Science Instructional Unit: Forces and Motion

Gina Laura Ciani

Lehigh University

TLT 426: Science in Elementary Education

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Dr. Alec Bodzin

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Forces and Motion

This unit focuses on a basic understanding of motion including distance and speed and different forces that can affect motion such as gravity and friction.

Grade Level of Target Learners

Grade 3

Unit Learning Goals

By the end of this unit, the third grader should be able to:

1. identify motion and forces affecting motion in the world around him or her.
2. recognize that all forces have an equal opposite force.
3. understand and identify the forces of gravity and friction.

Standards Addressed by the Unit:

Pennsylvania Content Standards

- **1.1 Learning to Read Independently.**
  - 1.1.3.E. Understand the meaning of and use correctly new vocabulary learned in various subject areas.
  - 1.1.3.F. Demonstrate understanding and interpretation of word/text.
- **1.2 Reading, Analyzing and Interpreting Text**
  - 1.2.3.A. Analyze text organization and content to derive meaning from text using criteria.
  - 1.2.3.E. Read, understand, and respond to essential content of text in all academic areas.
- **2.6 Statistics and Data Analysis:**
  - 2.6.3.A. Gather data from surveys and observations within the classroom or homes.
  - 2.6.5.C: Calculate mean and range, identify the median and the mode of a set of data, and use these quantities to describe the data. *(we will only focus on the mode as this is a Grade 5 standard)*
- **3.2.B Physical Science: Physics:**
  - 3.2.3.B1. Explain how movement can be described in many ways.
  - 3.2.4.B1. Explain how an object's change in motion can be observed and measured.
  - 3.2.6.B1. Explain how changes in motion require a force.
  - 3.2.3.A6. Science as Inquiry: Use data/evidence to construct explanations and understand that scientists develop explanations based on their evidence and compare them with their current scientific knowledge

- **PA ELPS Level 2 (Beginning)**
  - Reading: Locate and classify information associated with natural resources, technologies or tools within a small group. (applied as reading locating and classifying information associated with forces and motion within a small group or classroom group)
  - Speaking: Describe the parts of the body presented in a model or illustration working with a partner. *(applied as describing motion and forces using models and illustrations in a small group or with a partner)*
- **PA ELPS Level 3 (Expanding)**
  - Listening: Compare movement of real-life objects by following multiple step directions.
  - Writing: Describe and record objects made of different materials or textures from pictures or reality (such as: "The silk is shiny and smooth"). *(applied as using numbers and phrases to describe changes in motion and/or force)*

Unit Learning Objectives

- The student will be able to use the terms motion, position, speed and distance to describe a race when prompted to use these vocabulary words with 100% accuracy.
- The student will demonstrate a thorough understanding of motion and speed by being able to identify motion as a change a position, identify that distance and time are required to find an item's speed, and identify speed as a way to measure motion with 90% accuracy.
- The student will be able to complete a handout outlining the main topics from the day's reading (attached to Days 1, 3 and 5) individually or as part of a small group with 80% accuracy.
- The student will be able to observe and collect data about motions as demonstrated by recording the time it takes a toy car to travel down a ramp at three different slopes. The student will be able describe which slope resulted in the fastest and slowest speed based on their recorded data with 100% accuracy.
- The student will be able to describe the speed (using distance and time) of the car during a given trial in the format of feet per seconds (i.e. 6 feet per 12 seconds) with 100% accuracy.
- The student will be able to use the terms force, push and pull to describe what happens when you try to push over a wall and when you have a mini tug of war when prompted to use these vocabulary words with 100% accuracy.
- Given an image with at least 20 forces that can be identified, the student will be able to identify at least ten forces.
- Given a playground image, the student will be able to draw arrows to indicate forces when prompted with 90% accuracy.
- The student will be able to use the terms force, push and pull to describe what happens when a heavy box is moved when prompted to use these vocabulary words with 100%

accuracy.

- The student will be able to describe why they cannot jump off the ground to fly in terms of gravity with 100% accuracy.
- The student will be able to explain changes in motion due to forces during a sled pull with 100% accuracy.
- The students will be able to give at least two ways to reduce friction and two ways to increase friction with 100% accuracy when prompted.
- The student will be able to observe and collect data about friction as demonstrated by recording the winner of races on two surfaces (one control, one variable) for three trials of each surface condition. The student will be able to analyze this data as a group using the mode (descriptive statistic) to determine which surfaces have more or less friction with 100% accuracy.
- The student will be able to predict whether a car on a bumpy surface or a car on a smooth surface will win a ramp race based only on increased or decreased friction with 100% accuracy.
- The student will be able to describe the force that makes objects fall and the force that makes objects stop moving using the terms gravity and friction, respectively, with 100% accuracy.
- The student will be able to explain the results of equal and unequal forces in a tug of war with 100% accuracy.
- The student will be able to identify push and pull as forces, identify gravity as the force that holds one to the Earth and identify that weight is a measurement of how much gravity is pulling on an item with 90% accuracy.
- The student will be able to demonstrate a thorough understanding of how changes in the force of gravity on different planets are based on their size and that weights change as a result of this change in gravity. Students will demonstrate this by using weight data to order a series of planets and celestial bodies from largest to smallest as part of a class.

Assessment Modifications for Children with Special Needs/ English Language Learners

- All assessments (formative handouts and summative) will be read aloud to the class. The summative assessment will be read aloud one question at a time and students will be asked to not to go ahead so that they all have an equal opportunity to listen to and read each test item. On the formative assessments requiring reading, questions will be read aloud during the review of the handout.
- A modified summative assessment is included, which uses pictures and some color coding to help scaffold students' understanding of the questions. Written answers have an opportunity for picture usage as well.

Forces and Motion (Day 1): Introduction to Motion

1. Target Grade or Age Level: Grade 3

2. Pennsylvania Content Standards

- **1.1 Learning to Read Independently.**
  - 1.1.3.E. Understand the meaning of and use correctly new vocabulary learned in various subject areas.
  - 1.1.3.F. Demonstrate understanding and interpretation of word/text.
- **1.2 Reading, Analyzing and Interpreting Text**
  - 1.2.3.A. Analyze text organization and content to derive meaning from text using criteria.
  - 1.2.3.E. Read, understand, and respond to essential content of text in all academic areas.
- **3.2.B Physical Science: Physics:**
  - 3.2.3.B1. Explain how movement can be described in many ways.
  - 3.2.4.B1. Explain how an object's change in motion can be observed and measured.
- **PA ELPS Level 2 (Beginning)**
  - Reading: Locate and classify information associated with natural resources, technologies or tools within a small group. *(applied as reading and classifying information associated with motion within a small group or classroom group)*
  - Speaking: Describe the parts of the body presented in a model or illustration working with a partner. *(applied as describing motion using models and illustrations as part of a class discussion)*

3. Learning Objectives:

- The student will be able to use the terms motion, position, speed and distance to describe a race when prompted to use these vocabulary words with 100% accuracy.
- The student will demonstrate a thorough understanding of motion and speed by being able to identify motion as a change a position, identify that distance and time are required to find an item's speed, and identify speed as a way to measure motion with 90% accuracy.
- The student will be able to complete a handout outlining the main topics from the day's reading (see attached) as part of a small group with 80% accuracy.

4. Formative Assessments:

- After each section of the text, the teacher will engage students in question and answers about the text. The teacher should use this time to gauge students' understanding of key vocabulary words by having students demonstrate/model the terms for the class.

Additionally, questions that relate the material to prior knowledge should be used to make sure students understand the concepts discussed in the text outside the science-focused environment.

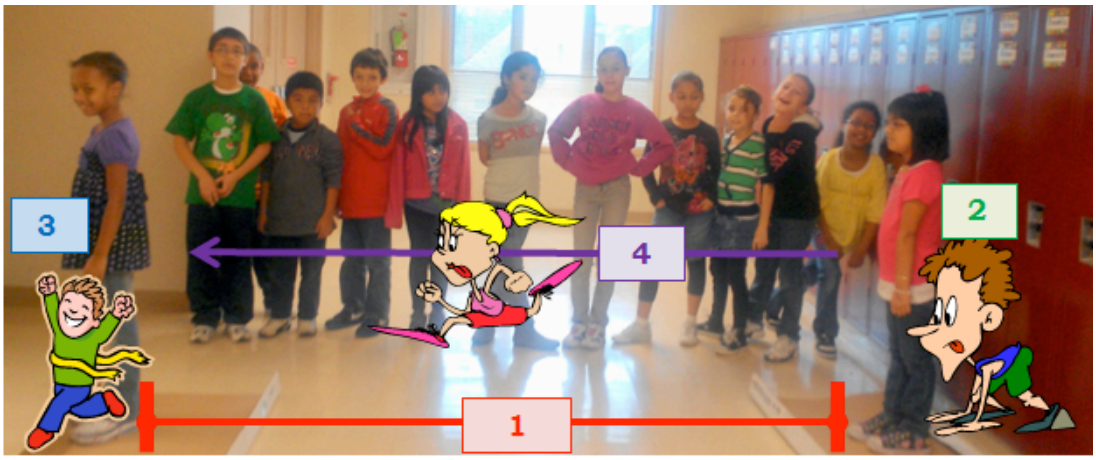
- After the reading, the students will complete the "Lesson Outline Handout" (attached) provided by the text. Students will sit in groups of four-six students and work together to find the best answers. Students will be allowed to use the text book in order to practice finding answers using text organization clues. While students are working on the handout, the teacher should circulate to assess how well the students understood the text by watching students answer questions and asking individual students other questions. The teacher should specifically ask students not contributing much to their groups' questions about the text. After sufficient time to complete the handout, the class will review the handout together. Here, the teacher can assess understanding of the whole class and review material that may not have been clear.
- Throughout the class, the teacher should ask students to either talk about or demonstrate different kinds of motion. Students should begin with simple examples such as waving a hand and may progress to more complex examples such as a car race or soccer game. Be sure to highlight that motion includes a change in position and that motion has speed. It is important to stress that speed requires both distance and time to measure it.
- At one point in the discussion, students should participate in a short race around the classroom. (Be sure to make the race as safe as possible by having a walking or silly step race and only including a few students at a time.) After the race students should discuss the starting and ending positions, the motion, the speed (and how it depends on distance and time) and differences in motion. All students should be able to independently describe the race before the end of the lesson.

5. Summative Assessments:

On the end of unit exam, students will be presented with the following questions. Each item will be read aloud to students to aid those with reading difficulties.

Directions: Look at the picture below. **Write** the vocabulary word from the **word bank** below next to the number that best described that part of the picture.

(3 points each; Note: image from classroom race should be used if possible.)



Word Bank

Starting Position	Ending Position
Distance	Motion

1. Distance
2. Starting Position
3. Ending Position
4. Motion

5. What **two** (2) things do you need to find something's **speed**? (4.5 points)
   a. motion and time
   b. position and motion
   c. time and distance
   d. position and distance

6. A **change** in **position** is called a: (4.5 points)
   a. Distance.
   b. Motion.
   c. Planet.
   d. Time.

7. What **measurement** can we use to describe a **motion**? (4.5 points)
   a. Speed
   b. Temperature
   c. Weight
   d. Price

6. Materials Needed:

One McGraw-Hill Grade 3 Science Textbook for each student
One Lesson Outline Handout for each student (attached)
Pencils for each student
One Stopwatch
One measuring tape

7. Expectations for Behavior and Class Activities:

1. When the teacher discusses the text, students will raise their hands and wait to be

called on before answering questions. If the class gets loud, the teacher will ring a bell or chimes in order to remind the class to stay quiet.

2. The teacher will explain the when someone is talking then others should be listening quietly. If necessary incorrect and correct models will be used at the start of class to remind students of these behaviors.
3. During the race, students are expected to race safely and to keep their hands and feet to themselves.
4. During group work on the handout, students are expected to equally contribute to the group and work out group conflicts maturely and quietly by talking within the group. Each group member should have a chance to give his or her opinion and the students should all be working towards finding the best answers.
5. Students are expected to study at home in addition to learning science material in school in order to receive an optimal grade on the end of unit assessment.

8. Description of Learning Activities:

Description of Introductory Activity (Anticipatory Set)

1. The teacher will begin by having students stand up and wiggle. Students will next be asked to stand completely still. The teacher will ask the students what is different about wiggling and standing still. After four or 5 student suggestions, the teacher will suggest that the students read the text to learn more about what could be different to scientists about wiggling and standing still.

Modeling/Demonstration (also elaborations/connections to content)

Included in Guided Practice and Feedback

Guided Practice and Feedback (also probing questions/student responses)

1. Students will read Unit E; Lesson 1 (with the exception of the What Do Maps Tell You section) of the McGraw-Hill Grade 3 Science textbook by the teacher selecting a student to read each paragraph aloud. After each section (denoted by headers), students will actively participate in class discussion led by the teacher. Each section discussion will include probing questions, modeling and connections as described below.

   Get Ready

   Take a class vote: Who thinks a lizard moves faster than a fish? Who thinks a fish moves faster than a lizard? Have at least one student from each voting side explain why.

   Question: How can we find the answer?
   Answer: Read the text to find out more.

   How Do You Know If Something Has Moved?

   Before reading: Ask students the header question. Get at least three student answers

and suggest that students keep reading to find the answer.

After reading:

Question: So, how do we know if something has moved?
Answer: There is a change in position

Question: What is something's position?
Answer: The location of an object.

Question: What are some words that we use to talk about position?
Answer: Above, below, left, right, ahead and behind.

Question: What is different between the pitcher in the before picture and the after picture?
Answer: His hand is behind his back. His left leg is up. He bent over.
Best Answer: His position.

Question: What is distance?
Answer: The length between two places.
Better Answer: The length between a starting position and an ending position.

Modeling Activity: Have all the students come up in front of the class (four-5 at a time) and have them make a starting position and freeze and an ending position and freeze again. Allow other students to describe the changes in their position using words like above, below, left, right, ahead and behind.

Demonstration: The teacher or a student volunteer should stand at one end of the classroom. Next, the demonstrator should run to the opposite end of the classroom. Ask students what you can measure to see how far the starting and ending positions are from each other. Answer = distance.

How Do You Measure Motion?

Before reading: Ask students to answer the heading question. After three-four suggestions, tell students that they must read the section to find the answer.

After reading:

Question: What do scientists call it when something has moved?
Answer: Motion

Question: What is speed?
Answer: How fast or slow something moves.

Question: What two things do we need to measure speed?
Answer: Distance and Time

Question: When might we use speed as a measurement? Whose speed is being measured in each situation?

Question: What are some things that move fast?

Question: What are some things that move slow?

Modeling Activity/Demonstration: Have two students come up in front of the class and prepare to skip across the classroom. Ask the class what you will need to measure their speed. (answer= distance and time). Ask the class how we can measure the time (clock) and show the students after a close response that you have a stop watch. Next, ask the students what we can use to measure the distance. (answer= ruler or measuring tape). After the appropriate answer, take out measuring tape and have two more student volunteers help measure the distance across the room. Have the skipping race and measure the time and distance. Write both on the board with the distance over the time. For example it might say, 30 feet on top and 10 seconds on the bottom. The teacher should read this to the class as 30 feet per 10 seconds. Since, third graders are not proficient in division; the teacher should always denote speed in this way.

2. When vocabulary words (bolded) are discovered in the text, add these words to the word wall. The word wall should remain posted until after the end of unit summative assessment. When each word is added to the wall, ask students for suggestions for a picture to draw next to the word. Not only does this picture add a visual reminder of the definition, but it also aids diverse learners in understanding the word wall item. If ELL students or students with learning disabilities are present in the class, it is best to choose these students for picture ideas. The pictures may be most meaningful to these students. For students with intellectual disabilities, photographs may be used on this word wall rather than hand-drawings.
3. After the reading and discussions, students should move to the hallway for a mini-race. Have students measure 10 feet of hallway and put a masking tape line at the start and end of the race. In groups of four-5 students, have students model the starting position and ending positions. Next, have students line up at the starting position, click the stopwatch on and have the race. To make the time longer, using a silly step or walk is suggested. Tell the students what the fastest speed for each race was using the 10 feet per XX seconds format. Repeat so that each student gets a chance to participate in the kinesthetic activity.

   For classrooms with students with physical disabilities, it is important to make this activity accessible. Use fewer students per group when a student with a wheelchair is participating and allow extra time for students using other motion assistance. For children with visual impairments allow a buddy race using arms around waists (similar to a three legged race). Students with hearing impairments may require a hand signal to start the race.

<u>Independent Practice/Exploring</u>

1. Separate students into groups of four-six students and distribute the handout (attached). Have students use their textbooks to find the appropriate answers to the handout. Be sure to equally mix diverse learners into groups with both academically strong students and those with learning disabilities incorporated in the same groups. Allow students to ask question and discuss the reading during this time as well. The

teacher should be circulating around the classroom to monitor students' comprehension of the material but also available for questions.

2. If students finish the handout early allow the groups to explore motions at their desks. Students may observe the changes in position between opened and closed text books, monitor how quickly pencils roll down their desks when opened to different angles or other exploratory investigations.
3. After enough time is allowed for all students to finish the handout and have some exploration of motion, bring the class back together. Go over the handout and write each answer on the board. This will allow students with learning disabilities or auditory disabilities to record correct answers. Remind students that this handout can be saved to study for the final test.

Discussion Questions

1. What are some kinds of motions you can think? What is the starting position and what is the ending position?
2. When do scientists need to measure motion with speed?
3. What do you think makes something go faster or slower?
4. What do you think is different about the lizard and the fish from the beginning of today's lesson?

Review and Preview

At the end of the lesson, the teacher should take out a car and car ramp from Lesson 2 of this unit. Show the students the items and ask where the starting position and ending position could be. Ask students what could be measured about the motion of the car (speed). Finally ask students something you can change about the situation to make an experiment (ramp height). Tell students that it is important to think about everything we learned today so that for the next lesson they can come back as motion scientists and conduct an experiment using the ramps.

General Accommodations for Diverse Learners

The teacher will make the following modifications for diverse learners:

1. Diverse learners will be seated in clusters with students performing at expected grade level. This will give a level of support for each student. The teacher must plan this seating arrangement with as little attention as possible in order to maintain a level of confidentiality for the special needs or ELL student.
2. A word wall will be present throughout the lesson and during the summative assessment. The word wall will include the following words from this lesson: position, motion, distance and speed. . Pictures will be drawn next to each written word to indicate word meaning. Pictures will be suggested by students and by students with special needs if possible (without drawing unnecessary attention). If students with intellectual disabilities are present, actual photographs of the concepts will be used instead of drawn pictures. This will help trigger knowledge of the activities to associate with the word.

3. The teacher will incorporate modeling whenever possible in the lesson to enhance the learning experience for students with limited language or auditory abilities. Images in the text will be drawn to students' attention whenever possible to reinforce knowledge in the same way.
4. A wait time of at least 5 seconds will be used after questions or prior to votes to ensure that all students have ample time to understand each question or topic.
5. Diverse learners will be expected to complete the objectives with equal accuracy to that of general education students. Any assistive technology used by diverse learners will be allowed for use during the lesson and assessment as it is normally used per the student's needs.

9. Sources:

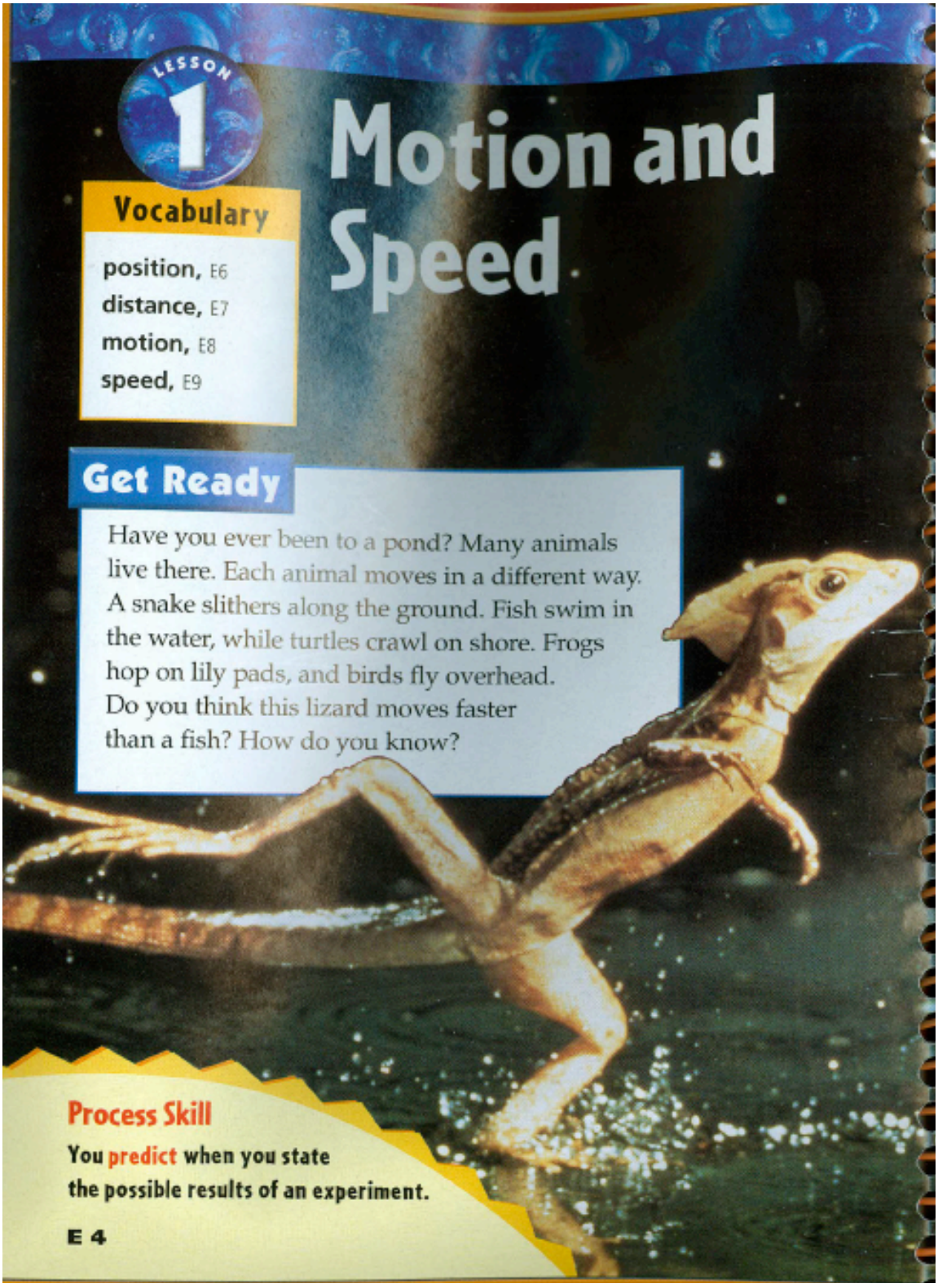
Moyer, R., Daniel, L., Hackett, J., Baptiste, H., Stryker, P., & Vasquez, J. (2002). *McGraw-Hill science: Macmillian/McGraw-Hill edition, teacher's edition*. New York, NY: Macmillian/McGraw-Hill.

10. Reflections:

After working through a draft version of this lesson in an with a class of mostly underprivileged students, I found that more examples that could relate to prior knowledge were necessary. The modeling was helpful, but students were too focused on the modeling and could not apply what they learned in the modeling activities to the science lessons. It's important to explicitly teach how the activities and modeling relate to the content of the lesson. For instance, students learned that a race was an example of motion and that speed could be measured with the distance in the race. Without having the students talk about other situations where speed might be used, the students don't easily make the connection that speed can be used elsewhere in science. For these reasons, I tried to incorporate discussion questions that helped broaden the learned knowledge to connect the lesson, the science and the world.

This is a well-designed lesson plan to begin the unit. The learning activity is appropriate to introduce student to the ideas related to motion, speed, and distance. Good sequence of learning activities; the demonstration is appropriate for the concepts. Assessment items align to the learning objectives. Nice reflective comments.

