SCIENCE:

GRADE 4–FORCE AND MOTION

GRADE 4

Force and Motion

Effects of Force

TEKS

4 (6) Force, motion, and energy. The student knows that energy exists in many forms and can be observed in cycles, patterns, and systems.

(D) The student is expected to design an experiment to test the effect of force on an object such as a push or a pull, gravity, friction, or magnetism.

Content Objective

I can design an experiment to test the effects of force on an object.

Science

Science Process Skills

4 (2) Scientific investigation and reasoning. The student uses scientific inquiry methods during laboratory and outdoor investigations.

(A) The student is expected to plan and implement descriptive investigations, including asking well-defined questions, making inferences, and selecting and using appropriate equipment or technology to answer his/her questions.

(B) The student is expected to collect and record data by observing and measuring, using the metric system, and using descriptive words and numerals such as labeled drawings, writing, and concept maps.

(C) The student is expected to construct simple tables, charts, bar graphs, and maps using tools and current technology to organize, examine, and evaluate data.

(D) The student is expected to analyze data and interpret patterns to construct reasonable explanations from data that can be observed and measured.

(E) The student is expected to perform repeated investigations to increase the reliability of results.

(F) The student is expected to communicate valid oral and written results supported by data.

4 (4) Scientific investigation and reasoning. The student knows how to use a variety of tools, materials, equipment, and models to conduct science inquiry.

(A) The student is expected to collect, record, and analyze information using tools, including calculators, microscopes, cameras, computers, hand lenses, metric rulers, Celsius thermometers, mirrors, spring scales, pan balances, triple beam balances, graduated cylinders, beakers, hot plates, meter sticks, compasses, magnets, collecting nets, and notebooks; timing devices, including clocks and stopwatches; and materials to support observation of habitats of organisms such as terrariums and aquariums.

Mathematics

4 (11) Measurement. The student applies measurement concepts. The student is expected to estimate and measure to solve problems involving length (including perimeter) and area. The student uses measurement tools to measure capacity/volume and weight/mass.

(A) The student is expected to estimate and use measurement tools to determine length (including perimeter), area, capacity and weight/mass using standard units SI (metric) and customary.

English Language Arts and Reading

4 (27) Listening and speaking/listening. Students use comprehension skills to listen attentively to others in formal and informal settings. Students continue to apply earlier standards with greater complexity.

(A) Students are expected to listen attentively to speakers, ask relevant questions, and make pertinent comments.

4 (28) Listening and speaking/speaking. Students speak clearly and to the point, using the conventions of language. Students continue to apply earlier standards with greater complexity. Students are expected to express an opinion supported by accurate information, employing eye contact, speaking rate, volume, and enunciation, and the conventions of language to communicate ideas effectively.

4 (29) Listening and speaking/teamwork. Students work productively with others in teams. Students continue to apply earlier standards with greater complexity. Students are expected to participate in teacher- and student-led discussions by posing and answering

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questions with appropriate detail and by providing suggestions that build upon the ideas of others.

Figure 19.

Reading/comprehension skills. Students use a flexible range of metacognitive reading skills in both assigned and independent reading to understand an author's message. Students will continue to apply earlier standards with greater depth in increasingly more complex texts as they become self-directed, critical readers.

(C) The student is expected to monitor and adjust comprehension (e.g., using background knowledge, creating sensory images, re-reading a portion aloud, generating questions).

(D) The student is expected to make inferences about text and use textual evidence to support understanding.

English Language Proficiency Standards

1 (E) Cross-curricular second language acquisition/learning strategies.The student is expected to internalize new basic and academic language by using and reusing it in meaningful ways in speaking and writing activities that build concept and language attainment.

Language Objective

I can use the appropriate vocabulary to describe an experiment.

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Response to Intervention/Tier 1 Differentiation

All science lessons support students in receiving quality Tier 1 instruction. Using the 5E model, knowledge is taught in a variety of contexts, integrating math, science, and ELA content, thus supporting the active engagement of students with the content. Lesson-specific differentiation strategies for addressing diverse student needs can be found throughout each lesson in sections titled "Differentiation Strategy."

