravity: _____

_____

4



Use gravity: _____

_____

Overcome gravity: _____

_____

54 Forces and Motion

Name _____ Date _____

Determining Speed and Velocity

Speed is a measure of how fast an object is moving. **Velocity** is a measure of how fast an object is traveling in a certain direction. An object can travel at a constant speed that does not change. However, if the direction in which it is traveling does, then its velocity has changed. To find the velocity of an object, use this formula.

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

1. Find the velocity of a truck that travels 75 miles north in 2.5 hours.

_____ kilometers per hour

2. Find the speed of a bicyclist who took an hour and a half to travel 10 kilometers.

_____ kilometers per hour

3. Find the velocity of a plane that traveled 3,000 miles west in 5 hours.

_____ miles per hour

4. Find the velocity of a car that took 7.5 hours to travel 491.25 miles due south.

_____ miles per hour

5. Find the average speed of a train that traveled 543 kilometers in 6 hours.

_____ kilometers per hour

6. Find the velocity of a train that traveled 420 miles northeast to northwest between two cities in 3.5 hours.

_____ miles per hour

7. A plane flies due west for 4 1/2 hours. It travels a total of 5,400 kilometers. What was its velocity?

_____ kilometers per hour

8. A cork floats a distance of 8 3/4 miles downriver after a period of 3 hours 30 minutes. What was its average speed?

_____ miles per hour

Unit 2.8 Handout 2 TEACHER ANSWER KEY

Friction (page 1)

Friction Is Used	Friction Is Reduced
Rubbing two sticks together starts a fire	A door hinge is oiled
Build a house of cards	Lotion helps remove a tight gold ring
Press on a car's brakes	A dolphin glides through the water
Walk across the road	Grease a bicycle chain
Grate cheese	Skate across the ice
Smooth wood with sandpaper	Butter a cake pan
Walk across a wood floor in shoes	Walk across a wood floor in socks
Pedal your bicycle	Slide down a snowy hill
Rub your hands together to warm them	Swan dive into a pool
	A canoe glides down a river

Effects of Gravity (page 2)

1. Use gravity on the downward swing. Overcome gravity when he swings his body upward.

2. Use gravity to pull the ball down into the basket. Overcome gravity by aiming and pushing the shot to go into the basket.

3. Use gravity to pull her down toward the water. Overcome gravity by springing on a diving board.

4. Use gravity to pull the body toward Earth. Overcoming gravity by slowing descent with glider.

Determining Speed and Velocity (page 3)

1. 30 kilometer per hour

2. 6.67 kilometers per hour

3. 600 miles per hour

4. 65.5 miles per hour

5. 90.5 kilometers per hour

6. 120 miles per hour

7. 1200 kilometers per hour

8. 2.5 miles per hour

Unit 2.8 Handout 3 ANSWER KEY

1. a. N (narrow)
   b. B (broad)
   c. M (main)
2. a
3. d
4. b
5. b
6. a