Text book pages:



Read to Learn

Main Idea You can find out about speed.

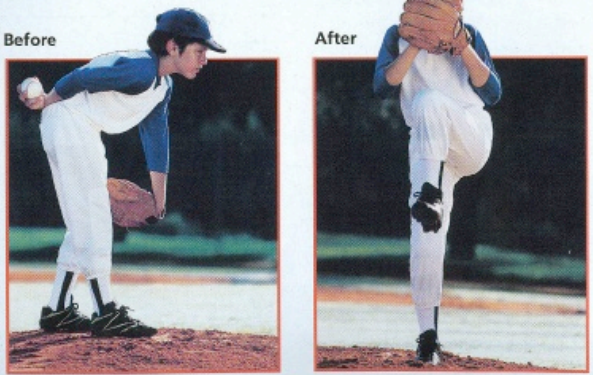
How Do You Know If Something Has Moved?

Look at the two pictures of the snail. What has happened? How do you know that the snail has moved?

You know that something has moved because you can see that it has changed **position** (puh·ZISH·uhn). Position is the location of an object. The snail started out at one end of the leaf. It stopped at the other end of the leaf. It changed position.

You can describe an object's position by comparing it with the positions of other objects. Words like *above* and *below*, *left* and *right*, *ahead* and *behind* give you clues about position.

Look at the pitcher's mitt in the pictures below. How has its position changed?



You can use a ruler to measure distance.

You can measure how far things move. **Distance** (DIS·tuhns) is the length between two places. When an object moves, it goes from a starting position to an ending position. Measuring the length between the starting and ending positions gives you distance. Knowing the distance tells you how far the object has moved.

READING Main Idea

What is distance?

Distance is the length between two places. Measuring distance tells you how far an object has moved.

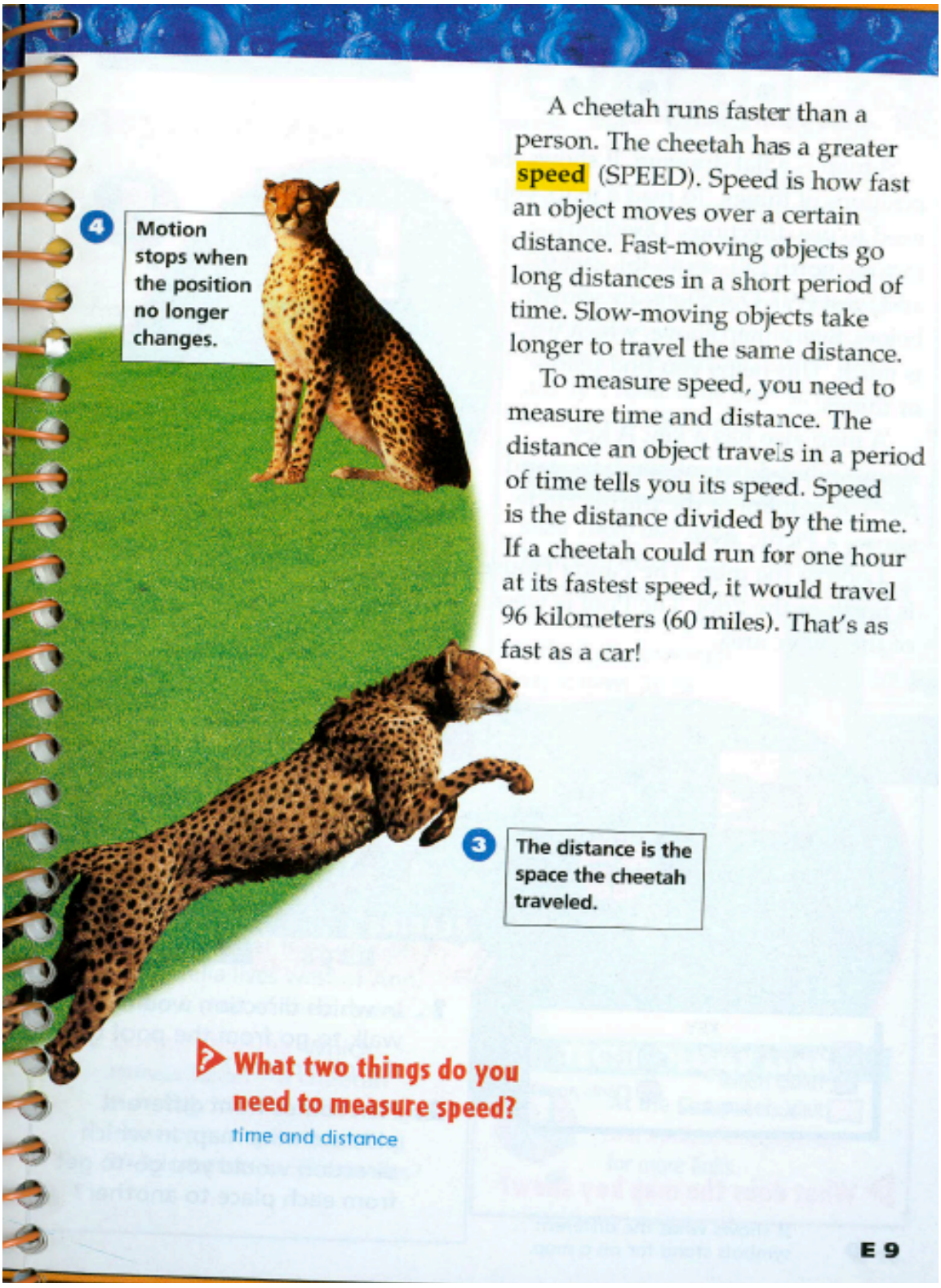
How Do You Measure Motion?

Look again at the snails on page E6. You know the snail moved because it changed position. While an object changes position, it is in **motion** (MOH·shuhn). Motion is a change in position.

Look at the cheetah in the diagram. As it runs the cheetah is in motion. It travels a distance from the start to the finish. It changes direction. Finally, its motion stops. Some motions, such as those of a moving snail, are very slow. Other motions, such as those of a cheetah, are fast. Some motions are very fast.

READING
Diagrams

1. How do you know motion has stopped?
2. How do you know that the cheetah moved?



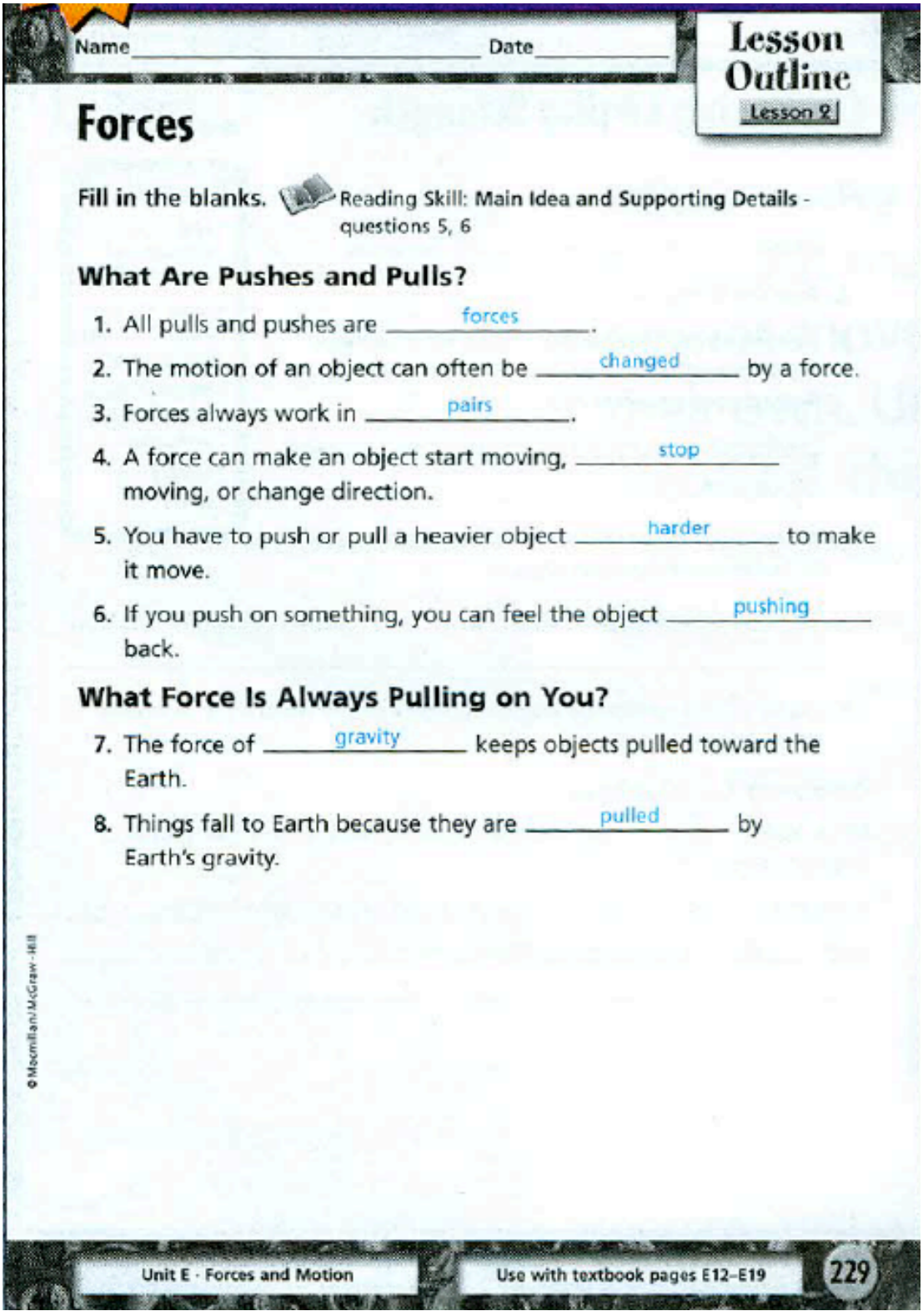
A cheetah runs faster than a person. The cheetah has a greater **speed** (SPEED). Speed is how fast an object moves over a certain distance. Fast-moving objects go long distances in a short period of time. Slow-moving objects take longer to travel the same distance.

To measure speed, you need to measure time and distance. The distance an object travels in a period of time tells you its speed. Speed is the distance divided by the time. If a cheetah could run for one hour at its fastest speed, it would travel 96 kilometers (60 miles). That's as fast as a car!

What two things do you need to measure speed?

time and distance

Lesson Outline Handout:



Name _____ Date _____

Lesson Outline
Lesson 9

Forces

Fill in the blanks. Reading Skill: Main Idea and Supporting Details - questions 5, 6

What Are Pushes and Pulls?

1. All pulls and pushes are forces.
2. The motion of an object can often be changed by a force.
3. Forces always work in pairs.
4. A force can make an object start moving, stop moving, or change direction.
5. You have to push or pull a heavier object harder to make it move.
6. If you push on something, you can feel the object pushing back.

What Force Is Always Pulling on You?

7. The force of gravity keeps objects pulled toward the Earth.
8. Things fall to Earth because they are pulled by Earth's gravity.

Forces and Motion (Day 2): What's the Car Motion?

1. Target Grade or Age Level: Grade 3

2. Pennsylvania Content Standards

- **1.1 Learning to Read Independently.**
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- **2.6 Statistics and Data Analysis:**
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- **PA ELPS Level 2 (Beginning)**
  - Speaking: Describe the parts of the body presented in a model or illustration working with a partner. *(applied as describing motion and forces using models and illustrations in a small group or with a partner)*
- **PA ELPS Level 3 (Expanding)**
  - Listening: Compare movement of real-life objects by following multiple step directions.
  - Writing: Describe and record objects made of different materials or textures from pictures or reality (such as: "The silk is shiny and smooth"). *(applied as using numbers and phrases to describe changes in motion and/or force)*

3. Learning Objectives:

- The student will be able to observe and collect data about motions as demonstrated by recording the time it takes a toy car to travel down a ramp at three different slopes. The student will be able describe which slope resulted in the fastest and slowest speed based on their recorded data with 100% accuracy.
- The student will be able to describe the speed (using distance and time) of the car during a given trial in the format of feet per seconds (i.e. 6 feet per 12 seconds) with 100% accuracy.

4. Formative Assessments:

- Students will need to understand the previous lesson's content to talk about the activity of

today's lesson in scientific terms. By using vocabulary such as motion, position, speed and distance to describe the experiment, the teacher can gauge students' understanding of the terms. If students do not understand the instructions for the activity when described in these terms, then the teacher must give extra attention and time to reviewing the terms and their meanings.

- Throughout the activity, the teacher should circulate among the groups and ask questions to check for students' understanding of motion and speed as well as understanding of the experiment. The teacher should also make sure to ask students to describe the speed of the car in feet per second (i.e. 6 feet per 12 seconds) and make sure that students are comprehending that speed requires distance and time.
- While participating in the experiment, each student should be completing the "What's the Car Motion?" worksheet (attached). After the lesson, the teacher should review the handouts for accurate data recording for both the individual group and whole class. Additionally, the teacher should check the answers to the questions about the motion's greatest speed and what caused the changes. These answers will help the teacher to know if the students made the appropriate assumption and indications from the experiment and collected data.
- Near the end of class, the teacher should engage students in a class discussion. Recorders from each group will write their data on the board and students should record all data and the means (as calculated by the teacher). A representative from each group should communicate each group's findings first and then the class as a whole should analyze the full data set. During this discussion the teacher must be sure to get answers of some sort from each student to make sure all the students understanding the topic.

5. Summative Assessments:

On the end of unit exam, students will be presented with the following questions. Each item will be read aloud to students to aid those with reading difficulties.

1. What **two** (2) things do you need to find something's **speed**? (4.5 points)
   a. Motion and Time
   b. Position and Motion
   c. Time and Distance
   d. Position and Distance

2. Sam released a toy car from the top of a **5 foot ramp**. The car took **22 second**s to get to the bottom of the **5 foot ramp**. What was the **speed** of the Sam's toy car? (4.5 points)
   a. 5 feet per 22 seconds
   b. 22 feet per 5 seconds
   c. 27 feet
   d. 225 seconds

3. If a toy car moved at a **speed of 4 feet per 10 seconds** on a **medium ramp** and at a speed of 9 feet per 10 seconds on a high ramp, which ramp has the **fastest speed**?

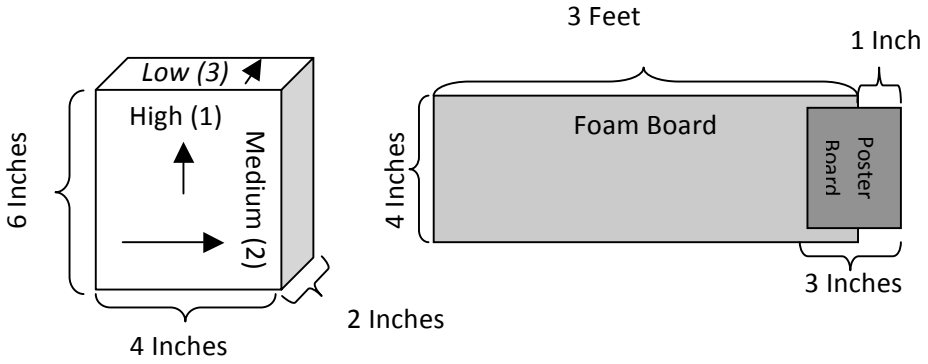
a. The ramps have the same speed
b. The medium ramp
c. The high ramp

6. Materials Needed:

One Experiment set for every four students
One "What's the Car Motion?" handout for each student
Chalk or dry erase board and writing materials as appropriate

Experiment Set:

One Toy Car
One 6"x4"x2" wooden block labeled as shown below
One 4"x3' strip of foam board with poster board strip as shown below
One 12" ruler
~ 4" of masking or painters tape
One stopwatch



7. Expectations for Behavior and Class Activities:

1. When the teacher or another student is talking, the class should be quite. If the class gets loud, the teacher will ring a bell or chimes in order to remind the class to stay quiet.
2. The teacher will explain the when someone is talking then others should be listening quietly. If necessary incorrect and correct models will be used at the start of class to remind students of these behaviors.
3. During the toy car activity, students should work together in teams without quarrelling and remembering to keep safety as a primary goal.
4. During the group activity, students are expected to equally contribute to the group and work out group conflicts maturely and quietly by talking within their groups. Students will choose numbers for jobs (car releaser/measurer, timer, recorder, communicator/ramp technician) and perform only those jobs.

8. Description of Learning Activities:

Description of Introductory Activity (Anticipatory Set)

1. The teacher will begin by reviewing key vocabulary (motion, position, distance, speed) from the previous day's lesson using the Word Wall.
2. Once students seem to recognize the words, the teacher should ask students about their experiences going down hills in cars. This should get the children to activate background knowledge and intrigue motivation. Ask the students how we can investigate motion of cars in the classroom. The teacher should suggest (if the students do not) that a model is used and present the Experiment Sets. The teacher should next ask the students what they might do to make an experiment using these items. The teacher should lead and prompt the students to suggest making a ramp at three different heights and timing the car as it travels down the ramp each time. The teacher should also prompt students to suggest three trials at each height. Once this information is provided by the students, the teacher can move on to modeling.

Modeling/Demonstration (also elaborations/connections to content)

1. The teacher should first show all the students how to set up the ramp. From here the teacher should get students to suggest that the same distance be used at all times (this will be the control factor). The teacher should model measuring the ramp and one foot from the base of the ramp; the one foot "finish line" should be marked with masking tape. Next, he or she should explain to the students that the car will always be traveling 4 feet total. The teacher should prompt students to say that the speed will be 4 feet per xx seconds.
2. After the distance is established, the teacher should draw a chart similar to the one on the worksheet on the board. The teacher should show students how to use the stopwatch and release the car and press the start button at the same time and then press the stop button when the car passes the "finish line." The numbers on the stopwatch (in seconds) should get recorded on the teacher's chart and this should be repeated twice. It is important to feign exasperation and difficulty doing all the tasks by the teacher's self. This will help students understand the roles set in their group and keep on task while doing the activity themselves.
3. Once this modeling is complete, the teacher should check for understanding. Have a few students come before the class and explain how to work the activity's various elements. This may be done using the different roles that will be assigned to the groups. It is important to specifically check for understanding from students with special needs or ELL students at this time. The modeling should be sufficient for all kinds of learners; however, the explanation portion of the modeling may be difficult for some students and slower or repeated demonstration might be necessary.

Guided Practice and Feedback (also probing questions/student responses)

1. Break students up into groups of four students each. An easy way to do this is to use the random colored number system (see attached). When using this system, the teacher will give a colored number to each student in the classroom. Next, the teacher will ask all students with the same of each color to get together (i.e. blue group, orange group, etc.). The numbers represent the students' roles in their groups.

Position One might be the car releaser/measurer; position two the timer; position three the recorder and position four the communicator/ramp technician. The job of the car releaser/measurer will be to release the car from the top of the ramp, retrieve the car after each trial and to measure the ramp and one foot from the base of the ramp. The job of the timer will be to time the car's motion from release to "finish line." The job of the record is to record the time each car's motion takes and to record these times on the board. The job of the communicator/ramp technician will be to communicate the group's findings to the class and to set up the ramp after each height change.

If there are students with special needs or differing abilities in the class, the job system may be a very easy way to accommodate these students. ELL students may take on the job of the car releaser/measurer or timer in order to be in a position that is mostly language independent. A student with a physical handicap might be best working as the recorder or timer as this requires little physical movement. Moreover, students with learning disabilities could be incorporated into groups with stronger learners to support and scaffold the student's abilities.

2. Once the students are in their groups with appropriate roles, have the students all complete the first low ramp trial together. The teacher should model the activity in the front of the room and explicitly name each role that should perform a task. The teacher should have the ramp technician prepare the ramp at the lowest height, the measurer measure and mark the "finish line," the car releaser release the car, the timer use the stopwatch and the recorder record the times. The teacher must make sure that students are clear on how to repeat this task two more times at this level and continue at the next levels. Once students seem to understand the activity, guidance is no longer necessary.

<u>Independent Practice/Exploring</u>

1. Have the grouped students complete the experiment with three trials at the high, three trials at the medium and three trials at the low ramp heights. When a group has completed these trials, they should all copy the times onto their own handouts, discuss their data in their groups to answer the two questions on the handout, and have the recorder write their data on the board.

2. When the data is on the board, allow students some independent time to "play" with the ramps. Invite students to make their own modifications and explore what will happen. It is important to allow all groups at least 5 minutes of this exploration time in order to solidify the students' understanding of the activity and its limits and extensions.

3. Once all groups have had at least 5 minutes of exploration time, have the students clean up the experiment kits and return to their desks. At this time, call on each group's communicator to tell the class about that group's findings. The communicator should talk about the same findings that the group previously discussed. Make sure each communicator tells the class which situation had the fastest and slowest times and recalls that fastest and slowest speeds in feet per seconds.

4. Once all the communicators have given their results, ask the students to make predictions about what the data from the combined class might reveal. Students will suggest a finding that is in line with the majority of the groups' findings. Once this is established, have students copy down the data from the remaining groups on their handouts. While students are doing this, use a calculator to find the mean (average) of each ramp situation. Write and circle this number on the board.

5. Once the students have finished copying the data from the board, discuss what a mean or average represents. Ask students what they think it might mean and when or where they have heard the term used. Once students understand the descriptive statistic, have students write down this number as well. From here, talk and discuss as a class what the cumulative results indicate. It is likely that the highest ramp will have the fastest speed and the lowest ramp will have the lowest speed.

Discussion Questions

1. What do the different groups' results indicate about the speed of the toy cars when the height of the ramp changes?
   The cars move faster down the high ramp and slower down the short ramp.

2. What does the class' results indicate about the speed of the toy cars when the height of the ramp changes?
   The cars move faster down the high ramp and slower down the short ramp.

3. Why are these results the same or different?
   The answers are the same because the data all has the same thing happening. OR

   The answers are different for some groups, but the groups that had the same answers most match the class answer because it happened for more times.

4. How can you tell me what the highest (and lowest) car speeds are using feet per seconds?
   4 feet per xx seconds

5. What makes the car move down the ramp?
   Gravity

6. Why would the car travel down the higher ramp faster than down the lower ramp?
   Because it gets pulled down by gravity more when it is higher up than it does when it is closer to the Earth.

7. If gravity makes the car move, then why does it go faster or slower? *see above*

Review and Preview

At the end of the lesson, the teacher should talk about gravity with students. The teacher should highlight that gravity helps make things move. Talk using science terms such as a change in position is motion and motion needs a force like gravity to happen. Tell the students that the more we know about forces, the more we can learn about the world around us. Ask a few students from different groups to come up and explain the class' findings from the day's experiment one more time for the whole class. Tell the students that tomorrow they will learn about gravity and two other forces and will have to become force detectives. The students will be excited to continue learning about forces and motion.

General Accommodations for Diverse Learners

The teacher will make the following modifications for diverse learners:

1. Diverse learners will be grouped with students performing at expected grade level. This will give a level of support for each student. The teacher must plan this grouping arrangement with as little attention as possible in order to maintain a level of confidentiality for the special needs or ELL student.
2. A word wall will be present throughout the lesson and during the summative assessment. The word wall will include the following words from this lesson: force, push, pull, gravity and weight . Pictures will be drawn next to each written word to indicate word meaning. Pictures will be suggested by students and by students with special needs if possible (without drawing unnecessary attention). If students with intellectual disabilities are present, actual photographs of the concepts will be used instead of drawn pictures. This will help trigger knowledge of the activities to associate with the word.
3. The teacher will incorporate modeling whenever possible in the lesson to enhance the learning experience for students with limited language or auditory abilities. Modeling and demonstrating will be repeated to the entire class or in a one-on-one environment as much as needed in order to communicate the experimental design and key vocabulary.
4. A wait time of at least 5 seconds will be used after questions to ensure that all students have ample time to understand each question or topic.
5. Diverse learners will be expected to complete the objectives with equal accuracy to that of general education students. Any assistive technology used by diverse learners will be allowed for use during the lesson and assessment as it is normally used per the student's needs.