Differentiation should

- focus on skills students did not understand and extend the lesson for advanced students;
- be conducted in small groups or embedded in whole-group instruction; and
- provide students with a variety of strategies to process the information, such as
    - allowing for additional opportunities for verbal brainstorming of words associated with a topic (with teacher taking dictation);
    - making clear connections of new and more complex concepts to foundational aspects and prior knowledge;
    - participating in more tangible experiences, such as experiments, investigations, and active exploration;
    - sorting academic vocabulary words into categories by common attributes—process words or science content vocabulary;
    - organizing brainstorming into semantic maps or creating graphic organizers;
    - discussing the meaning of a graphic organizer with a partner; and
    - creating a visual representation to demonstrate understanding.

See the handout in the Content Resources section that addresses instructional strategies.

College and Career Readiness Standards

I.A4 Cognitive skills in science. Rely on reproducible observations of empirical evidence when constructing, analyzing, and evaluating explanations of natural events and processes.

I.B1 Scientific inquiry. Design and conduct scientific investigations in which hypotheses are formulated and tested.

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Vocabulary Focus

force
friction
gravity
magnetism
object

Prerequisite Science Knowledge

K (6)(B) The student is expected to explore interactions between magnets and various materials.

1 (6)(B) The student is expected to predict and describe how a magnet can be used to push or pull an object.

2 (6)(B) The student is expected to observe and identify how magnets are used in everyday life.

3 (6)(B) The student is expected to demonstrate and observe how position and motion can be changed by pushing and pulling objects to show work being done such as swings, balls, pulleys, and wagons.

3 (6)(C) The student is expected to observe forces such as magnetism and gravity acting on objects.

5E Lesson Summary

Engage
Students observe the effects of friction.

Explore
Students test the effects of different forces.

Explain
Students explain different forces and how an experiment is designed to test the effects of force.

Elaborate
Students design their own experiments to test force.

Evaluate
Students assess whether an experiment was properly designed and if it produced reliable data.

Engage

Teacher Note

Students may or may not know about the force of friction. This activity addresses friction without defining it. We will define friction in the Explain portion of the lesson.

Materials

For teacher

- stopwatch

For each student

- soles of his or her shoes

Teacher Instruction

- Instruct students to sit in chairs and to feel the soles of their shoes.
- Ask the following: Do the soles of your shoes feel cold, cool, room temperature, warm, or hot? *Answers may vary but should include cool or room temperature.*
- Instruct students to quickly move their shoes back and forth on the floor for 5–10 seconds.
- Instruct students to stop and feel the soles of their shoes.

Facilitation Questions

- Do the soles of your shoes feel cold, cool, room temperature, warm, or hot? *Answers may vary but should include room temperature or warm.*
- Why do you think the soles of your shoes changed temperature? *Accept all reasonable answers.*
- What form of energy was generated by moving your shoes back and forth on the floor? *Heat/thermal energy was generated by moving our shoes back and forth on the floor.*

Teacher Instruction

- Instruct students to quickly move their shoes back and forth on the floor for 15–20 seconds.

Facilitation Questions

- Do the soles of your shoes feel cold, cool, room temperature, warm, or hot? *Answers may vary but should include warm or hot.*

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- How did the temperature of your shoes differ between rubbing them on the floor for a shorter and longer period of time? *The soles of our shoes were warmer after rubbing them on the floor for a longer period of time.*
- Were any force(s) involved in moving your shoes back and forth? If so, which one(s)? *Pushing and pulling forces were used to move our shoes back and forth. Students may or may not know the force of friction is involved.*

Explore

Teacher Note

You may need multiple setups of each experiment, depending on how many student groups you have in your class. Push-pull spring scales can be purchased from science material suppliers. Spring scales need to measure force in newtons. Bath towels can be cut into sections and taped down to substitute for carpeted areas in Experiment A.

Advance Preparation

For Experiment C, locate two identical square or rectangular plastic containers. Leave Container A empty. Fill Container B with gravel, rocks, or dry beans.