9. Sources:

None.

10. Reflections:

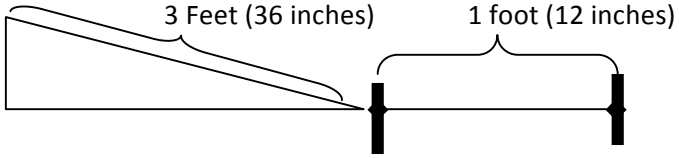
This experiment was performed with Grade 3 students during my classroom experience. I ran into some major group cooperation problems which led me to incorporate the colored numbering job assignment system. Also, I used a distance of three feet from the base of the ramp. This was too far and cars on the lowest ramp just stopped traveling after about two feet. This led to heavily skewed results and an adjustment to the activity. In performing this modified activity on my own, the cars always were able to travel the appropriate distance.

This is a good lesson plan that has students investigate a factor related to speed. The activity is engaging and involves students with collecting and analyzing data. Good sequence of learning activities. Handouts are appropriately designed for the activity. Assessment items are fine.

Name:_____ Group: _____

What's the Car Motion?

1. In your groups measure 1 foot from the end of the ramp to the "finish line" and place tape at each end



2. Start the stopwatch drop the car from the top of the ramp (starting position) and stop the timer when the car passes the finish line (ending position).

3. Record the time in the table below in seconds.

4. Repeat the experiment three times for each ramp height.

	Trial 1	**Trial 2**	**Trial 3**
High (1)	_____ seconds	_____ seconds	_____ seconds
Medium (2)	_____ seconds	_____ seconds	_____ seconds
Low (3)	_____ seconds	_____ seconds	_____ seconds

Class Results

	Red Group	Blue Group	Yellow Group	Green Group	Purple Group	Mean (Average)
High (1)	1: 2: 3:	1: 2: 3:	1: 2: 3:	1: 2: 3:	1: 2: 3:	
Medium (2)	1: 2: 3:	1: 2: 3:	1: 2: 3:	1: 2: 3:	1: 2: 3:	
Low (3)	1: 2: 3:	1: 2: 3:	1: 2: 3:	1: 2: 3:	1: 2: 3:	

When was the **motion** of the cars at the greatest **speed**?

What do *you* think made the cars go faster or slower?

Grouping Numbers

1	2	3	4
1	2	3	4
1	2	3	4
1	2	3	4
1	2	3	4
1	2	3	4

Forces and Motion (Day 3): Introduction to Forces

1. Target Grade or Age Level: Grade 3

2. Pennsylvania Content Standards:

- **1.1 Learning to Read Independently.**
  - 1.1.3.E. Understand the meaning of and use correctly new vocabulary learned in various subject areas.
  - 1.1.3.F. Demonstrate understanding and interpretation of word/text.
- **1.2 Reading, Analyzing and Interpreting Text**
  - 1.2.3.A. Analyze text organization and content to derive meaning from text using criteria.
  - 1.2.3.E. Read, understand, and respond to essential content of text in all academic areas.
- **3.2.B Physical Science: Physics:**
  - 3.2.4.B1. Explain how an object's change in motion can be observed and measured.
  - 3.2.6.B1. Explain how changes in motion require a force.
- **PA ELPS Level 2 (Beginning)**
  - Reading: Locate and classify information associated with natural resources, technologies or tools within a small group. *(applied as reading and classifying information associated with forces within a small group or classroom group)*
  - Speaking: Describe the parts of the body presented in a model or illustration working with a partner. *(applied as describing forces using models and illustrations as part of a class discussion)*
- **PA ELPS Level 3 (Expanding)**
  - Writing: Describe and record objects made of different materials or textures from pictures or reality (such as: "The silk is shiny and smooth"). *(applied as using numbers and phrases to describe changes in motion and/or force)*

3. Learning Objectives:

- The student will be able to use the terms force, push and pull to describe what happens when you try to push over a wall and when you have a mini tug of war when prompted to use these vocabulary words with 100% accuracy.
- The student will be able to complete a handout outlining the main topics from the day's reading (see attached) as part of a small group with 80% accuracy.
- Given an image with at least 20 forces that can be identified, the student will be able to identify at least ten forces.
- Given a playground image, the student will be able to draw arrows to indicate forces

when prompted with 90% accuracy.

- The student will be able to identify push and pull as forces, identify gravity as the force that holds one to the Earth and identify that weight is a measurement of how much gravity is pulling on an item with 90% accuracy.

4. Formative Assessments:

- After each section of the text, the teacher will engage students in question and answers about the text. The teacher should use this time to gauge students' understanding of key vocabulary words by having students demonstrate/model the terms for the class. Additionally, questions that relate the material to prior knowledge should be used to make sure students understand the concepts discussed in the text outside the science-focused environment.
- After the reading, the students will complete the "Lesson Outline Handout" (attached) provided by the text. Students will sit in pairs and work together to find the best answers. Students will be allowed to use the text book in order to practice finding answers using text organization clues. While students are working on the handout, the teacher should circulate to assess how well the students understood the text by watching students answer questions and asking individual students other questions. The teacher should specifically ask students not contributing much to their groups questions about the text. After sufficient time to complete the handout, the class will review the handout together. Here, the teacher can assess understanding of the whole class and review material that may not have been clear.
- Throughout the class, the teacher should ask students to either talk about or demonstrate different kinds of forces. Students should keep in mind that forces are pushes and pulls and use those words to describe the forces in daily activities.
- Near the end of class, the teacher will display the playground scene image for the class using either a projector or multiple copies of the image. Students will be instructed to write sentences about as many forces they see in the picture as possible. Remind students to use words like push, pull and gravity. The class should be able to get a minimum of ten forces in the image with a minimum of 20 forces (example attached). The prize for the class will be an outdoor or gym review (the idea is that the class will always win).

5. Summative Assessments:

On the end of unit exam, students will be presented with the following questions. Each item will be read aloud to students to aid those with reading difficulties.

Look at the picture below. Draw numbered arrows to show the forces describes in each item below. Number 1 is done for you.

1. The kid in the orange overalls is **pushing** on the swing.
2. Gravity is **pulling** the girl in pink down the slide. (up to 5 points)
3. The boy in the hat is **pulled** himself up the ladder. (up to 5 points)

5 points	4 points	3 points	2 points	1 point	0 points
Arrow points in exactly the correct direction and is appropriately labeled.	Arrow points in generally the correct direction and is appropriately labeled.	Arrow points in generally the correct direction and is not labeled or inappropriately labeled.	Arrow does not point in the correct direction, but is located in the correct area. Arrow is labeled correctly.	Arrow does not point in the correct direction but is located in the correct area. Arrow is not labeled correctly.	Arrow is in the wrong location or not drawn at all.

4. Which set of words are used to describe **forces**? (4.5 points)
   a. Weight and motion
   b. Push and pull
   c. time and distance
   d. black and white

5. What do you feel when you **push** something?
   a. You feel the object getting colder.
   b. You feel the object exploding.
   c. You feel the object pulling on you.
   d. You feel the object pushing back.

6. What do you call the **force** that holds you to the Earth?
   a. Gravity
   b. Newtons
   c. Weight
   d. Electricity

7. How to you **measure** how much **gravity** is pulling on you?
   a. Speed
   b. Weight
   c. Motion
   d. Distance

6. Materials Needed:

One McGraw-Hill Grade 3 Science Textbook for each student
One Lesson Outline Handout for each student (attached)
Pencils and lined paper for each student
One 3 foot rope
four halves of pipe insulation
One marble
Masking Tape
One projector with playground picture (attached) or copies of the picture for each student

7. Expectations for Behavior and Class Activities:

1. When the teacher discusses the text, students will raise their hands and wait to be called on before answering questions. If the class gets loud, the teacher will ring a bell or chimes in order to remind the class to stay quiet.
2. The teacher will explain the when someone is talking then others should be listening quietly. If necessary incorrect and correct models will be used at the start of class to remind students of these behaviors.
3. During the pulling activity, students are expected to race safely and to keep their hands and feet to themselves.
4. During pair work on the handout, students are expected to equally contribute to the group and work out group conflicts maturely and quietly by talking within their pairs. Each student in the pairs should have a chance to give his or her opinion and the students should both be working towards finding the best answers.

5. During the gravity coaster activity, students are expected to appropriately work together and clean up after themselves.
6. Students are expected to study at home in addition to learning science material in school in order to receive an optimal grade on the end of unit assessment.

8. Description of Learning Activities:

Description of Introductory Activity (Anticipatory Set)

1. The teacher will begin by reviewing the Car Motion activity from the previous lesson. The teacher should ask students what made the car change positions and why it traveled down the ramp. Once the teacher gets an answer related to forces or gravity, he or she should get excited and suggest that the students read the chapter with him or her to find out more.

Modeling/Demonstration (also elaborations/connections to content)

Included in Guided Practice and Feedback

Guided Practice and Feedback (also probing questions/student responses)

1. Students will read Unit E; Lesson 2 of the McGraw-Hill Grade 3 Science textbook by the teacher selecting a student to read each paragraph aloud. After each section (denoted by headers), students will actively participate in class discussion led by the teacher. Each section discussion will include probing questions, modeling and connections as described below.

   Get Ready

   Before reading: Ask students about the picture on the page. Ask what is going on (steer are helping a farmer pull a plow), why the farmer needs the steer (the plow is heavy), and what the steer add (more power or force).

   After reading: Have students name other times they might use a push or a pull. Get at least three answers for a push and three for a pull that all students in the class will be able to understand.

   What Are Pushes and Pulls

   Before reading: Ask students the header question. Students should answer that pushes are putting your weight on something to move it and pulls are leaning your weight away from something to move it.

   After reading:

   Question: When might you use a pull? A push?
   (Get at least three answers of each, different from earlier in class)

   Question: What are the two kinds of forces we learned about so far?
   Answer: Push and Pull

   Have students stand up. Tell students to pretend to push something and yell "push" and then pretend to pull something and yell "pull." Have students repeat this several

times. They should have fun, but if they don't seem to be enjoying the activity have the students repeat the kinesthetic reminders in different voices (high pitch, low pitch, loud, soft, etc.)

Question: What objects are more difficult to push or pull?
Answer: Heavier objects.

Question: Do you need more or less force to move a heavier object?
Answer: More

Question: Can we use a force to change the motion of an object?
Answer: Yes (also get an example, like kicking a moving soccer ball)

Question: Forces work in pairs. What does that mean?
Answer: It means whenever you push on something it pushes back on you and whenever you pull something it pulls on you.

Modeling Activity/Demonstration: Have about four students come up in front of the class and try to push over the classroom wall. Act surprised that the students cannot do it. Invite another four students to help them and act even more astonished that the wall is still up. Continue this until the entire class is trying to push down the wall. Be careful as some students might fall down during this activity. Finally, tell the students that you can see they can't do it, so they should all sit down. Ask the following questions?

1. What happened? (We tried to push down the wall but we couldn't.)
2. Why couldn't you get the wall down? (We are not strong enough. The wall is really heavy.)
3. Why did some of you fall down? (The wall was pushing back on us really hard.)
4. Walls can't push, can they? (The force we put on the wall had a pair that pushed on us.)
5. So when you pushed, the wall just pushed you back? (Yes!)

What Force Is Always Pulling on You?

Before reading: Ask students to answer the heading question. After three-four suggestions, tell students that they must read the section to find the answer.

After reading:

Question: So, what force is always pulling on us?
Answer: Gravity

Question: Why doesn't gravity pull us into the Earth?
Answer: The ground holds us up. The Earth pushes on us.

Modeling Activity/Demonstration: Ask the students to stand up. Tell the students they should try to fly. Students will jump and flap, but not be able to fly. After about 30 seconds tell the students to sit down and have a class discussion about what the

students felt when they tried to fly. Students should discover and explain that gravity was pulling them back down.

What Is Weight?

Before reading: Ask students to answer the heading question. Students should tell the teacher about how big they are and similar topics. Try to aim the students to think about weight in terms of force and continue reading for answers.

After reading:

Question: How can we tell what weight is when we talk about forces?
Answer: It's how much the force, gravity, is pulling on you.

Question: Is your weight always the same?
Answer: No, our weight will be different on different planets.

Question: What is a special measure of weight scientists might use?
Answer: Newtons

Question: From the picture on page E17, can you tell me how many Newtons are in two pounds?
Answer: Nine Newtons.

2. When vocabulary words (bolded) are discovered in the text, add these words to the word wall. The word wall should remain posted until after the end of unit summative assessment. When each word is added to the wall, ask students for suggestions for a picture to draw next to the word. Not only does this picture add a visual reminder of the definition, but it also aids diverse learners in understanding the word wall item. If ELL students or students with learning disabilities are present in the class, it is best to choose these students for picture ideas. The pictures may be most meaningful to these students. For students with intellectual disabilities, photographs may be used on this word wall rather than hand-drawings.
3. There are a lot of physical type activities in this lesson. For classrooms with students with physical disabilities, it is important to make these activity accessible. Allow extra time and space for students using motion assistance devices. Also focus on not singling out students with special needs as much as possible.

Independent Practice/Exploring

1. Have students separate into pairs at desks and distributed the lesson outline handout (attached). Have students use their textbooks to find the appropriate answers to the handout. Be sure to equally mix diverse learners into the pairs with both academically strong students and those with learning disabilities incorporated in the same pairs. Allow students to ask questions and discuss the reading during this time as well. The teacher should be circulating around the classroom to monitor students' comprehension of the material but also available for questions.

2. While students are working on the handout, call two pairs of students (four total) to the gravity coaster section at a time, students will have time to make a mini roller coaster by taping together the halves of pipe insulation and allowing a marble to roll down the coaster. Reminder students that they cannot push the marble and that only gravity can pull the marble down. Also reminder students to use the information from the previous lesson's Car Motion activity to make a functional roller coaster. Students should be allowed 5 minutes for this exploration before calling up the next group.

3. Pass the 3 foot rope around the classroom to pairs working together on the Lesson Outline handout. Each pair should be allowed about 2.5 minutes to explore with the rope. Tell students to try to mimic the tug of war in the images on page E24 in their text book while sitting. Observe how they are pulling and are being pulled on. Similarly try pulling equally and unequally on each side of the rope. What happens?

4. After enough time is allowed for all students to finish the handout and activities, have some discussion time. Go over the handout and write each answer on the board. This will allow students with learning disabilities or auditory disabilities to record correct answers. Remind students that this handout can be saved to study for the final test. After the handout has been discussed, the gravity coaster activity using the discussion questions below. In the same way, discuss the rope pulling activity with the questions below.

Discussion Questions

Gravity Coaster

1. How many of you made a roller coaster that worked without you pushing the marble at all?
2. How did the marble travel down the coaster? (gravity)
3. Did you need to make any changes to make your gravity coasters work? What changes?
4. Why did you need to make those changes? Why did they work or not work?

Rope Pulling Activity

1. When you pulled on each side of the rope what did you feel? (When I pulled on the rope I felt it pulling back on me.)
2. What happened if both sides pulled equally? (The rope didn't move.)
3. What happened if one side pulled a lot harder or softer than the other? (The rope moved.)
4. Were there forces in this activity? (Yes, pulling and opposite pulling)

General Questions

1. What three forces did we learn about today? (Push, Pull, Gravity)

2. Name three pushes.
3. Name three pulls.
4. Name three times you notice gravity.

Review and Preview

At the end of the lesson, the teacher should project or hand out copies of the attached playground scene or a similar photograph. Students should put their names on the top of a piece of lined paper. The teacher should tell students that they will have five minutes to write down as many forces as they can identify in the picture you are about to show them. Remind the students that they need to use the words push, pull and gravity to talk about the forces they see. Tell the students that if everyone can come up with at least ten forces that they will have fun outdoor or gym review activity before the test. Project the picture for five minutes and then have the class name some of the forces they saw. Write them on the board until you have ten and congratulate the students on their prize-winning behavior. Tell the students that tomorrow they will learn about one more force, so they can be force experts before the end of the unit.

General Accommodations for Diverse Learners

The teacher will make the following modifications for diverse learners:

1. Diverse learners will be seated in clusters with students performing at expected grade level. This will give a level of support for each student. The teacher must plan this seating arrangement with as little attention as possible in order to maintain a level of confidentiality for the special needs or ELL student.
2. A word wall will be present throughout the lesson and during the summative assessment. The word wall will include the following words from this lesson: force, push, pull, gravity and weight . Pictures will be drawn next to each written word to indicate word meaning. Pictures will be suggested by students and by students with special needs if possible (without drawing unnecessary attention). If students with intellectual disabilities are present, actual photographs of the concepts will be used instead of drawn pictures. This will help trigger knowledge of the activities to associate with the word.
3. The teacher will incorporate modeling whenever possible in the lesson to enhance the learning experience for students with limited language or auditory abilities. Images in the text will be drawn to students' attention whenever possible to reinforce knowledge in the same way.
4. A wait time of at least 5 seconds will be used after questions or prior to votes to ensure that all students have ample time to understand each question or topic.
5. Diverse learners will be expected to complete the objectives with equal accuracy to that of general education students. Any assistive technology used by diverse learners will be allowed for use during the lesson and assessment as it is normally used per the student's needs.

9. Sources:

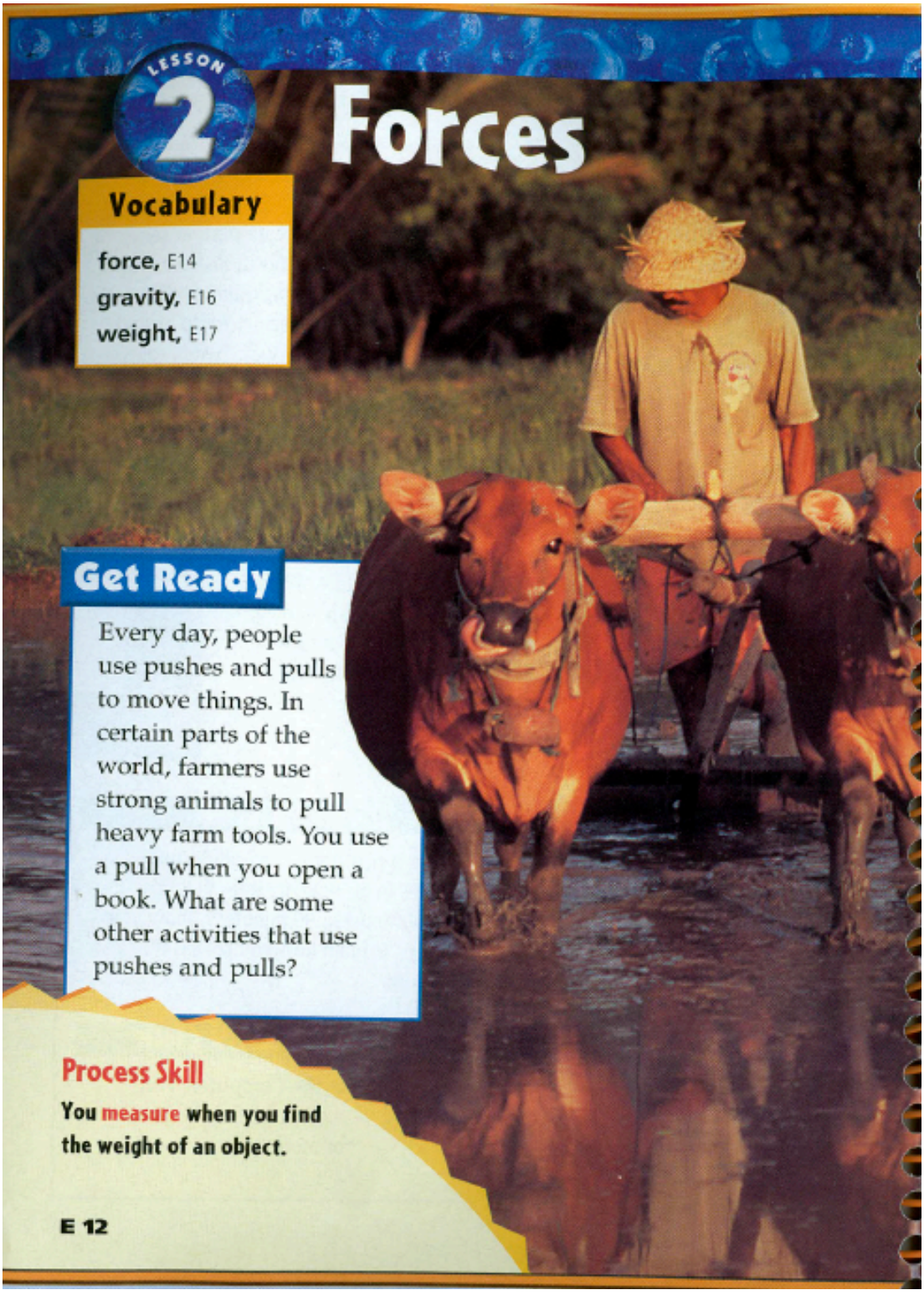
Moyer, R., Daniel, L., Hackett, J., Baptiste, H., Stryker, P., & Vasquez, J. (2002). *McGraw-Hill science: Macmillian/McGraw-Hill edition, teacher's edition*. New York, NY: Macmillian/McGraw-Hill.

10. Reflections:

After working through a draft version of this lesson, I realized that doing the handout and pulling activities in pairs is better than working in groups of four-six students. For the Gravity Coaster activity, four students was the magic number that kept the activity performable but under control. The Lesson Outline focuses much on finding information in the text for this lesson, which is great PSSA practice. Doing this in groups wasn't entirely effective because the students wound up working mostly in pairs anyway. I think this kind of information gathering lends itself to pairs easily, so it should have been intuitive for me to place children in the sets of two rather than larger. Students work well with one focusing on the question and the information needed to answer the question and the other on the information seeking task. This is similar to real-world science in that a Principle Investigator focuses on what needs to be answered and delegates the information seeking/research. Perhaps, this pair work is an optimal model for this kind of task.

This is a good lesson plan to get young children to think about different types of forces that they experience in their daily lives. The activity involves active learning and appropriate delivery of content. Good sequence of diverse learning activities. Assessment items align to the learning objectives. Nice reflective comments.

Text book pages:



Read to Learn

Main Idea You use forces to move things.

What Are Pushes and Pulls?

You push and pull on things every day to make them move. You push to open a door. You pull to put on your backpack.

All pushes and pulls are **forces** (FAWRS-uhz). Forces always work in pairs. When you push on something, such as a door, you can feel it pushing back.

Often a force can change an object's motion. It can make an object start moving, stop moving, or change direction. As you add force to a door, it moves. Sometimes an object doesn't move. No matter how hard you push, you can't push over a brick wall.

Heavier objects need more force to make them move. You have to push or pull a heavier object harder to make it move.

What do you feel when you push something?

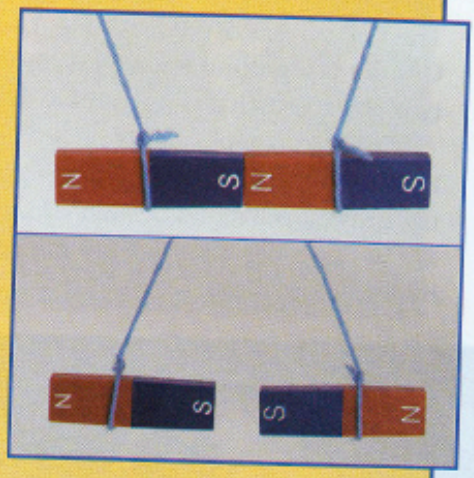
You feel the object pushing back.

1 *All pushes and pulls are forces.* Pushes move away from you. Pulls move toward you.

2 *Forces may change the motion of an object.* The heavier an object, the more force you need to move it.

Facts About Forces

3 *Forces work in pairs.* Whenever you push or pull on something, it pushes or pulls on you. The push or pull that you feel is a force in the opposite direction.



4 *Many things can create forces.* Some forces push or pull on objects without even touching them.

READING
Diagrams

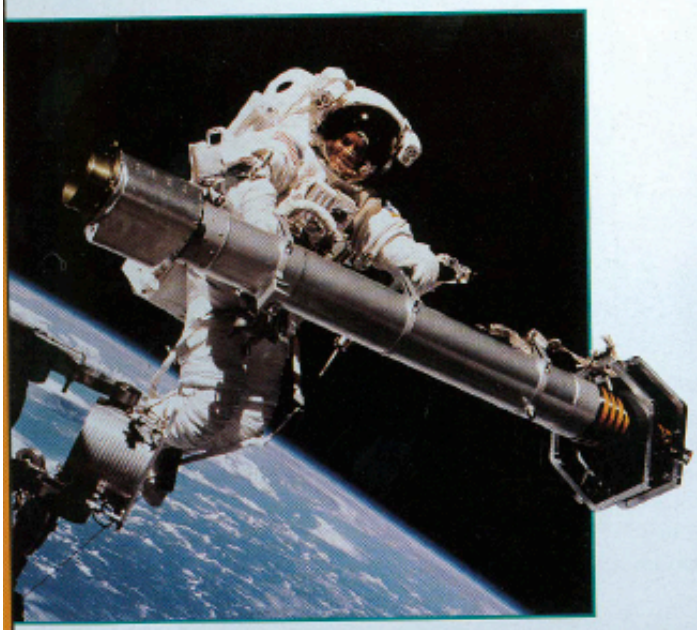
1. What is a force?
2. Do you need more or less force to move a heavier object?

E 15

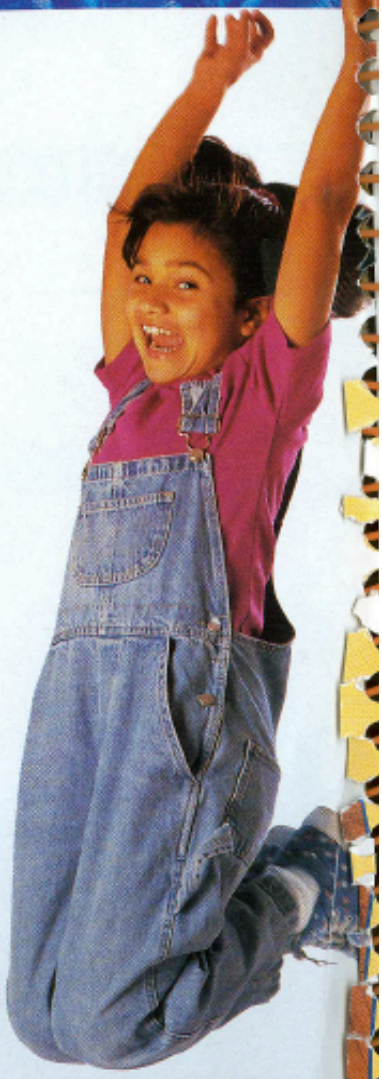
What Force Is Always Pulling on You?

One force is everywhere on Earth. It is even pulling on you right now. The force is **gravity** (GRAV·i·tee). Gravity is a pulling force between two objects, such as you and Earth.

This force keeps objects pulled toward Earth. Even when things go up, gravity pulls them down. Things fall to Earth because they are pulled by Earth's gravity.



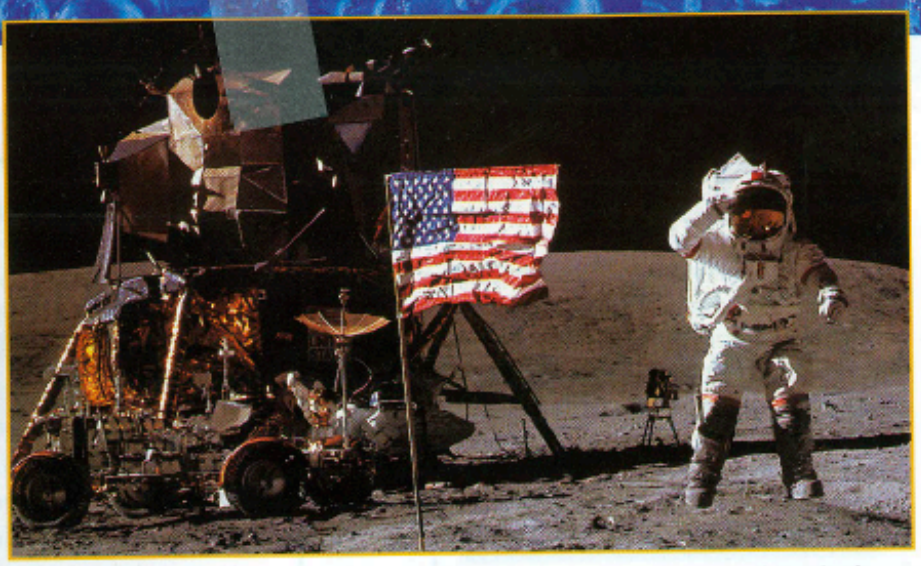
Performing tasks in space is quite an experience for this astronaut.



READING Main Idea

When you jump up, why do you come down?

Gravity pulls you down.



The pull of gravity is less on the Moon than on Earth.

What Is Weight?

The pull of gravity is just about the same all over Earth. **Weight** (WAYT) is how much pull gravity has on an object.

That means an object's weight will be about the same anywhere on Earth. On other planets and the Moon, the pull of gravity is different. This is why objects have different weights away from Earth.

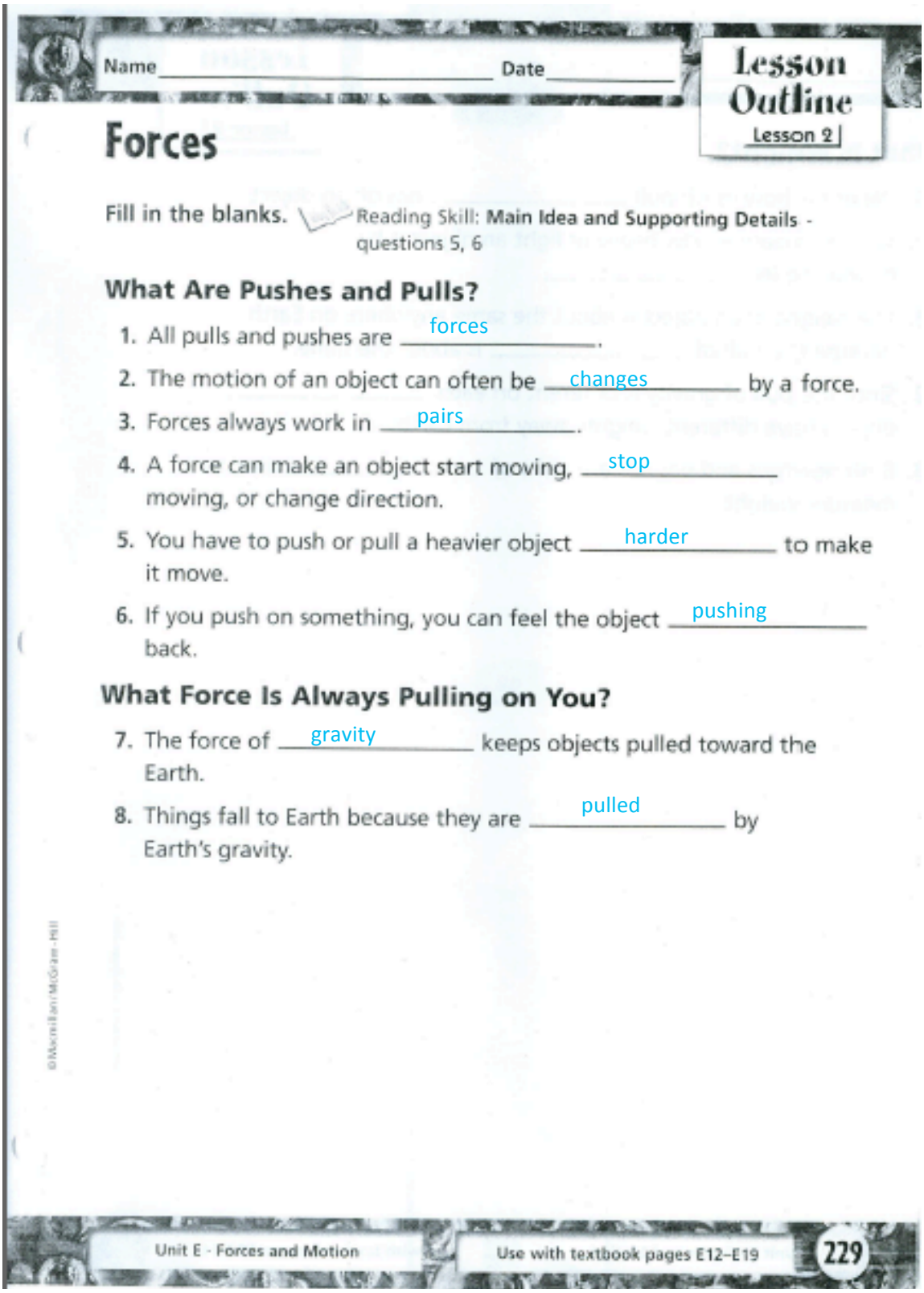
You can find out how heavy or light things are by measuring their weight. Some objects are heavy. Some are light. Scientists measure weight in *newtons*. A newton is the unit of force in the metric system. In the English system of measurement, the unit is the *pound*.

These apples weigh nine newtons, or two pounds.

Would you weigh the same amount on the Moon?

No, you would not weigh the same amount on the Moon because the pull of gravity is different.

Lesson Outline Handout:



Name _____ Date _____

Lesson Outline
Lesson 2

Forces

Fill in the blanks. Reading Skill: **Main Idea and Supporting Details** - questions 5, 6

What Are Pushes and Pulls?

1. All pulls and pushes are forces.
2. The motion of an object can often be changes by a force.
3. Forces always work in pairs.
4. A force can make an object start moving, stop moving, or change direction.
5. You have to push or pull a heavier object harder to make it move.
6. If you push on something, you can feel the object pushing back.

What Force Is Always Pulling on You?

7. The force of gravity keeps objects pulled toward the Earth.
8. Things fall to Earth because they are pulled by Earth's gravity.

Name _____ Date _____

Lesson Outline
Lesson 2

What Is Weight?

9. Weight is how much pull ___gravity___ has on an object.
10. You can measure how heavy or light an object is by measuring its ___weight___.
11. The weight of an object is about the same anywhere on Earth because the pull of ___gravity___ is about the same.
12. Since the pull of gravity is different on each ___planet___, objects have different weights away from Earth.

Name the Forces Game

1. The man on left is pushing on the ground to kneel.
2. Gravity is pulling on the kneeling man to pull him to the Earth.
3. Gravity is pulling the girl down the slide.
4. The girl is pushing on the slide with her foot to slow down.
5. The boy in the blue and white striped shirt is pushing on the swing to move it.
6. Gravity is pulling the boy in the swing back to the Earth.
7. The two kids on the double swing are pushing the swing to make it move.
8. Gravity is pulling on the double swing to keep it from floating away.
9. The boy climbing is pushing on the foot holds to get up.
10. Gravity is trying to hold the climbing boy down.
11. The boy on the green slide is being pulled down the slide by gravity.
12. Gravity is holding the other kids to the earth (can be up to 4 forces for girl in pink striped, boy in house, sitting boy in the red and white strips and the digging girl in pink.)
16. The girl in pink is pushing into the sand to dig in it.
17. The sand is pushing back on the shovel to make it hard to go in.
18. Gravity is holding the trees and grass to the Earth.
19. The woman is pushing her hands together to clap.
20. The woman's hands are pushing away from each other after she claps.
21. The climbing boy is pulling himself into the house with his arms.
22. The boy in the house is pulling himself up on the ledge of the house to see.

Forces and Motion (Day 4): My Weight Around the Worlds

1. Target Grade or Age Level: Grade 3

2. Pennsylvania Content Standards:

- **1.1 Learning to Read Independently.**
  - 1.1.3.E. Understand the meaning of and use correctly new vocabulary learned in various subject areas.
- **3.2.B Physical Science: Physics:**
  - 3.2.3.A6. Science as Inquiry: Use data/evidence to construct explanations and understand that scientists develop explanations based on their evidence and compare them with their current scientific knowledge
- **PA ELPS Level 2 (Beginning)**
  - Speaking: Describe the parts of the body presented in a model or illustration working with a partner. *(applied as describing forces and size as part of a class discussion)*
- **PA ELPS Level 3 (Expanding)**
  - Writing: Describe and record objects made of different materials or textures from pictures or reality (such as: "The silk is shiny and smooth"). *(applied as using numbers and phrases to describe forces and weights on various planets.)*

3. Learning Objectives:

- The student will be able to demonstrate a thorough understanding of how changes in the force of gravity on different planets are based on their size and that weights change as a result of this change in gravity. Students will demonstrate this by using weight data to order a series of planets and celestial bodies from largest to smallest as part of a class discussion with 90% accuracy.

4. Formative Assessments:

- While students are working on the "My Weight Around the Worlds" project, the teacher should circulate and ask questions about the students' weights on other planets. The teacher should ask why these differences are happening to check for understanding and appropriate implications from the data.
- After handouts are completed, the teacher should check that the handouts are answered accuracy to assess students understanding of the material.
- During the "Traveler Conference" attention should be paid to get feedback from all students in order to make sure the concepts were understood by every student.

5. Summative Assessments:

On the end of unit exam, students will be presented with the following question. Each

item will be read aloud to students to aid those with reading difficulties.

1. When **gravity** is **<u>increased</u>** (like on a large planet), your **weight** will be: (4.5 points)
   a. Decreased.
   b. The same.
   c. Reversed.
   d. Increased.

6. Materials Needed:

One set of the two worksheets for "My Weight Around the Worlds" for each student
Computers with internet connection
One scale
Chalk or dry erase board and appropriate writing utensil

7. Expectations for Behavior and Class Activities:

1. When the teacher or another student is talking, the class should be quite. If the class gets loud, the teacher will ring a bell or chimes in order to remind the class to stay quiet.
2. The teacher will explain the when someone is talking then others should be listening quietly. If necessary incorrect and correct models will be used at the start of class to remind students of these behaviors.
3. During the Web-Facilitated Activity, students are expected to only go to the website instructed and work safely and carefully on the computers. Students should work independently while using the computers and may work in groups when they return to their clustered desks.

8. Description of Learning Activities:

<u>Description of Introductory Activity (Anticipatory Set)</u>

1. The teacher will begin by welcoming the students a "Space Travelers" to the meeting hall of the Milky Way Galaxy (our galaxy). The teacher should read the selection on the scroll of the first handout to the students and pass out this first handout. The teacher should ask students for suggestions on ways they might help the Earthlings. Once students have given ideas (at least three-4), the teacher should continue by having a student read the Oh No! paragraph below the first section. From here, students will know that they can help the Earthlings by using their weights.

<u>Modeling/Demonstration (also elaborations/connections to content)</u>

1. At this point it is important for the teacher to show students how to get to the webpage on the computers (if all students cannot work at computers at once, you may want to have the website already open for the students). Many students do not have as much Internet exposure at home as would be expected so it is important to use explicit modeling at this time.
2. The teacher should show students how to click in the box to type in their weight and

tell students that one at a time they may use the scale in the front of the classroom if they do not already know their weight. Next, the teacher should show students how to click on the "Calculate Button" and scroll down to see their weights.

Guided Practice and Feedback (also probing questions/student responses)

1. Once the procedures are reviewed and modeled, the students will be ready to use the website to find their own weights. Handout the second worksheet in the "My Weight Around the Worlds" project and have students go to work on their computers finding and recording their weights on the different planets.
2. Due to the need for computer skills some students with fine motor impairments may have trouble with this task. In these conditions, have students (all students) pair up and work together to collect data. This process may also be needed in classrooms where students with visual impairments are present. Always allow assistive technology to be used as is stated in students' IEPs. Also, allow extra time and space for students using motion assistance devices. Remember to focus on not singling out students with special needs as much as possible.

Independent Practice/Exploring

1. When students are finished with the computer portion of the activity, they should return to their desks and talk to their neighbors as needed. At this time, students should complete the questions on the "My Weights Around the Worlds" worksheet. Student will need to make their own inferences about the meaning of their data in order to correctly answer the questions. They may need to talk to neighbors to answer some of the questions and to digest some of the material into something more comprehensible. Allow talking that is quiet during this time. The teacher should be circulating to monitor students' progress as they process and analyze the data. Scaffolding may be required for some students (perhaps those with learning disabilities or trouble making inferences).
2. The handout suggests that students who finish early spend some time independently reading. This time is also good to make sure the students finishing earlier fully comprehended the data. Be sure to ask these students the more developed questions and check for full understanding.

Discussion Questions

During this time, hold the "Traveler's Conference." Use the questions from the Traveler's Conference: Teacher's Guide . These questions are provided below.

1. Where did you weigh the most? (After this question take a class vote to see how many other students weighed the most on this planet. It is likely that all students will raise their hands.)
2. Where did you weigh the least? (After this question take a class vote to see how many other students weighed the least on this planet. It is likely that all students will raise their hands.)
3. Why do we have so many students with the same answers?

4. If a planet is big, did we weight more or less on that planet?
5. What is the relationship between weight and planet size?
6. What does this have to do with gravity?
7. Can you help me make a list of the smallest to largest planets and celestial bodies so we can send that information to the Earthlings?

Review and Preview

After the Traveler's Conference, have students suggest how to send this information to the Earthlings. If you would like to incorporate writing into the class, have students write a letter to communicate their findings to the Earthlings. Remind students that they are now experts on pushing, pulling and gravity and that they still have one more important force to learn about that will be discussed during the next lesson. Tell students the next force is called friction and have students guess what that might be. This will end the lesson on a question and get the students ready to learn more.

General Accommodations for Diverse Learners

The teacher will make the following modifications for diverse learners:

1. Diverse learners will be seated in clusters with students performing at expected grade level. This will give a level of support for each student. The teacher must plan this seating arrangement with as little attention as possible in order to maintain a level of confidentiality for the special needs or ELL student.
2. The teacher will incorporate modeling whenever possible in the lesson to enhance the learning experience for students with limited language or auditory abilities. Images in the text will be drawn to students' attention whenever possible to reinforce knowledge in the same way.
3. A wait time of at least 5 seconds will be used after questions or prior to votes to ensure that all students have ample time to understand each question or topic.
4. Diverse learners will be expected to complete the objectives with equal accuracy to that of general education students. Any assistive technology used by diverse learners will be allowed for use during the lesson and assessment as it is normally used per the student's needs.

9. Sources:

Hipschman, R. (2011). Your weight on other worlds | Exploratorium. Retreieved from: http://www.exploratorium.edu/ronh/weight/.

10. Reflections:

Originally, I planned this activity to be incorporated as an element during the Day 3 lesson. After submitting my web-facilitated activity project for class, I realized this was a lesson on its own. For that reason, I built this as an individual lesson in the Forces and Motion unit.

This is a well-designed lesson plan to get learners to apply concepts in this unit to planetary bodies. The learning activity takes advantage of a Web-facilitated activity and involves students with important science process skills. Good sequence of learning activities. Assessment items align to the learning objectives.

Greetings, Space Traveler!

Welcome to the Milky Way Galaxy. Due to the recent incident, we have lost data indicating the sizes of planets and other bodies in our solar system. We thank you for your help in regaining this information. Using your vast knowledge about forces, please visit the planets and bodies listed in your **Travel Log** and **record your weight** on each. We are relying on you and your friends for our success.

Thank you,

The Earthlings

Oh No! We need to help!

The Earthlings have lost their information about which planets and other celestial bodies *(items in outer space that are large, but not planets such as moons and stars)* are bigger and smaller than each other. The Earthlings need to stay on their planet to fix some other things since the incident, so they have asked for your help. Since the planets are too big to measure with rulers and two heavy to move near each other to compare, we need to find another way to learn about the planets' sizes. Luckily, we have e-scales on each planet to weigh ourselves with. Visit the website in the directions that follow to access the e-scales. Use your weight and the information you have learned about **forces** and **gravity** to determine which planets are bigger and smaller. You can **record your weights** and answer some guiding questions on your Travel Log and then we will come together with the other travelers for a Traveler Conference. During the Traveler Conference, we will

discuss our findings and order the planets and celestial bodies from smallest to largest. Then we can send our results to the Earthlings and save the day!

Directions

1. Go to http://www.exploratorium.edu/ronh/weight/
2. Type your weight in the "Enter Your Weight Here Box."
   Note: If you don't know your weight you may use the class scale near the computers. Only one person may use the scale at a time.

3. Press the "Calculate" button.
4. Scroll down to see your weights on the various planets and celestial bodies.
5. Record your weight in the chart on your Travel Log.
6. Answer the questions on the opposite side of the Travel Log to prepare you for the Traveler Conference.
7. When you are finished answering the question, you may read to yourself until it is time for the Traveler Conference to begin.

Traveler's Conference Notes:

_____

_____

_____

_____

_____

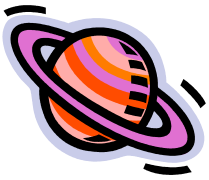
_____

_____

_____

Biggest:_____ Smallest:_____

My Weight Around the Worlds
Travel Log



TRAVELER NAME: _____

1. Go to http://www.exploratorium.edu/ronh/weight/
2. Type your weight in the "Enter Your Weight Here Box."

3. Press the "Calculate" button.
4. Scroll down to see your weights on the worlds below.
5. Record your weight in the chart below.

World		My Weight
Earth		
Venus		
Mercury		
The Moon		
Mars		
Jupiter		
Saturn		
Uranus		
Neptune		
Pluto		
Moons of Jupiter	Io	
	Europa	
	Ganymede	
	Callisto	
The Sun		
A White Dwarf		

A Neutron Star	

Answer the questions below.

Where do you weigh the **most**? _____

Where do you weigh the **least**? _____

Do your classmates weight the most and least on the **same** worlds or **different** worlds? _____

Why do you think you weight is more or less on different worlds? Does **gravity** or the **size** of the planet have anything to do with this?

_____

_____

_____

_____

Think about your weights on different world. How can you tell which planets are bigger or smaller using this information? Can forces predict planet size?

_____

_____

_____

_____

Answer Key

Where do you weigh the **most**? A Neutron Star

Where do you weigh the **least**? Pluto

Do your classmates weight the most and least on the **same** worlds or **different** worlds? Yes on the same worlds

Why do you think you weight is more or less on different worlds? Does **gravity** or the **size** of the planet have anything to do with this?

Gravity is stronger on bigger planets and weaker on smaller planets. Your weight is how much the force of gravity pulls on you. When gravity is strong you weigh more than when gravity is weak.

Think about your weights on different world. How can you tell which planets are bigger or smaller using this information? Can forces predict planet size?

If I weigh more on a planet it is bigger and if I weigh less on a planet it is smaller. I can use weight to predict planet size by comparing my weights on different worlds to tell which are bigger and smaller. Weight can predict planet size.

TRAVELER'S CONFERENCE: TEACHER'S GUIDE

The Traveler's Conference is a student-led examination of the collected data. As the teacher, it is your job to facilitate the class discussion. Use the guiding questions below to encourage the students to discuss their data with the class. Near the end of the conference, have the students order the worlds from smallest to largest while you write them on the board. If you would like to incorporate writing instruction, have students write letters to the Earthlings after the conference to communicate their findings.