Teacher Instruction

- Divide the class into groups of three.
- Assign each group Experiment A, Experiment B, or Experiment C.
- Explain the layout or structure of the experiments on *RMs 1–3*.
  - Each *RM* begins with a question to which students must find an answer. The structure of each experiment is as follows:
    - Question: A question is asked based on what a scientist wants to know.
    - Hypothesis: A hypothesis is a prediction stating what a scientist thinks will happen in an experiment. When looking at the hypotheses, instruct students to circle one of the words in each set of parentheses. They must also fill in the blank after the word *because* to complete the statement.
    - Materials: The materials list details what supplies a scientist will need to conduct an experiment.
    - Procedure: A procedure is a set of instructions detailing how scientists are to conduct an experiment.
    - Data collection: As scientists do an experiment, they can record their observations and data in a table.

Materials

Experiment A

For each student

- RM 1

For student groups

- carpeted area
- tiled area
- large, heavy book
- string
- masking tape
- meter stick
- push-pull spring scale or pull spring scale, 5 N

Experiment B

For each student

- RM 2

For student groups

- smooth surface such as a desk or tabletop
- horseshoe magnet
- bar magnet
- ring magnet
- small paper clip

continued . . .

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- . . . *continued*
- metric ruler

Experiment C

For each student

- RM 3

For student groups

- empty square or rectangular plastic container, labeled "Container A"
- square or rectangular plastic container filled with gravel, rocks, or dry beans, labeled "Container B"
- string
- masking tape
- meter stick
- push-pull spring scale or pull spring scale, 5 or 10 N, depending on the mass of Container B

  - ○ Results: Scientists analyze their results and devise a conclusion based on their findings.
  - ○ Conclusion: Scientists reflect back on their predictions, or hypotheses, to see if they predicted the correct outcome. They also list the things that were done well in the experiment as well as the things that could have been done differently or better.
- Host a whole-group share after the groups have finished their experiments. Students may enjoy participating in a gallery walk in which they have the opportunity to circulate through the classroom to view other groups' experiments.

Facilitation Questions

Experiment A

- What were you testing? *We were testing whether it took more force to pull a book on carpet or tile.*
- Was your hypothesis correct? *Answers may vary.*
- What was the only difference in your experiment? *The only difference in our experiment was the kind of flooring we used: carpet or tile.*
- Why was each person allowed to the pull the book three times on each surface? *Each person was allowed to pull the book three times on each surface because different people may pull with different amounts of force. Each person's results need to be as consistent as possible, so each person should record only his or her own results.*
- What things stayed the same in your experiment? *The things that stayed the same in our experiment were that we used the same book on both surfaces, we pulled the book with the same amount of force each time, we pulled the book the same distance on both surfaces, and we used the same spring scale and meter stick to take all measurements.*
- Why is it important to have only one difference in an experiment? *We need to know what is causing the results in the experiment. For example, if we used different sizes of books and different types of flooring, we would not know whether the size of book or the type of flooring was affecting the results of the experiment.*

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- Was more force needed to pull the book on carpet or tile? *More force was needed to pull the book on carpet.*
- Why was more force needed to pull the book on one surface than the other? *Answers will vary but may include that more force was needed to pull the book on carpet because carpet is rougher or bumpier than tile.*
- Were all your measurements the same? If not, why not? *Answers will vary but may include that each person's data was relatively the same, while one person's data was different from another person's data. This could be a result of one person pulling with more or less force than another. Even one person may not always pull with the same amount of force each time.*
- Why did you repeat the experiment? *We repeated the experiments to make sure we were getting accurate measurements and reliable data. If a scientist does an experiment only one time, he or she might not collect reliable data. The experiment needs to be repeated to make sure the data is similar each time.*

Experiment B

- What were you testing? *We were testing which type of magnet was the strongest.*
- Was your hypothesis correct? *Answers may vary.*
- What was the only difference in your experiment? *The only difference in our experiment was the kinds of magnets we used.*
- What things stayed the same in your experiment? *The things that stayed the same in our experiment were that we used the same metric ruler and paper clip and moved the paper clip 1 cm each time.*
- Why is it important to have only one difference in an experiment? *We need to know what is causing the results in the experiment. For example, if we used different kinds of magnets and different types of magnetic objects, we would not know whether the different kinds of magnets or the different types of magnetic objects were affecting the results of the experiment.*
- Which magnet proved to be strongest? *Answers will vary based on the magnets used.*

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Download Grade4_Explore_F&M from Drop Boxes in your Science Academies for Grades K–4 Project Share group to use on a SMART™ or Mimio® interactive whiteboard.