Facilitating Questions:

1. Where did you weigh the most? (After this question take a class vote to see how many other students weighed the most on this planet. It is likely that all students will raise their hands.)
2. Where did you weigh the least? (After this question take a class vote to see how many other students weighed the least on this planet. It is likely that all students will raise their hands.)
3. Why do we have so many students with the same answers?
4. If a planet is big, did we weight more or less on that planet?
5. What is the relationship between weight and planet size?
6. What does this have to do with gravity?
7. Can you help me make a list of the smallest to largest planets and celestial bodies so we can send that information to the Earthlings?

1. Pluto	7. Mars	13. Neptune
2. Callisto	8. Mercury	14. Jupiter
3. Europa	9. Uranus	15. The Sun
4. Ganymede	10. Venus	16. A White Dwarf
5. The Moon	11. Earth	17. A Neutron Star
6. Io	12. Saturn	

Forces and Motion (Day 5): Introduction to Changes in Motion and Friction

1. Target Grade or Age Level: Grade 3

2. Pennsylvania Content Standards:

- **1.1 Learning to Read Independently.**
  - 1.1.3.E. Understand the meaning of and use correctly new vocabulary learned in various subject areas.
  - 1.1.3.F. Demonstrate understanding and interpretation of word/text.
- **1.2 Reading, Analyzing and Interpreting Text**
  - 1.2.3.A. Analyze text organization and content to derive meaning from text using criteria.
  - 1.2.3.E. Read, understand, and respond to essential content of text in all academic areas.
- **3.2.B Physical Science: Physics:**
  - 3.2.6.B1. Explain how changes in motion require a force.
- **PA ELPS Level 2 (Beginning)**
  - Reading: Locate and classify information associated with natural resources, technologies or tools within a small group. *(applied as reading and classifying information associated with forces within a small group or classroom group)*
  - Speaking: Describe the parts of the body presented in a model or illustration working with a partner. *(applied as describing forces using models and illustrations as part of a class discussion)*
- **PA ELPS Level 3 (Expanding)**
  - Writing: Describe and record objects made of different materials or textures from pictures or reality (such as: "The silk is shiny and smooth"). *(applied as using numbers and phrases to describe changes in motion and/or force)*

3. Learning Objectives:

- The student will be able to describe the force that makes objects fall and the force that makes objects stop moving using the terms gravity and friction, respectively, with 100% accuracy.
- The student will be able to explain the results of equal and unequal forces in a tug of war with 100% accuracy.
- The student will be able to complete a handout outlining the main topics from the day's reading (see attached) as part of a small group with 80% accuracy.

4. Formative Assessments:

- After each section of the text, the teacher will engage students in question and answers

about the text. The teacher should use this time to gauge students' understanding of key vocabulary words by having students demonstrate/model the terms for the class. Additionally, questions that relate the material to prior knowledge should be used to make sure students understand the concepts discussed in the text outside the science-focused environment.

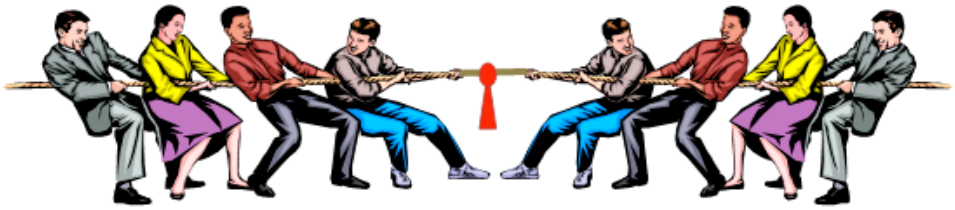
- After the reading, the students will complete the "Lesson Outline Handout" (attached) provided by the text. Students will sit in groups of three-4 and work together to find the best answers. Students will be allowed to use the text book in order to practice finding answers using text organization clues. While students are working on the handout, the teacher should circulate to assess how well the students understood the text by watching students answer questions and asking individual students other questions. The teacher should specifically ask students not contributing much to their group's questions about the text. After sufficient time to complete the handout, the class will review the handout together. Here, the teacher can assess understanding of the whole class and review material that may not have been clear.
- Throughout the class, the teacher should ask students to either talk about or demonstrate different elements of friction and changes in motion. Students should keep in mind that friction is a force that slows things down and describe different areas where friction might apply in this way. As for changes in motion, students should talk about changes in the direction of motions due to force as well as changes in motion due to equal or unequal forces.
- Students will have an opportunity to explore different surfaces and their friction during handout time. During this time the teacher should stop by to hear students' predictions about various levels of friction from the materials. Later, the teacher should see what the students found out. This exploratory learning task should solidify the students' understanding of friction, but the teacher should make sure the materials are providing an accurate understanding of the force.

5. Summative Assessments:

On the end of unit exam, students will be presented with the following questions. Each item will be read aloud to students to aid those with reading difficulties.

Look at the pictures below. Describe where the flag will move in each scene. Remember to talk about equal and unequal forces and the motions that they will cause. (up to 15 points)

Tug of War 1



Side A Side B

Tug of War 2

Side C Side D

Example Answer:

In Tug of War 1 there is equal force on both sides so the flag will not move. In Tug of War 2 there is more force on side D than on side C so the flag will move towards side D.

Rubric

	Forces (6 points)	Motion (6 points)	Grammar (3 points)
3/6	Student identifies equal forces on both sides in Tug of War 1 and unequal (or more or less on each side) forces in Tug of War 2.	Student describes that there will be no motion in Tug of War 1 and there will be motion in the direction of Side D in Tug of War 2.	Student uses proper sentence construction and grammar. (Capital letters, punctuation, proper word usage)
2/4	Students identifies either equal forces in Tug of War 1 or unequal forces in Tug of War 2. (one correct, one incorrect or omitted)	Student describes either no motion in Tug of War 1 or motion in the direction of Side D in Tug of War 2. (one correct, one incorrect or omitted.	Student has some mistakes in sentence construction and grammar, but they do not hinder the meaning or understanding of the writing.
1/2	Student does not identify forces or incorrectly identifies forces.	Student does not describe motion or incorrectly describes motion.	There are multiple sentence construction and grammar errors that hinder the understanding and/or meaning of the writing.

1. Which of the following could **decrease friction**? (5 point)
   a. Oil
   b. Sandpaper
   c. Rubber
   d. Glue

2. When you have **a lot** of **friction**, the item moving might _____. (4.5 points)
   a. go faster.
   b. stop moving.
   c. start moving.
   d. freeze.

3. **Passing a ball** back and forth is an example of force causing: (4.5 points)
   a. gravity.
   b. precipitation.
   c. friction.
   d. a change in motion.

6. Materials Needed:

One McGraw-Hill Grade 3 Science Textbook for each student
One Lesson Outline Handout for each student (attached)
One Jar lid
One wooden block (the ramp pieces from What's the Car Motion work well)
Four-six marbles
A few pieces of various grades of sandpaper
A piece of tin foil
A piece of wax paper
Four toy cars
Something rubber (silicone baking mat will do)
Something slippery (greased baking sheet is good)

7. Expectations for Behavior and Class Activities:

1. When the teacher discusses the text, students will raise their hands and wait to be called on before answering questions. If the class gets loud, the teacher will ring a bell or chimes in order to remind the class to stay quiet.
2. The teacher will explain the when someone is talking then others should be listening quietly. If necessary incorrect and correct models will be used at the start of class to remind students of these behaviors.
3. During the friction exploration, students are expected to work quietly and share materials with each other. Students should also be careful not to break materials and to keep them

organized for the next group.

4. During pair work on the handout, students are expected to equally contribute to the group and work out group conflicts maturely and quietly by talking within their pairs. Each student in the pairs should have a chance to give his or her opinion and the students should both be working towards finding the best answers.
5. Students are expected to study at home in addition to learning science material in school in order to receive an optimal grade on the end of unit assessment.

8. Description of Learning Activities:

Description of Introductory Activity (Anticipatory Set)

1. The teacher will begin by having students open to Lesson 3 of Unit E in the McGraw-Hill Grade 3 Science textbook. Students will look at the picture of the tug of war on the first page. The teacher should guide students to discuss the mini-tug of war activity from the lesson before last. Students will focus on how when they pulled the rope pulled back on them. The teacher should guide students to think about what happens when one side or another pulls harder. Students might suggest that the rope moves. From here, the teacher will guide students to read the lesson to learn more about changes in motion like they experiences with the mini-tug of war.

Modeling/Demonstration (also elaborations/connections to content)

Included in Guided Practice and Feedback

Guided Practice and Feedback (also probing questions/student responses)

1. Students will read Unit E; Lesson 3 of the McGraw-Hill Grade 3 Science textbook by the teacher selecting a student to read each paragraph aloud. After each section (denoted by headers), students will actively participate in class discussion led by the teacher. Each section discussion will include probing questions, modeling and connections as described below.

   Get Ready
   After reading: Ask students to predict which side will win based on their experiences from the previous day. Ask students to explain their guesses and have students read on to find the correct answers.

   What Causes a Change in Motion?

   Before reading: Ask students the header question. Students should answer that forces cause changes in motion. Suggest reading further to understand how forces cause these changes and how we can predict what will happen.

   After reading:

   Question: Based on what you read, what will happen in the first picture?
   Answer: No motion.

   Question: Based on what you read, what will happen in the second picture?
   Answer: The flag will move to the side with two kids on it.

Question: What do unequal forces cause?
Answer: A change in motion.

Question: What do equal forces cause?
Answer: No change in motion.

Modeling Activity/Demonstration: Have ten students come up before the class and have a pretend tug of war with five on each side. Ask the students what will happen. (The flag will not move). Why? (Because there are equal forces on each side). Have four students sit down and have a tug of war with five against one and ask students what will happen. (The flag will move towards the side with five.) Why? (There are unequal forces and more force on the side with five and less on the side with one.)

Question: When else might we see forces causing a change in motion?
Possible Answers: When we kick a soccer ball. When you roll a ball and it bounces off the wall. When you make a roller coaster.

Go through the image of the skier with students. When you are done, have two or three students come before the class to model a similar change in motion. Read each step and have the students act it out. (1. A body at rest starts moving. 2. A moving body speeds up. 3. A moving body changes direction. 4. A moving body slows down. 5. A moving body stops.) Make sure to complete this modeling activity in an area of the classroom where ELL students and those with other language or auditory difficulties can easily benefit from the experience. This demonstration allows students with a thorough understanding of the text to solidify their learning using a kinesthetic activity while added extra support for those students in need.

Have students give three examples of each step of changes in motion as described in the picture. Examples for each follow:

1- A car starts moving; A ball is thrown; You open your desk.
2- A car accelerates; A marble speeds up going down a hill; You start dancing faster.
3- You pass a soccer ball; You turn on your bike; You toss a ball up and it falls down.
4- You use your breaks to slow down your bike or car; A roller coaster slows down at the top of a hill; You start running slower as you get tired.
5- A rolling ball slows to a stop; You use your breaks to stop your bike; A spinning top stops and falls over.

Why Do Things Stop Moving?

Before reading: Ask students to answer the heading question. After three-4 suggestions, tell students that they must read the section to find the answer.

After reading:

Question: So, what force is makes things stop moving?
Answer: Friction

Question: What are some materials that cause increased friction?
Answer: Rubber, rough surfaces.

Modeling Activity/Demonstration: Have students stand up and repeat the push and pull kinesthetic activity from the previous lesson. Students will push an imaginary object and say, "push." Next, students will pull and imaginary object and say, "pull." Tell students that you will add two new parts to this and ask them to guess what they are. The students should guess gravity and friction. For gravity, have students squat to the ground as if they are being pulled and say, "gravity." For friction, have the students rub the ground with their hands and say, "friction." Put it all together with push, pull, gravity, friction and repeat the dance five-six times. Have students do it in different parts of the room or facing different directions. Maybe have students try using differently pitched voices or speeding up or slowing down the activity. The more times the activity is repeated, the more likely it is that students will remember the set of four forces.

How Can You Control Friction?

Before reading: Ask students to answer the heading question. Students should tell the teacher things like use a rough surface or make it smoother. Suggest continued reading to learn more..

After reading:

Question: So, how can we control friction?
Answer: We can use materials to decrease it or increase it?

Question: What are some materials that cause decreased friction?
Answer: Oil, wet surfaces.

Question: How do we get completely rid of friction?
Answer: We can't.

Modeling Activity/Demonstration: Read the "Marbles in Motion" activity on the left side of the textbook pages. Tell the students that they are going to try this on their own. Pass around the wooden block, jar lid and marbles and have each student have a chance to try the activity. Be sure to observe students during this activity as much as possible so that you know they tried just the block and the block with the marbles.

2. When vocabulary words (bolded) are discovered in the text, add these words to the word wall. The word wall should remain posted until after the end of unit summative assessment. When each word is added to the wall, ask students for suggestions for a picture to draw next to the word. Not only does this picture add a visual reminder of the definition, but it also aids diverse learners in understanding the word wall item. If ELL students or students with learning disabilities are present in the class, it is best to choose these students for picture ideas. The pictures may be most meaningful to these students. For students with intellectual disabilities, photographs may be used on

this word wall rather than hand-drawings.

3. There are a few physical type activities in this lesson. For classrooms with students with physical disabilities, it is important to make these activities accessible. Allow extra time and space for students using motion assistance devices. Also focus on not singling out students with special needs as much as possible.

Independent Practice/Exploring

1. Have students separate into pairs at desks and distributed the lesson outline handout (attached). Have students use their textbooks to find the appropriate answers to the handout. Be sure to equally mix diverse learners into the pairs with both academically strong students and those with learning disabilities incorporated in the same pairs. Allow students to ask questions and discuss the reading during this time as well. The teacher should be circulating around the classroom to monitor students' comprehension of the material but also available for questions.

2. While students are working on the handout, call four students at a time to the friction exploration. At this station, there should be one toy car for each student, various grades of sand paper, the rubber surface (silicone baking mat), the slick surface (greased baking pan), wax paper and tinfoil. Give students about 4 minutes to explore the materials and how the cars move differently on each of the materials. Be sure to stop by each group at the start of their time to explain the exploration and at some point during the exploration to find out if they are learning about friction and modifying friction from the activity.

3. After enough time is allowed for all students to finish the handout and activities, have some discussion time. Go over the handout and write each answer on the board. This will allow students with learning disabilities or auditory disabilities to record correct answers. Remind students that this handout can be saved to study for the final test. After the handout has been discussed, talk about the friction exploration and Marbles in Motion activities using the discussion questions below.

Discussion Questions

Marbles in Motion

1. How did the block feel when you tried to push it along your desk by itself? (it was hard to push)
2. How did the block feel when you tried to push it along your desk using the marbles? (it was much easier to push)
3. What did the marbles do that made the block easier to push? (they make the friction less)
4. How do you think the marbles made the friction less? (They were smooth. They acted like wheels)
5. Where might you use this in real life? (Putting a car on wheels, using a wagon to carry things, using a shopping cart at the grocery store.

Friction Exploration

1. Which of the materials seemed to make the most friction? (high grade sandpaper or rubber)
2. Which of the materials seemed to make the least friction? (greased pan or wax paper)
3. What happened when the friction was more or less? (When it was more the cars went slow or didn't move at all. When it was less the cars went faster.)
4. Could you see friction? (You can't see it, but you can see how it works)

General Questions

1. What new force did we learn about today? (Friction)
2. Name three times there is a lot of friction.
3. Name three times there is a little bit of friction.
4. Why do we need friction? (so we can stop moving)

Review and Preview

At the end of the lesson, the teacher should ask the students if playing on the different surfaces with the cars was fun. They will say yes. From here, the teacher should suggest that students design an experiment like the one they did earlier. The students should be prompted to suggest that they use the high car ramp to see how the cars move on the different surfaces. The teacher should introduce the term, "control" and suggest students have no change on one side and a changing or "variable" surface on the other side. Students will agree this is a good idea and soon suggest using three trials like last time. End the lesson here to keep students eager for the next lesson.

General Accommodations for Diverse Learners

The teacher will make the following modifications for diverse learners:

1. Diverse learners will be seated in clusters with students performing at expected grade level. This will give a level of support for each student. The teacher must plan this seating arrangement with as little attention as possible in order to maintain a level of confidentiality for the special needs or ELL student.
2. A word wall will be present throughout the lesson and during the summative assessment. The word wall will include the following word from this lesson: friction. A picture will be drawn next to the written word to indicate word meaning. The picture should be suggested by a student and by a student with special needs if possible (without drawing unnecessary attention). If students with intellectual disabilities are present, actual photographs of the concept will be used instead of drawn pictures. This will help trigger knowledge of the activities to associate with the word.
3. The teacher will incorporate modeling whenever possible in the lesson to enhance the learning experience for students with limited language or auditory abilities. Images in the text will be drawn to students' attention whenever possible to reinforce

knowledge in the same way.

4. A wait time of at least 5 seconds will be used after questions or prior to votes to ensure that all students have ample time to understand each question or topic.
5. Diverse learners will be expected to complete the objectives with equal accuracy to that of general education students. Any assistive technology used by diverse learners will be allowed for use during the lesson and assessment as it is normally used per the student's needs.

9. Sources:

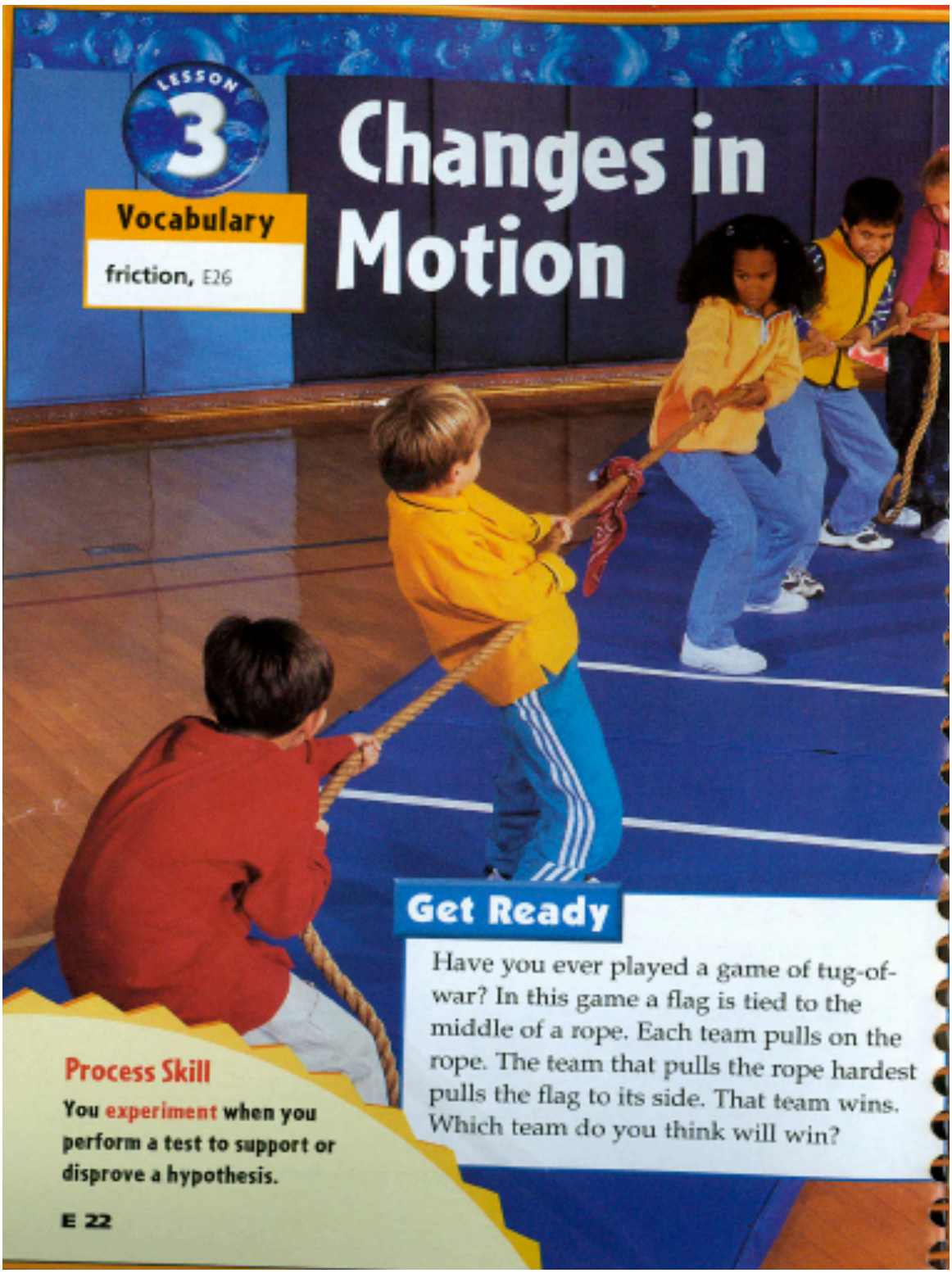
Moyer, R., Daniel, L., Hackett, J., Baptiste, H., Stryker, P., & Vasquez, J. (2002). *McGraw-Hill science: Macmillian/McGraw-Hill edition, teacher's edition*. New York, NY: Macmillian/McGraw-Hill.

10. Reflections:

After working through this lesson with students, I realized how important it was to use rubber surfaces in examples and explorations. Students have a hard time understanding that rubber increases friction even though it is smooth. Also, an example of using oil needs to be presented. Students understand that oil makes things move smoothly and decreases friction, but they are still surprised to see it actually work. This example makes the connection for students and helps present effortless learning opportunities.

This is a good lesson plan to get young children to think about important things that affect motion such as forces and friction. The activity involves active learning activities and appropriate delivery of content. Good sequence of a variety learning activities. Assessment items align to the learning objectives. Nice reflective comments.

Text Book Pages:



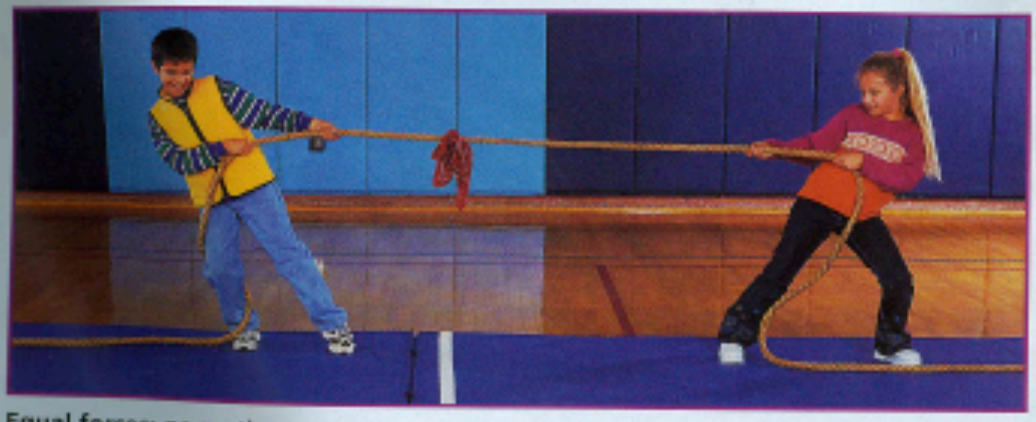
Read to Learn

Main Idea Forces can change an object's motion.

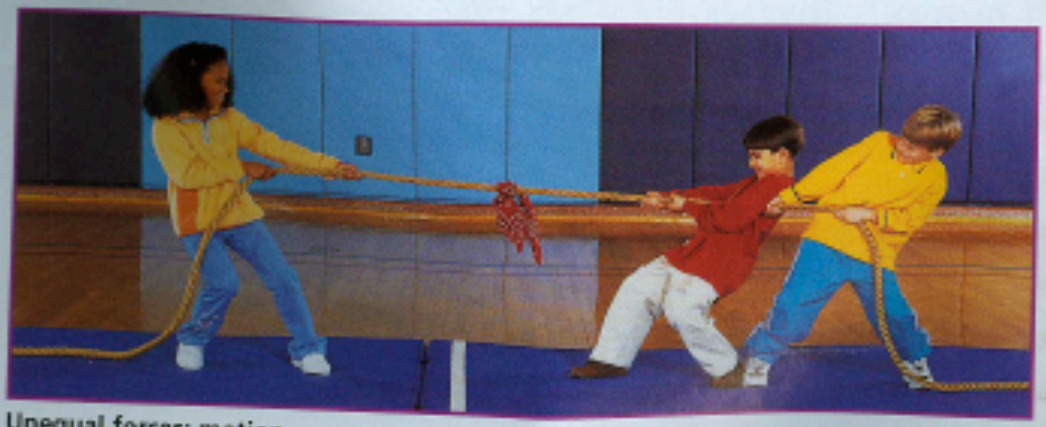
What Causes a Change in Motion?

When each person pulls on the rope, each applies a force. When the forces are equal, or balanced, there is no change in motion. The flag stays at rest.

What if one person pulls harder on the end of the rope? The forces are now unequal, or unbalanced. The flag moves to one side of the marker.



Equal forces: no motion



Unequal forces: motion

There is a change in its motion. A change in an object's motion comes from all the forces that are acting on it. Unequal forces cause a change in motion.

A change in motion occurs when an object starts moving or stops moving. It also occurs when a moving object speeds up, slows down, or changes direction. Here are some examples.

What causes a change in motion? Unequal forces cause a change in motion.

Changes in Motion

READING
Diagrams

What are five examples of a change in motion?

Why Do Things Stop Moving?

What happens when you roll a ball on the floor? It starts moving quickly but soon slows down. Then it stops. This means a force must be acting on the ball.

The force that slows the ball is called **friction** (FRIK-shuhn). Friction is the force that occurs when one object rubs against another. The ball rubbing on the floor creates friction.

Different materials produce different amounts of friction. Rough materials rub best. They produce a lot of friction. Many smooth materials don't rub well. They produce less friction. Other materials, such as rubber, are smooth but still produce a lot of friction.

Friction keeps the car's rubber tires on the road, even when the road is wet.

Ice reduces the amount of friction. The cars slide.

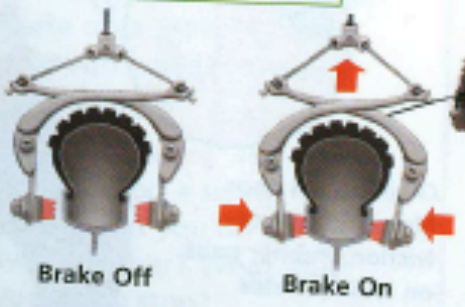
What objects rub together when you ride a bicycle? Friction slows the bike down even if you are riding on a very smooth sidewalk. You have to keep pedaling to keep the bike in motion.

How do brakes stop a bike's motion? When you squeeze the brake lever, the brake pad presses against the wheel. This creates friction between the brake pad and the rim of the wheel. The wheel slows down. The bike stops.

How does friction help a bike slow down?

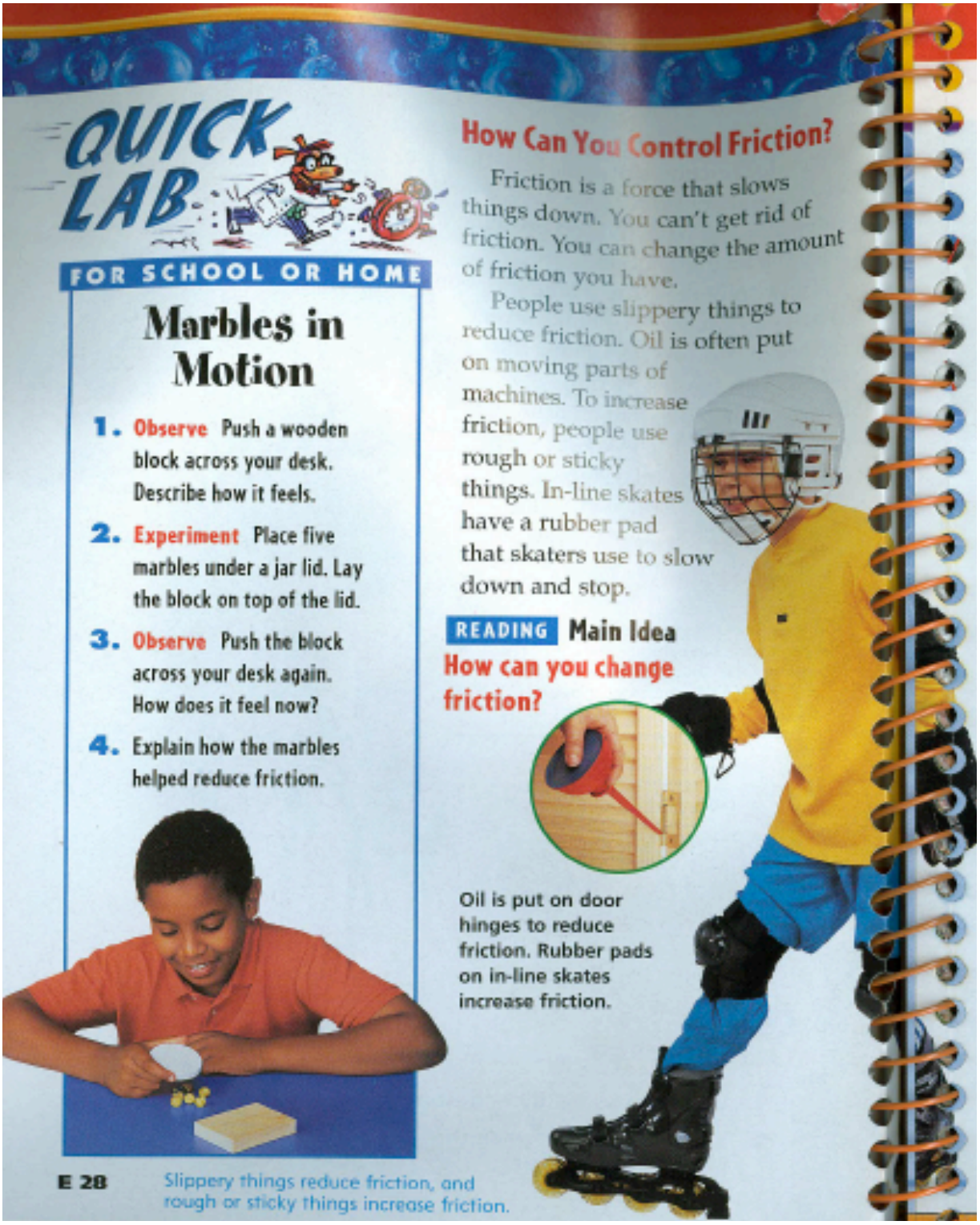
When you squeeze the brake on a bike, the brake pad presses against the wheel. This creates friction. The friction slows down the bike.

Bike Brake



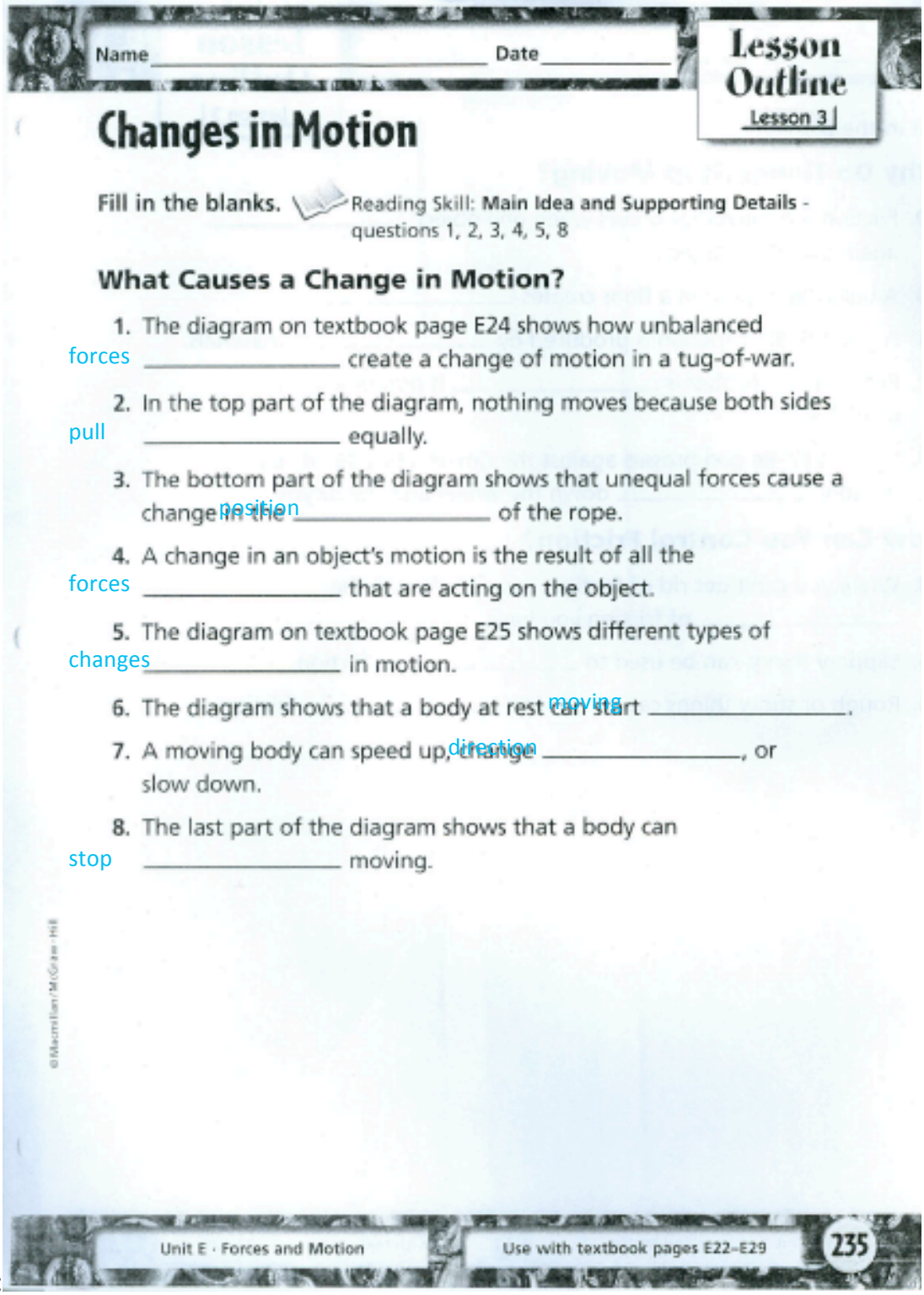
READING Diagrams

1. What causes the bike to stop?
2. Is friction greater when the brakes are on or off?


QUICK LAB
FOR SCHOOL OR HOME
Marbles in Motion
1. Observe Push a wooden block across your desk. Describe how it feels.
2. Experiment Place five marbles under a jar lid. Lay the block on top of the lid.
3. Observe Push the block across your desk again. How does it feel now?
4. Explain how the marbles helped reduce friction.
How Can You Control Friction?
Friction is a force that slows things down. You can't get rid of friction. You can change the amount of friction you have.
People use slippery things to reduce friction. Oil is often put on moving parts of machines. To increase friction, people use rough or sticky things. In-line skates have a rubber pad that skaters use to slow down and stop.
READING Main Idea
How can you change friction?
Oil is put on door hinges to reduce friction. Rubber pads on in-line skates increase friction.
E 28
Slippery things reduce friction, and rough or sticky things increase friction.

Lesson Outline

Handout:



Name _____ Date _____

Lesson Outline
Lesson 3

Changes in Motion

Fill in the blanks. Reading Skill: **Main Idea and Supporting Details** - questions 1, 2, 3, 4, 5, 8

What Causes a Change in Motion?

1. The diagram on textbook page E24 shows how unbalanced forces _____ create a change of motion in a tug-of-war.
2. In the top part of the diagram, nothing moves because both sides pull _____ equally.
3. The bottom part of the diagram shows that unequal forces cause a change in the position _____ of the rope.
4. A change in an object's motion is the result of all the forces _____ that are acting on the object.
5. The diagram on textbook page E25 shows different types of changes _____ in motion.
6. The diagram shows that a body at rest can start moving _____.
7. A moving body can speed up, change direction _____, or slow down.
8. The last part of the diagram shows that a body can stop _____ moving.

Name _____ Date _____

Lesson Outline
Lesson 3

Fill in the blanks.

Why Do Things Stop Moving?

9. Friction is a force that occurs when one object ___rubs___ against another object.
10. A ball rubbing across a floor creates ___friction___.
11. A great deal of friction is produced by ___rough___ materials.
12. Even though rubber is ___smooth___, it produces a lot of friction.
13. When a brake pad presses against the rim of a bicycle wheel, friction ___slows___ down the wheel and the bicycle.

How Can You Control Friction?

14. While you can't get rid of friction, you can change the ___amount___ of friction you have.
15. Slippery things can be used to ___reduce/ decrease___ friction.
16. Rough or sticky things can be used to ___increase___ friction.

Forces and Motion (Day 6): The Friction Factor

1. Target Grade or Age Level: Grade 3

2. Pennsylvania Content Standards

- **1.1 Learning to Read Independently:**
  - 1.1.3.E. Understand the meaning of and use correctly new vocabulary learned in various subject areas.
- **2.6 Statistics and Data Analysis:**
  - 2.6.3.A. Gather data from surveys and observations within the classroom or homes.
  - 2.6.5.C: Calculate mean and range, identify the median and the mode of a set of data, and use these quantities to describe the data. *(we will only focus on the mode as this is a Grade 5 standard)*
- **3.2.B Physical Science: Physics:**
  - 3.2.3.B1. Explain how movement can be described in many ways.
  - 3.2.4.B1. Explain how an object's change in motion can be observed and measured.
  - 3.2.6.B1. Explain how changes in motion require a force.
  - 3.2.3.A6. Science as Inquiry: Use data/evidence to construct explanations and understand that scientists develop explanations based on their evidence and compare them with their current scientific knowledge
- **PA ELPS Level 2 (Beginning)**
  - Speaking: Describe the parts of the body presented in a model or illustration working with a partner. *(applied as describing motion and forces using models and illustrations in a small group or with a partner)*
- **PA ELPS Level 3 (Expanding)**
  - Listening: Compare movement of real-life objects by following multiple step directions.
  - Writing: Describe and record objects made of different materials or textures from pictures or reality (such as: "The silk is shiny and smooth"). *(applied as using numbers and phrases to describe changes in motion and/or force)*

3. Learning Objectives:

- The student will be able to observe and collect data about friction as demonstrated by recording the winner of races on two surfaces (one control, one variable) for three trials of each surface condition. The student will be able to analyze this data as a group using the mode (descriptive statistic) to determine which surfaces have more or less friction with 100% accuracy.
- The student will be able to predict whether a car on a bumpy surface or a car on a smooth

surface will win a ramp race based only on increased or decreased friction with 100% accuracy.

4. Formative Assessments:

- Students will need to understand the previous lessons' content to talk about the activity of today's lesson in scientific terms. By using vocabulary such as motion, position, speed, distance, gravity and friction to describe the experiment, the teacher can gauge students' understanding of the terms. If students do not understand the instructions for the activity when described in these terms, then the teacher must give extra attention and time to reviewing the terms and their meanings.
- Throughout the activity, the teacher should circulate among the groups and ask questions to check for students' understanding of the relationship between friction and speed as well as understanding of the experiment. The teacher should also make sure to ask students to describe how the changes in friction based on the surfaces affect the speed of the car and make sure that the students understand that more friction makes things slower and less friction makes things faster. This will ensure correct data analysis at the end of today's lesson.
- While participating in the experiment, each student should be completing the "Friction Factor" worksheet (attached). After the lesson, the teacher should review the handouts for accurate data recording for both the individual group and whole class.
- Near the end of class, the teacher should engage students in a class discussion. Recorders from each group will write their data on the board and students should record all data and the modes (as calculated by the class in discussion). A representative from each group should communicate each group's findings first and then the class as a whole should analyze the full data set. During this discussion the teacher must be sure to get answers of some sort from each student to make sure all the students understanding the topic.

5. Summative Assessments:

On the end of unit exam, students will be presented with the following questions. Each item will be read aloud to students to aid those with reading difficulties.

1. If you race two cars with one on a smooth surface and one on a rough surface, which car will usually win? 4.5 points
   a. It will be a tie.
   b. The smooth surface car will win.
   c. The rough surface car will win.

6. Materials Needed:

One Experiment set for every 4 students

One "Friction Factor" handout for each student

Chalk or dry erase board and writing materials as appropriate

Experiment Set:

- Sloped Track - 2' or greater in length by 1' or greater width, and 1 foot height
  Pieces of sturdy plywood or thick cardboard (that will resist flexing) placed on top of stacked books or other objects to a height of roughly 1 foot.
- Enough of the following materials to cover the variable side of the track (one half width of the sloped track and the entire length of the track).
  - Aluminum foil
  - Wax paper
  - High Grade Sandpaper
  - Low Grade Sandpaper
  - Corrugated Cardboard
  - Bubble Wrap
  - Plastic Wrap over poster board (sprayed with cooking spray)
- Sturdy 12" ruler OR other thin, but sturdy object approximately the width of the track to hold cars back on the ramp until ready for test trials
- (2) toy cars, same size and weight
- Optional – Masking Tape

7. Expectations for Behavior and Class Activities:

1. When the teacher or another student is talking, the class should be quite. If the class gets loud, the teacher will ring a bell or chimes in order to remind the class to stay quiet.
2. The teacher will explain the when someone is talking then others should be listening quietly. If necessary incorrect and correct models will be used at the start of class to remind students of these behaviors.
3. During the toy car activity, students should work together in teams without quarrelling and remembering to keep safety as a primary goal.
4. During the group activity, students are expected to equally contribute to the group and work out group conflicts maturely and quietly by talking within their groups. Students will choose numbers for jobs (car releaser/measurer, timer, recorder, communicator/ramp technician) and perform only those jobs.

8. Description of Learning Activities:

<u>Description of Introductory Activity (Anticipatory Set)</u>

1. The teacher will begin by reviewing key vocabulary (motion, position, distance, speed, gravity, friction) from the previous days' lessons using the Word Wall.
2. Once students seem to recognize the words, the teacher should ask students about their experiences traveling on bumpy, smooth, slippery and regular surfaces. This should get the children to activate background knowledge and intrigue motivation. Ask the students how we can investigate motion of these surface types in the classroom. The teacher should suggest (if the students do not) that a model is used and present the Experiment Sets. The teacher should next ask the students what they

might do to make an experiment using these items. The teacher should lead and prompt the students to suggest using the ramp and putting one experimental surface on a side and an empty (or control) surface on the opposite side and racing the cars. The teacher should also prompt students to suggest three trials with each surface. Once this information is provided by the students, the teacher can move on to modeling.

Modeling/Demonstration (also elaborations/connections to content)

1. The teacher should first show all the students how to set up the ramp. Next, the teacher should model the control side of the ramp as used properly. The teacher will put the car at the top of the ramp using the ruler to hold it back and then release the ruler to let the car go. This should be repeated with two cars (one on each side of the ramp). Finally, an experimental (or variable) surface should be used on one side and the cars should be placed at the top, behind the ruler. The ruler will be released so that the cars are allowed to move at the same time and the winning car will be recorded.
2. After the experimental procedure is estabilised, the teacher should draw a chart similar to the one on the worksheet on the board. The teacher should show students how to have one student place the variable road condition, have another student hold the ruler, have another student place the cars, and another say, "Go," (at this point the ruler student will lift the ruler). The student that said, "Go," should be the judge as well and decide who won the race for all the students to record on their respective worksheets.
3. Once this modeling is complete, the teacher should check for understanding. Have a few students come before the class and explain how to work the activity's various elements. This should be done using the different roles as described above to ensure they will be followed when students break into groups.. It is important to specifically check for understanding from students with special needs or ELL students at this time. The modeling should be sufficient for all kinds of learners; however, the explanation portion of the modeling may be difficult for some students and slower or repeated demonstration might be necessary.

Guided Practice and Feedback (also probing questions/student responses)

1. Break students up into groups of four students each. An easy way to do this is to use the random colored number system (see attached). When using this system, the teacher will give a colored number to each student in the classroom. Next, the teacher will ask all students with the same of each color to get together (i.e. blue group, orange group, etc.). The numbers represent the students' roles in their groups. Position one might be the road condition selector (Friction Engineer); position 2 the ruler holder/releaser (Motion Initiator); position three the judge (Speed Evaluator) 4 the car placer (Starting Position Technician).

   If there are students with special needs or differing abilities in the class, the job system may be a very easy way to accommodate these students. ELL students may take on the job of the Starting Position Technician or Motion Initiator in order to be in a position that is mostly language independent. A student with a physical handicap

might be best working as the Speed Evaluator as this requires little physical movement. Moreover, students with learning disabilities could be incorporated into groups with stronger learners to support and scaffold the student's abilities.

2. Once the students are in their groups with appropriate roles, have the students all complete their first condition together. Have the Friction Engineers place their selected surface on the ramp as a group and check to make sure all students have done this correctly. Next, have the Motion Initiators place the ruler and the Starting Position Technicians place the cars. Again, check to make sure this was done in the correct fashion and help students as needed. Finally, have the Motion Initiators move the rulers and the Speed Evaluators determine the winners and make sure each process is completely flawlessly and the teams record their data appropriately on their handouts. Have the students complete two more trials in this way while you circulate the room to make sure the students understand the activity. After the first set of three trials is complete, make sure the students recorded the mode (most common) winning condition correctly. After this is finished, students may begin on the independent practice portion of the experiment..

Independent Practice/Exploring

1. Have the grouped students complete the experiment with three trials using each of the remaining six surface conditions. When a group has completed these trials, they should discuss their data in their groups and find the mode for each condition. The Speed Evaluator should write their mode data on the board. If the student in the Speed Evaluator position is a student with special needs that limit his or her writing ability, another student from the group may complete this task.

2. When the data is on the board, allow students some independent time to "play" with the surfaces. Invite students to make their own conditions by combining surfaces or racing two surfaces against each other. The students should explore what will happen. It is important to allow all groups at least 5 minutes of this exploration time in order to solidify the students' understanding of the activity and its limits and extensions.

3. Once all groups have had at least 5 minutes of exploration time, have the students clean up the experiment kits and return to their desks. At this time, call on each group's Starting Position Technician to tell the class about that group's findings. This student should talk about the same findings that the group previously discussed. Again, if the Starting Position Technician is a student with special needs that limits his or her speaking ability, another student from the group may complete this task.

4. Once all the communicators have given their results, ask the students to make predictions about what the data from the combined class might reveal. Students will suggest a finding that is in line with the majority of the groups' findings. Once this is established, have students look at the data on the board to figure out the mode of each condition and record this information on their worksheets.

5. Once the students have finished finding the modes, discuss what a mode represents.

Ask students what they think it might mean and when or where they have heard the term used. Once students understand the descriptive statistic, have students tell you what they figured the mode out to be. From here, talk and discuss as a class what the cumulative results indicate. It is likely that the baking spray, wax paper and tin foil (if not crunched) will be faster than the control and that the 2 sandpapers, cardboard and bubble wrap will be slower than the control.

Discussion Questions

1. Which surfaces had the most friction?
   The cardboard and the bubble wrap.

2. Which surfaces had the least friction?
   The baking spray and the wax paper.

3. Why are these results the same or different?
   The answers are the same because the data all has the same thing happening. OR

   The answers are different for some groups, but the groups that had the same answers most match the class answer because it happened for more times.

4. When there was a lot of friction which side won, variable or control?
   Control

5. When there was a little bit of friction which side won, variable or control?
   Variable

Review and Preview

At the end of the lesson, the teacher should talk about friction with students. The teacher should highlight that friction always makes things go slower, but some items can increase or decrease friction. Tell students that when we had an item that beat the control, that means the surface we used decreased the friction between the ramp and the car and that when we had the control side win that the surface we used helped increase friction between the ramp and the car. Continue this discussion by making sure that students know that items like oil decrease friction and items like sandpaper increase friction. Tell the students that the more we know about forces, the more we can learn about the world around us. Ask a few students from different groups to come up and explain the class' findings from the day's experiment one more time for the whole class. Tell the students that now that they know so much about motion and forces, they are ready for a big review day. Remind them that they won the outside (or gym) Active Review and that tomorrow's lesson will be just that.

General Accommodations for Diverse Learners

The teacher will make the following modifications for diverse learners:

1. Diverse learners will be grouped with students performing at expected grade level. This will give a level of support for each student. The teacher must plan this grouping arrangement with as little attention as possible in order to maintain a

level of confidentiality for the special needs or ELL student.

2. A word wall will be present throughout the lesson and during the summative assessment. The word wall will include the following words from this lesson: force, push, pull, gravity, weight and friction. Pictures will be drawn next to each written word to indicate word meaning. Pictures will be suggested by students and by students with special needs if possible (without drawing unnecessary attention). If students with intellectual disabilities are present, actual photographs of the concepts will be used instead of drawn pictures. This will help trigger knowledge of the activities to associate with the word.
3. The teacher will incorporate modeling whenever possible in the lesson to enhance the learning experience for students with limited language or auditory abilities. Modeling and demonstrating will be repeated to the entire class or in a one-on-one environment as much as needed in order to communicate the experimental design and key vocabulary.
4. A wait time of at least 5 seconds will be used after questions to ensure that all students have ample time to understand each question or topic.
5. Diverse learners will be expected to complete the objectives with equal accuracy to that of general education students. Any assistive technology used by diverse learners will be allowed for use during the lesson and assessment as it is normally used per the student's needs.

9. Sources:

Yaich, J. (2011). Affects of surface types. Presented on September 29, 2011.

10. Reflections:

This lesson was based on Jessica Yaich's experiment in class for the inquiry based learning activity. I thought it was a great activity and really introduced students to the ideas of friction, control and variable conditions very well. I didn't have time to do this exact version of this lesson in my class, but I modeled this activity using two separate ramps from the What's the Car Motion activity from Day 2. The kids really liked it and I wish I had enough time to do this entire lesson as well. I thought what was missing from Jessica's version of this plan was a very slick surface. This is why I added the plastic surface with baking spray. Kids seem to have a difficult time understanding things that lesson friction. I think this is because we give them so many examples of things that make it more and so few of things that make it less. I wanted to incorporate something kid-friendly that could really demonstrate this kind of friction modification.

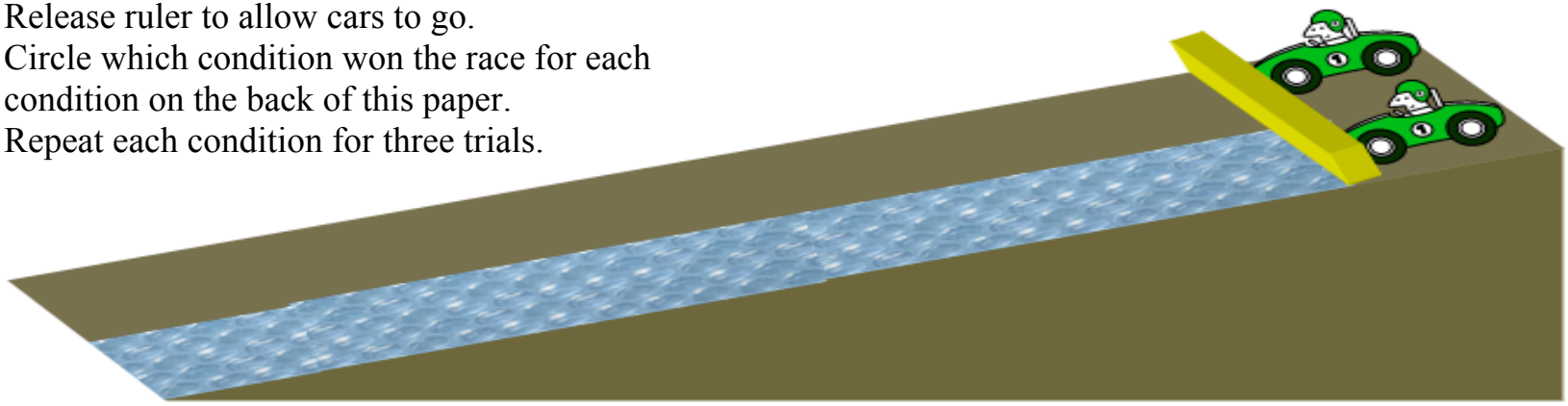
This is a good lesson plan that has students observe the effects of friction with different surfaces. I like the fact that you have students engage with open exploration. The activity is engaging and involves students with collecting data. Good sequence of learning activities. Handouts are appropriately designed for the activity. Assessment items are fine.

Grouping Numbers

1	2	3	4
1	2	3	4
1	2	3	4
1	2	3	4
1	2	3	4
1	2	3	4

The Friction Factor

1. Set up your ramp as show above.
2. Release ruler to allow cars to go.
3. Circle which condition won the race for each condition on the back of this paper.
4. Repeat each condition for three trials.



How do I find the **mode**?

The **mode** is the answer that happened the most times.

To find the **mode** you need to see which answer was given the most number of times.

Example: Gina rolled a dice 12 times and got the following numbers:

1, 1, 2, 2, 2, 3, 4, 4, 4, 4, 4, 5

What is the **mode**? Gina rolled a 1 two times, a 2 three times, a 3 one time, a 4 five times and a 5 one time. Since Gina rolled the 4 the most times (5 times), 4 is the **mode**.

Circle Variable or Control to show which side won or which was the mode.

Variable Condition	Trial 1 Winner	Trial 2 Winner	Trial 3 Winner	Group Mode	Class Mode
Tin Foil	Variable Control	Variable Control	Variable Control	Variable Control	Variable Control
Rougher Sandpaper	Variable Control	Variable Control	Variable Control	Variable Control	Variable Control
Baking Spray	Variable Control	Variable Control	Variable Control	Variable Control	Variable Control
Smoother Sandpaper	Variable Control	Variable Control	Variable Control	Variable Control	Variable Control
Wax Paper	Variable Control	Variable Control	Variable Control	Variable Control	Variable Control
Bubble Wrap	Variable Control	Variable Control	Variable Control	Variable Control	Variable Control
Corrugated Cardboard	Variable Control	Variable Control	Variable Control	Variable Control	Variable Control

Forces and Motion (Day 7): Active Review

1. Target Grade or Age Level: Grade 3

2. Pennsylvania Content Standards:

- **3.2.B Physical Science: Physics:**
  - 3.2.3.B1. Explain how movement can be described in many ways.
  - 3.2.4.B1. Explain how an object's change in motion can be observed and measured.
  - 3.2.6.B1. Explain how changes in motion require a force.
- **PA ELPS Level 2 (Beginning)**
  - Speaking: Describe the parts of the body presented in a model or illustration working with a partner. *(applied as describing motions and forces using models and illustrations as part of a class discussion)*
- **PA ELPS Level 3 (Expanding)**
  - Listening: Compare movement of real-life objects by following multiple step directions.

3. Learning Objectives:

- The student will be able to use the terms motion, position, speed and distance to describe a race when prompted to use these vocabulary words with 100% accuracy.
- The student will be able to use the terms force, push and pull to describe what happens when a heavy box is moved when prompted to use these vocabulary words with 100% accuracy.
- The student will be able to describe why they cannot jump off the ground to fly in terms of gravity with 100% accuracy.
- The student will be able to explain changes in motion due to forces during a sled pull with 100% accuracy.
- The students will be able to give at least 2 ways to reduce friction and 2 ways to increase friction with 100% accuracy when prompted.

4. Formative Assessments:

- Each element of the active review is a formative assessment of the students' learning. After each activity a objective will be tested and assessed in the students. Meeting each objected will formatively assess the students' comprehension of that element of the material and allow progression to the next activity.

5. Summative Assessments:

As this lesson is a review of previous lessons, all questions noted prior in this unit relate to this lesson. For an appropriate listing of the summative assessment questions that respond to this unit see the summative assessment and modified assessment at the end of this unit.

6. Materials Needed:

Measuring tape
Masking tape
Camera
Box filled with a heavy material such as concrete mix or cat litter
One square foot seated scooter (optional)
Silicone baking sheet (optional)
Two large sheets of cardboard
~20 small novelty erasers

7. Expectations for Behavior and Class Activities:

1. When the teacher is talking, students will raise their hands and wait to be called on before answering questions. If the class gets loud, the teacher will ring a bell or chimes in order to remind the class to stay quiet.
2. The teacher will explain the when someone is talking then others should be listening quietly. If necessary incorrect and correct models will be used at the start of class to remind students of these behaviors.
3. During the all the activities, all students are expected to pay attention and equally contribute to the discussion and review. Students should always perform safely by keeping hands and feet to themselves and not yelling.
4. Students are expected to study at home in addition to learning science material in school in order to receive an optimal grade on the end of unit assessment. Studying before the review will also help students to perform better during the review activities.

8. Description of Learning Activities:

<u>Description of Introductory Activity (Anticipatory Set)</u>

1. Get the students to stand up and select teams. Using the children that were able to find the most forces in the Introduction to Forces lesson is a good way to pick team leaders. You might also wish to split the class into boys and girls if your gender ratio is close to even. Students should be excited to be in teams. From here, either move the class outside or to a gym or hallway (in inclement weather). They should be ready for their active review and excited to get started.

<u>Modeling/Demonstration (also elaborations/connections to content)</u>

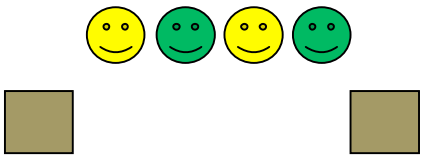
Included in Guided Practice and Feedback

Guided Practice and Feedback (also probing questions/student responses)

1. Each activity below should be performed at one time. At the end of each activity there are questions. Students should receive erasers for correct answers. At the end of the activity, the team with the most erasers wins. All students should get to keep the erasers. The prize for the winning team should be that their picture will be on the unit test (picture of race).

   The Vocabulary of Motion Race

   Place two large pieces of cardboard on the floor across from each other. Have the students line up behind the line that the pieces of cardboard would make as shown below.



   First have one student use the measuring tape to measure the distance between the two pieces of cardboard and leave the tape on the floor as shown below. Have the student tell the class what the distance is between the cardboards.

   Next, choose one or student to demonstrate the starting position and another student to demonstrate ending position of a race with one students on one piece of cardboard and the other on the second piece. All students in position should be from the same group. Take a picture of the scene to be used on the unit test and repeat this with the second group to get a similar picture. Have all four students return to their places and have a volunteer come up and point out the starting position, ending position, distance and motion that would be part of the race using the students and measuring tape. If the student gets any part wrong, stop him or her and get a new volunteer to start from the beginning. Continue this until one student is able to get all the elements identified. That student should receive and eraser.

   Note that we cannot measure the speed in this race. Ask students what else we would need to find the speed of the runners of the race. The student who says time (because we need distance and time to calculate speed) should receive and eraser.

   After, one student has demonstrated proficiency, have the class shout the different vocabulary words when you point to them in the model. Repeat this two or three times and move to the next activity.

   The Forceful Vocabulary Push

   Set one box filled with a heavy material in the middle of a circle of students. Call on five-ten students to take turns trying to move the object either alone or in pairs. It is

important to stop the students attempts a bit quickly to make sure no student improperly strains their muscles.

Next, the teacher should try to move the box and feign and over-exaggerated amount of exertion. Call on a student to identify the pushing forces when the teachers tries to push the object. If they identify the teacher pushing the object and the object pushing back on the teacher they should receive and eraser. Repeat this procedure for a model where the teacher attempts to pull the box and award the eraser in the same fashion. Finally, pretend to be exasperated at the situation. Have a student come before the class and explain why the box is difficult to push. They must describe the phenomenon using the terms weight and gravity and should receive a bonus eraser if they mention friction. The student should tell the class that because the box has a very heavy weight, gravity is pulling really hard on the object so the teacher must push more than gravity is pulling to move the object. Keep calling on students until one can identify the full procedure. If no student is able to do so after seven students are given a turn, then the teacher should explain what is going on. If a student suggests that friction is very great because the weight is high you may award that student a bonus eraser.

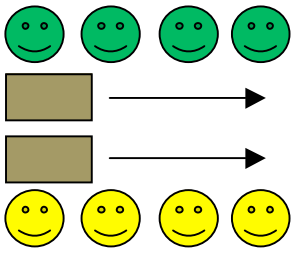
Flying Forces!

With the students still standing in the circle, tell the students that they should try to fly. After about 2 minutes of time to attempt flying by jumping or flapping their arms, stop the students and ask the following questions, rewarding erasers for correct answers.

1. What force was preventing you from flying? (gravity)
2. Why might birds be able to fly? (students may not get that answer, and that is ok. This is a question to help expand the learning of gifted and talented students. A student who suggests that the flapping is creating enough force to push the bird up that is more than gravity pulls it down or mentions lift at all should receive an eraser.)

A Sled of the Change

Place the two pieces of cardboard on the floor next to each other with some room in front of them. Students should be lined up in teams on either side of the cardboard pieces as shown below.



Have one student site cross-legged style on each piece of cardboard and one student be ready to try to pull the cardboard with the one student on it. Each set of students

(one on cardboard and one pulling) should be from the same team. Try to pick sets of students that are similar in weight and/or height. The students should try to pull the other student. They may or may not be able to, but regardless it will be difficult. Have the volunteering students reset the activity and return to their groups. Repeat the activity under the following conditions:

(1) Two students seated on cardboard and one pulling.

(2) One student seated on cardboard and two pulling.

(3) Three students seated on cardboard and one pulling.

Challenge a student to volunteer to come up and explain what happened differently under all the conditions. Note that the student should use the terms equal and unequal forces and motion to describe what happened. The student should explain that with one on each side it was hard to move because the forces were close to equal. With two or three sitting and one pulling the students could not be moved because the force of the students being on the sled was more than the force of the one student pulling. With two students pulling and one sitting, the sled moved because the force of the two students pulling was greater than (unequal) the one student on the ground. If a student talks mentioning that the force of the students sitting was actually gravity pulling them to the earth, award a bonus eraser.

Ask the following questions to award more erasers:

1. What would happen if three students pulled the sled and two sat on it? (the sled would be able to be pulled because three pullers is more than two sitters)
2. If a very heavy person sat on the sled and a very small person tried to pull the sled (or maybe if the teacher sat on the sled and a student tried to pull the sled) what would happen? (The sled would be very hard to move since the big person weighs more).
3. What force is really pulling back on the people trying to pull the sleds? (gravity)

Controlling Friction

Have students circle around the heavy box again. Ask about what we might do to move the box. If a student suggests using a cart or wagon, use the scooter to show that this would work. As the student what force was decreased when we used the scooter. If they answer friction award an eraser. Ask for more suggestions on how to reduce friction. Award erasers for up to three more correct answers. Next, ask students what we might want to do if we had something easier to move that we wanted to keep in one place. The student that suggests increasing friction should receive an eraser. From here, ask for ways to increase friction and award up to three addition erasers for correct answers.

2. Once the activities have been completed, ask students on each team to hold up their erasers. The team that won the most erasers will win and you should tell them that their picture gets to be on the test. Although this is a minor reward, the age of the students will allow it to appropriately reinforce their exceptional learning. Additionally, research suggests that personalizing education and assessment leads to

better results and using a picture of the students' peers should help the students recall the learning and answer the item correctly. Have students return to the classroom for some independent question time and a wrap up.

3. There are a lot of physical type activities in this lesson. For classrooms with students with physical disabilities, it is important to make these activities accessible. Allow extra time and space for students using motion assistance devices. Also focus on not singling out students with special needs as much as possible.

Independent Practice/Exploring

1. When students have returned to the classroom, allow time for individual questions. Tell students that this is their chance to ask questions about what they don't understand from the chapter and to find out more about things they have learned about. If possible, have a computer with internet connection available (and projector if possible). When students ask questions the teacher does not know the answer to, the computer will allow the teacher to instantly look up the answer. If projection of the computer's images is possible, students will be able to see how the teacher uses the Internet to find information.

Discussion Questions

1. What questions do you have about motion, forces or anything else we learned recently?

2. Name three pushes, three pulls, three times you notice gravity and three times you notice friction.

3. What are some ways we can measure forces and motion? (speed, weight)

4. What else do you want to know about forces and motion?

Review and Preview

At the end of the lesson, have students retrieve all of their Lesson Outline handouts. If there is time, read through all the questions or ask randomly selected questions from the handouts to the class. Some classes might benefit from playing a Jeopardy type game using the questions from the handouts (and maybe the items that will be used on the test). Remind students to review these handouts and perhaps reread the chapter to prepare for the unit test. The last part of this unit is administering the unit test. Make sure you have given attention to all the students in the class to gauge their understanding of the material learned. If you notice that some students might need extra help, you can pair them with gifted and talented students as study buddies or designated some time to help them review. Provide parents notes about students who may need additional study time if applicable.

General Accommodations for Diverse Learners

The teacher will make the following modifications for diverse learners:

1. Diverse learners will be seated in clusters with students performing at expected grade level. This will give a level of support for each student. The teacher must plan this seating arrangement with as little attention as possible in order to maintain a level of confidentiality for the special needs or ELL student.
2. This lesson focuses on incorporating a variety of modeling and hands-on demonstrations of the concepts taught throughout this unit. This should provide exceptional assistance to ELL students and those with special needs.
3. A wait time of at least 5 seconds will be used after questions or prior to votes to ensure that all students have ample time to understand each question or topic.
4. Diverse learners will be expected to complete the objectives with equal accuracy to that of general education students. Any assistive technology used by diverse learners will be allowed for use during the lesson and assessment as it is normally used per the student's needs.
5. The unit's summative assessment has a modified version for those students still acquiring language abilities. This modified assessment focuses on using images as much as possible. Additionally, the unmodified assessment aligns with best practices for presenting questions to students with special needs by bolding and/or underlining words to draw attention to the most important aspects of the questions. These elements will allow all levels of students to perform equally on the test given equal level of conceptual comprehension within the unit.

9. Sources:

Moyer, R., Daniel, L., Hackett, J., Baptiste, H., Stryker, P., & Vasquez, J. (2002). *McGraw-Hill science: Macmillian/McGraw-Hill edition, teacher's edition*. New York, NY: Macmillian/McGraw-Hill.

10. Reflections:

I did this review with my students before their test. I felt like this was the most concrete part of their learning. The students in my class usually require a lot of drilling on material as they have limited background experiences on which to build. Providing students with experiences of each of the concepts led the students to not just repeat back what they were learning but developed a thorough understanding of the material. Students were not only able to regurgitate vocabulary words but could discuss the concepts and apply them in their worlds. This review seemed to be the most effective part of the instruction; nonetheless, without the readings to introduce the topics and concepts the review would have been meaningless. This was what brought the unit together as a whole and tied forces and motion into one packet of information for the students to learn and apply to their daily experiences.

This is a good lesson plan to get review the unit concepts. The activity involves appropriate delivery of content. Good sequence of learning activities. Assessment discussion is acceptable.

UNIT TEST

Name:_____

Directions: Circle the best answer below each question. Remember to eliminate the ridiculous when you can.

1. What **two** (2) things do you need to find something's **speed**?
   a. Motion and Time
   b. Position and Motion
   c. Time and Distance
   d. Position and Distance

2. A **change** in **position** is called a:
   a. Distance.
   b. Motion.
   c. Planet.
   d. Time.

3. What **measurement** can we use to describe a **motion**?
   a. Speed
   b. Temperature
   c. Weight
   d. Price

4. Which **two** (2) words are used to describe **forces**?
   a. Weight and Motion
   b. Push and Pull
   c. Time and Distance
   d. Black and White

5. What do you feel when you **push** something?
   a. You feel the object getting colder.
   b. You feel the object exploding.
   c. You feel the object pulling on you.
   d. You feel the object pushing back.

6. What do you call the **force** that holds you to the Earth?

a. Gravity
b. Newtons
c. Weight
d. Electricity

7. How to you **measure** how much **gravity** is pulling on you?

a. Speed
b. Weight
c. Motion
d. Distance

8. Which of the following could **decrease friction**?

a. Oil
b. Sandpaper
c. Rubber
d. Glue

9. When you have a lot of friction, the item moving might _____.

a. go faster.
b. stop moving.
c. start moving.
d. freeze into ice.

10. Passing a ball back and forth is an example of force causing:

a. Gravity.
b. Precipitation.
c. Friction.
d. A change in motion.

11. Sam released a toy car from the top of a **5 foot ramp**. The car took **22 seconds** to get to the bottom of the 5 foot ramp. What was the **speed** of the Sam's car?

a. 5 feet per 22 seconds
b. 22 feet per 5 seconds
c. 27 feet
d. 225 seconds

12. If a toy car moved at a speed of **4 feet per 10 seconds on a medium ramp** and at a speed of 9 feet per 10 seconds on a high ramp, which ramp has the **fastest** speed?

    a. The ramps have the same speed
    b. The medium ramp
    c. The high ramp

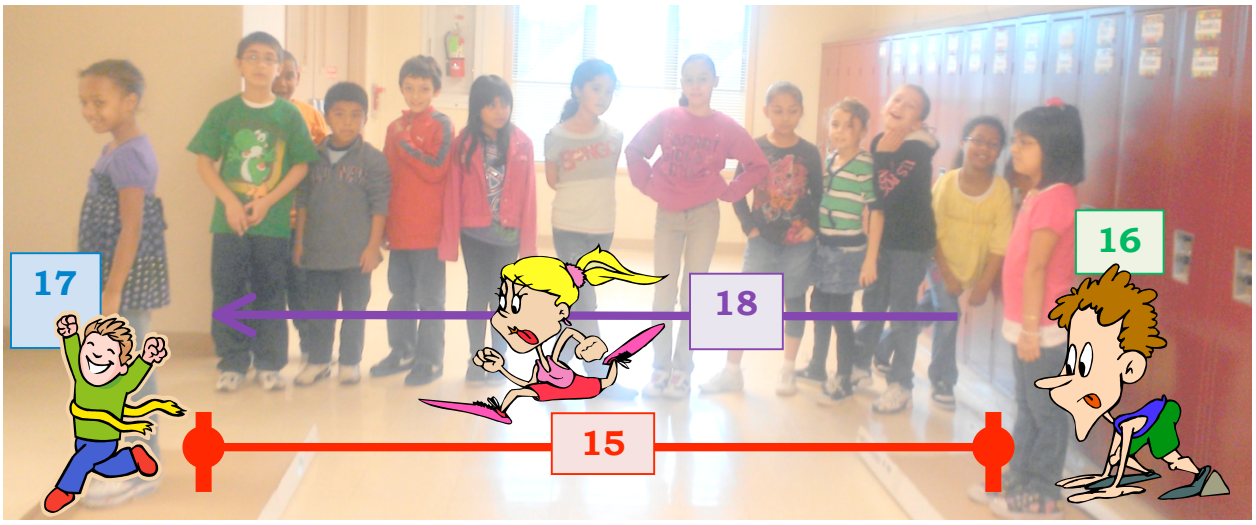
13. When gravity is increased (like on a large planet), your weight will be:

    a. Decreased.
    b. The same.
    c. Reversed.
    d. Increased.

14. If you race two cars with **one on a smooth surface** and one on a rough surface, which car will usually **win**?

    a. It will be a tie.
    b. The smooth surface car will win.
    c. The rough surface car will win.

Directions: Look at the picture below. **Write** the vocabulary word from the **word bank** below next to the number that best described that part of the picture.



Word Bank

Starting Position	Ending Position
Distance	Motion

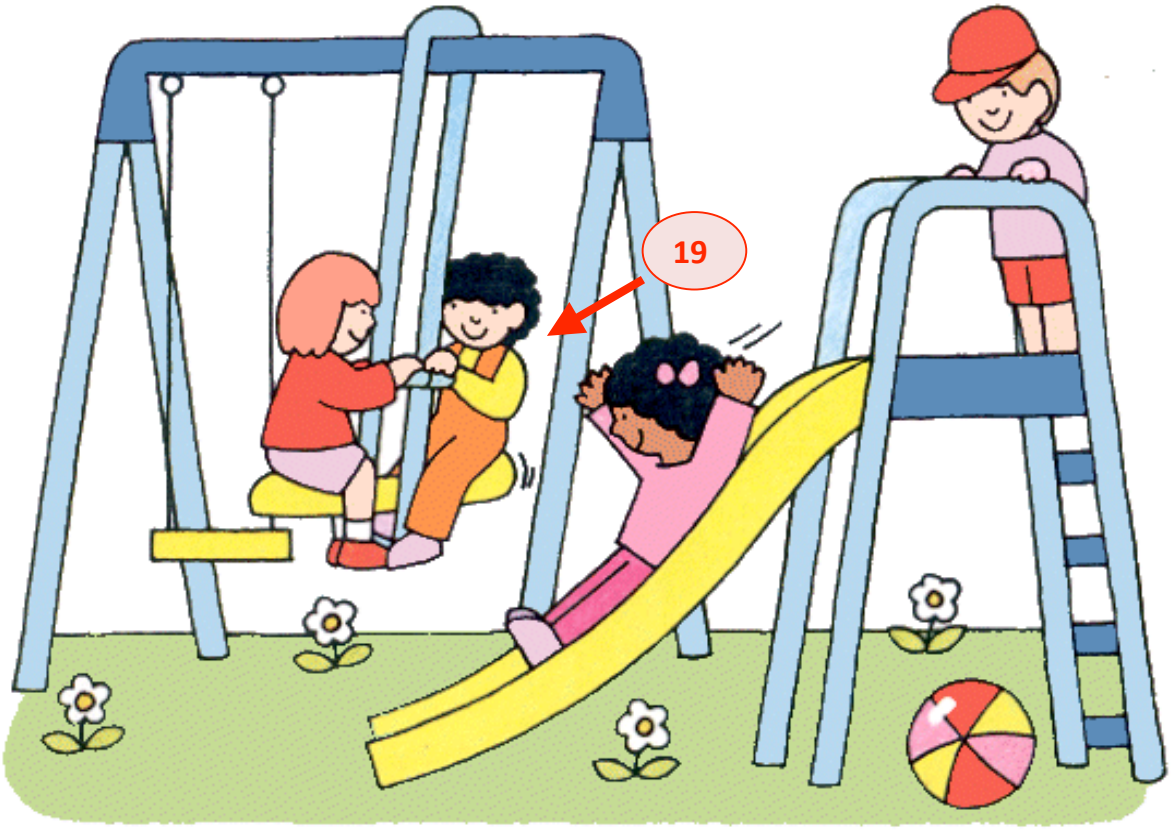
15._____

16._____

17._____

18._____

Directions: Look at the picture below. Draw numbered arrows to show the forces describes in each item below. Number 19 is done for you.



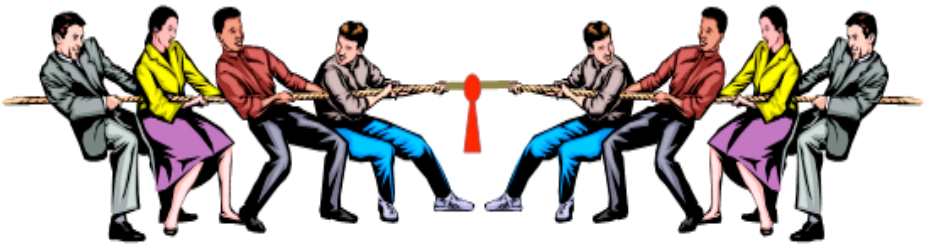
19. The kid in the orange overalls is **pushing** on the swing.

20. Gravity is **pulling** the girl in pink down the slide.

21. The boy in the hat is **pulled** himself up the ladder.

Directions: Look at the pictures below. Describe where the flag will move in each Tug of War. Remember to talk about **equal** and **unequal forces** and the **motions** that they will cause.

Tug of War 1



Side A Side B

Tug of War 2

Side C Side D

22._____

_____

_____

_____

_____

_____

_____

_____

_____

_____

Name:_____ Modified Assessment

Directions: Circle the best answer below each question. Remember to eliminate the ridiculous when you can.

1. What **two** (2) things do you need to find something's **speed**?

   a. Motion and Time
   b. Position and Motion
   c. Time and Distance
   d. Position and Distance

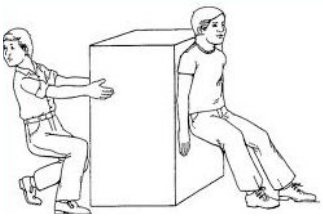
2. A **change** in **position** is called a:

   a. Distance.
   b. Motion.
   c. Planet.
   d. Time.

3. What **measurement** can we use to describe a **motion**?

   a. Speed
   b. Temperature
   c. Weight
   d. Price

4. Which **two** (2) words are used to describe **forces**?



   a. Weight and Motion
   b. Push and Pull
   c. Time and Distance
   d. Black and White

5. What do you feel when you **push** something?

   a. You feel the object getting colder.
   b. You feel the object exploding.
   c. You feel the object pulling on you.
   d. You feel the object pushing back.

6. What do you call the **force** that holds you to the Earth?

a. Gravity
b. Newtons
c. Weight
d. Electricity

7. How to you **measure** how much **gravity** is pulling on you?

a. Speed
b. Weight
c. Motion
d. Distance

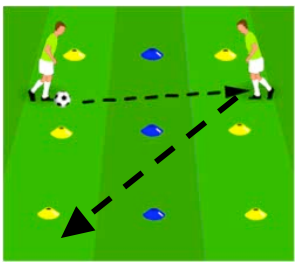
8. Which of the following could **decrease friction**?

a. Oil
b. Sandpaper
c. Rubber
d. Glue

9. When you have a lot of friction, the item moving might _____.

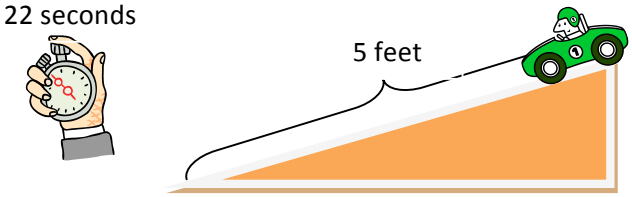
a. go faster.
b. stop moving.
c. start moving.
d. freeze into ice.

10. Passing a ball back and forth is an example of force causing:



a. Gravity.
b. Precipitation.
c. Friction.
d. A change in motion.

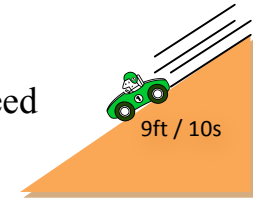
11. Sam released a toy car from the top of a **5 foot ramp**. The car took **22 seconds** to get to the bottom of the 5 foot ramp. What was the **speed** of the Sam's car?

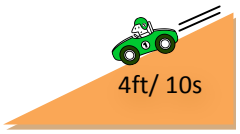


a. 5 feet per 22 seconds
b. 22 feet per 5 seconds
c. 27 feet
d. 225 seconds

12. If a toy car moved at a speed of **4 feet per 10 seconds on a medium ramp** and at a speed of 9 feet per 10 seconds on a high ramp, which ramp has the **fastest** speed?

    a. The ramps have the same speed
    b. The medium ramp
    c. The high ramp



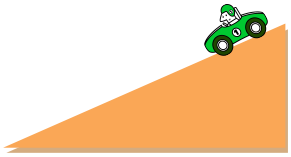


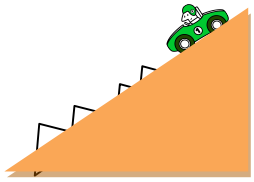
13. When gravity is increased (like on a large planet), your weight will be:

    a. Decreased.
    b. The same.
    c. Reversed.
    d. Increased.

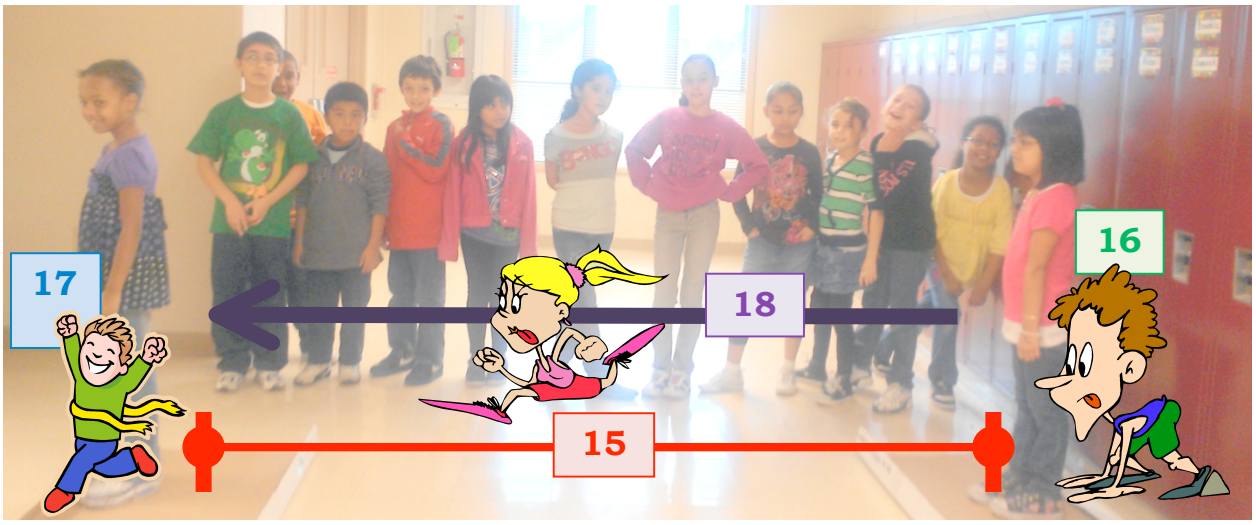
14. If you race two cars with **one on a smooth surface** and one on a rough surface, which car will usually **win**?

    a. It will be a tie.
    b. The smooth surface car will win.
    c. The rough surface car will win.





Directions: Look at the picture below. **Write** the vocabulary word from the **word bank** below next to the number that best described that part of the picture.



Word Bank

Starting Position	Ending Position
Distance	Motion

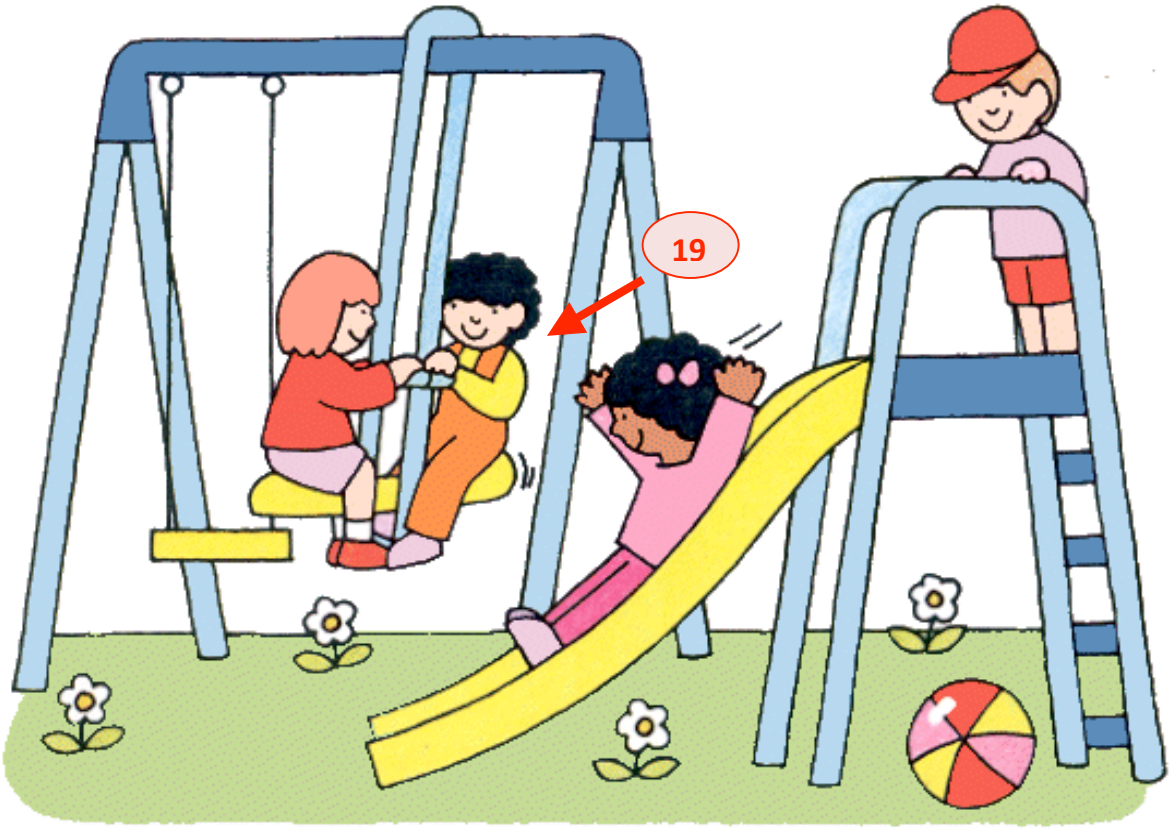
15._____

16._____

17._____

18._____

Directions: Look at the picture below. Draw numbered arrows to show the forces describes in each item below. Number 19 is done for you.



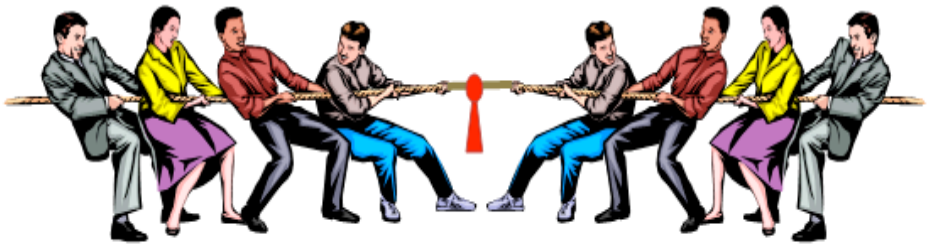
19. The kid in the orange overalls is **pushing** on the swing.

20. Gravity is **pulling** the girl in pink down the slide.

21. The boy in the hat is **pulled** himself up the ladder.

Directions: Look at the pictures below. Describe where the flag will move in each Tug of War. Remember to talk about **equal** and **unequal forces** and the **motions** that they will cause. You may use arrows and pictures to help in your explanation.

Tug of War 1



Side A Side B

Tug of War 2

Side C Side D

22._____

_____

_____

_____

_____

_____

_____

Drawing Box

Answer Key

Directions: Circle the best answer below each question. Remember to eliminate the ridiculous when you can.

1. What **two** (2) things do you need to find something's **speed**? 4.5 points
   a. Motion and Time
   b. ~~Position and Motion~~
   c. Time and Distance
   d. ~~Position and Distance~~

2. A **change** in **position** is called a: 4.5 points
   a. Distance.
   b. Motion.
   c. Planet.
   d. Time.

3. What **measurement** can we use to describe a **motion**? 4.5 points
   a. Speed
   b. Temperature
   c. Weight
   d. Price

4. Which **two** (2) words are used to describe **forces**? 4.5 points
   a. ~~Weight and Motion~~
   b. Push and Pull
   c. ~~Time and Distance~~
   d. Black and White

5. What do you feel when you **push** something? 4.5 points
   a. You feel the object getting colder.
   b. You feel the object exploding.
   c. ~~You feel the object pulling on you.~~
   d. You feel the object pushing back.

6. What do you call the **force** that holds you to the Earth? 4.5 points

a. Gravity
b. Newtons
c. Weight
d. Electricity

7. How to you **measure** how much **gravity** is pulling on you? 4.5 points

a. Speed
b. Weight
c. Motion
d. Distance

8. Which of the following could **decrease friction**? 4.5 points

a. Oil
b. Sandpaper
c. Rubber
d. Glue

9. When you have a lot of friction, the item moving might _____. 4.5 points

a. go faster.
b. stop moving.
c. start moving.
d. freeze into ice.

10. Passing a ball back and forth is an example of force causing: 4.5 points

a. Gravity.
b. Precipitation.
c. Friction.
d. A change in motion.

11. Sam released a toy car from the top of a **5 foot ramp**. The car took **22 seconds** to get to the bottom of the 5 foot ramp. What was the **speed** of the Sam's car? 4.5 points

a. 5 feet per 22 seconds
b. 22 feet per 5 seconds
c. 27 feet
d. 225 seconds

12. If a toy car moved at a speed of **4 feet per 10 seconds on a medium ramp** and at a speed of 9 feet per 10 seconds on a high ramp, which ramp has the **fastest** speed? 4.5 points

    a. The ramps have the same speed
    b. The medium ramp
    c. The high ramp

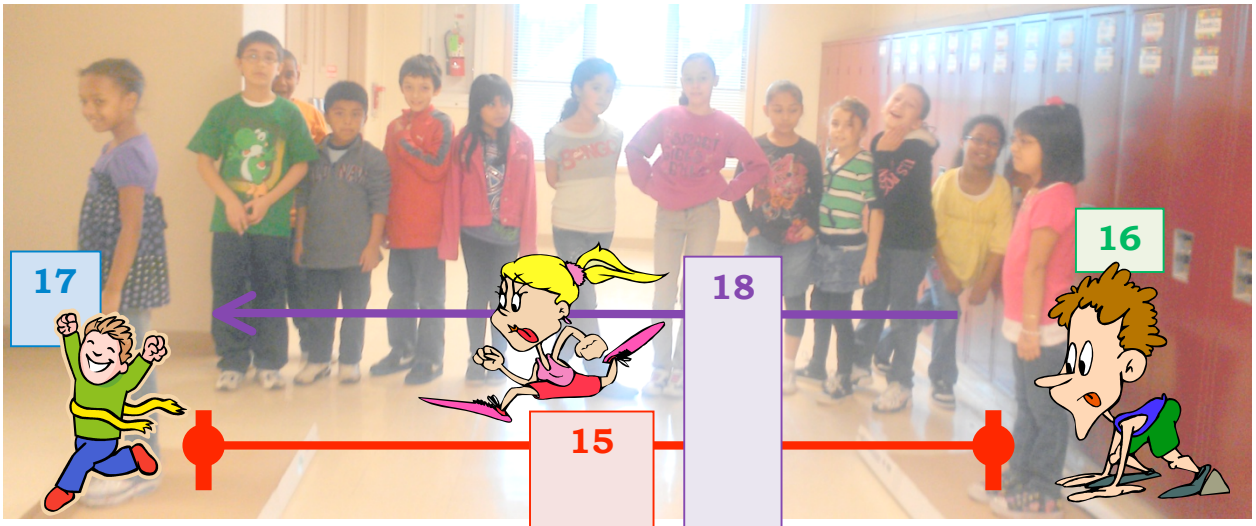
13. When gravity is **increased** (like on a large planet), your **weight** will be: 4.5 points

    a. Decreased.
    b. The same.
    c. Reversed.
    d. Increased.

14. If you race two cars with **one on a smooth surface** and one on a rough surface, which car will usually **win**? 4.5 points

    a. It will be a tie.
    b. The smooth surface car will win.
    c. The rough surface car will win.

Directions: Look at the picture below. **Write** the vocabulary word from the **word bank** below next to the number that best described that part of the picture. 12 points total



Word Bank

Starting Position	En sition
Distance	n

15. Distance 3 points

16. Starting Position 3 points

17. Ending Position 3 points

18. Motion 3 points

Directions: Look at the picture below. Draw numbered arrows to show the forces describes in each item below. Number 19 is done for you. (up to 5 points per rubric below)

22. The kid in the orange overalls is **pushing** on the swing.

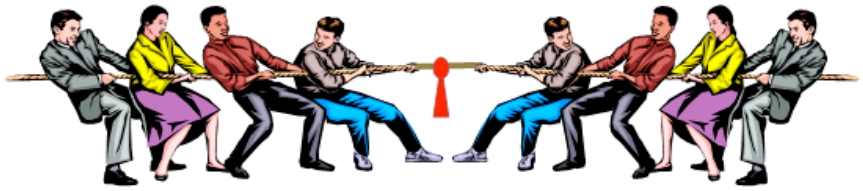
23. Gravity is **pulling** the girl in pink down the slide.

24. The boy in the hat is **pulled** himself up the ladder.

5 points	4 points	3 points	2 points	1 point	0 points
Arrow points in exactly the correct direction and is appropriately labeled.	Arrow points in generally the correct direction and is appropriately labeled.	Arrow points in generally the correct direction and is not labeled or inappropriately labeled.	Arrow does not point in the correct direction, but is located in the correct area. Arrow is labeled correctly.	Arrow does not point in the correct direction but is located in the correct area. Arrow is not labeled correctly.	Arrow is in the wrong location or not drawn at all.

Directions: Look at the pictures below. Describe where the flag will move in each Tug of War. Remember to talk about **equal** and **unequal forces** and the **motions** that they will cause. (up to 15 points based on rubric below.)

Tug of War 1



Side A Side B

Tug of War 2

Side C Side D

Example Answer:

In Tug of War 1 there is equal force on both sides so the flag will not move. In Tug of War 2 there is more force on side D than on side C so the flag will move towards side D.

Rubric

	Forces (6 points)	Motion (6 points)	Grammar (3 points)
3/6	Student identifies equal forces on both sides in Tug of War 1 and unequal (or more or less on each side) forces in Tug of War 2.	Student describes that there will be no motion in Tug of War 1 and there will be motion in the direction of Side D in Tug of War 2.	Student uses proper sentence construction and grammar. (Capital letters, punctuation, proper word usage)
2/4	Students identifies either equal forces in Tug of War 1 or unequal forces in Tug of War 2. (one correct, one incorrect or omitted)	Student describes either no motion in Tug of War 1 or motion in the direction of Side D in Tug of War 2. (one correct, one incorrect or omitted.	Student has some mistakes in sentence construction and grammar, but they do not hinder the meaning or understanding of the writing.
1/2	Student does not identify forces or incorrectly identifies forces.	Student does not describe motion or incorrectly describes motion.	There are multiple sentence construction and grammar errors that hinder the understanding and/or

			meaning of the writing.

Rubric for modified assessment

	Forces (6 points)	Motion (6 points)	Communication (3 points)
3/6	Student identifies equal forces on both sides in Tug of War 1 and unequal (or more or less on each side) forces in Tug of War 2. This may be done with text or with words written by pictures or in symbols.	Student describes that there will be no motion in Tug of War 1 and there will be motion in the direction of Side D in Tug of War 2. This may be done with text or using arrows or other appropriate symbols.	Student makes some attempt at using comprehensible text and uses clear understandable symbols and images if those are used as well.
2/4	Students identifies either equal forces in Tug of War 1 or unequal forces in Tug of War 2. (one correct, one incorrect or omitted) This may be done with text or with words written by pictures or in symbols.	Student describes either no motion in Tug of War 1 or motion in the direction of Side D in Tug of War 2. (one correct, one incorrect or omitted. This may be done with text or using arrows or other appropriate symbols.	Student uses clear understandable symbols and images only.
1/2	Student does not identify forces or incorrectly identifies forces. This may be done with text or with words written by pictures or in symbols.	Student does not describe motion or incorrectly describes motion. This may be done with text or using arrows or other appropriate symbols.	Student's writing and images are hard to comprehend.

This is a well-design unit assessment. Nice use of graphics.