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- Were all your measurements the same? If not, why not? *Answers will vary but may include that some students' measurements were similar. However, some students may have had different measurements. This could be a result of releasing the magnet instead of holding it in place the whole time or pushing the paper clip instead of moving it forward and releasing it. Magnets lose strength if they are dropped, which could also affect the results.*
- Why did you repeat the experiment? *We repeated the experiment to make sure we were getting accurate measurements and reliable data. If a scientist does an experiment only one time, he or she might not collect reliable data. The experiment needs to be repeated to make sure the data is similar each time.*

Experiment C

- What were you testing? *We were testing whether it took more force to move an empty container or a container filled with gravel, rocks, or dry beans.*
- Was your hypothesis correct? *Answers may vary.*
- What was the only difference in your experiment? *The only difference in our experiment was the mass of the containers.*
- Why was each person allowed to pull each container three times? *Each person was allowed to pull each container three times because different people may pull with different amounts of force.*
- What things stayed the same in your experiment? *The things that stayed the same in our experiment were that we used the same surface, we pulled the containers with the same amount of force each time, we pulled the containers the same distance on both surfaces, and we used the same spring scale and meter stick to take all measurements.*
- Why is it important to only have one difference in an experiment? *We need to know what is causing the results in the experiment. For example, if we used two different containers and two different surfaces, we would not know whether the different containers or the different surfaces were affecting the results of the experiment.*
- Was more force needed to move Container A or Container B? *More force was needed to move Container B.*

- Why was more force needed to move Container B? *Answers will vary but may include that Container B is heavier.*
- Were all of your measurements the same? If not, why not? *Answers will vary but may include that each person's data was similar, while one person's data was different from another person's data. This could be a result of one person pulling with more or less force than another. Even one person may not always pull with the same amount of force each time.*
- Why did you repeat the experiment? *We repeated the experiment to make sure we were getting accurate measurements and reliable data. If a scientist does an experiment only one time, he or she might not collect reliable data. The experiment needs to be repeated to make sure the data is similar each time.*

Force and Motion

Explain

Teacher Instruction

- Read and discuss *Forces among Us*.

Facilitation Questions

- What is a force and what are some kinds of force? *A force is a push or pull. Forces include magnetism, gravity, and friction.*
- What causes magnets to repel? *Magnets repel when like poles, two north or two south poles, face each other.*
- How do magnets behave when they repel? *Repelling magnets may flip over, spin around, or push away from each other.*
- What causes magnets to attract? *Magnets attract when two different poles, a north and a south pole, face each other.*
- What does gravity cause? *Gravity causes a pull between two objects. For example, everything on Earth pulls toward its surface.*
- Why does Earth have such a huge gravitational pull? *Earth has a huge gravitational pull because it has an enormous mass.*
- What is friction? *Friction is a force that occurs when two objects rub against each other.*
- What does friction cause? *Friction causes motion to slow down or stop. For example, when brakes are applied to car tires, the tires slow their rotation.*
- How do people experience friction in their everyday lives? *People rub their hands together to keep them warm or wear shoes with rubber soles to prevent them from slipping.*
- What are spring scales and why do we use them? *Spring scales are tools that help us measure force.*
- What metric unit do we use to measure force? *We use the metric unit of newtons to measure force.*

Materials

For teacher

- *Forces among Us* book

For each student

- *Forces among Us* book

Visit http://www.socrative.com to conduct interactive student polling for formative assessment.

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- How do you begin an experiment? *You begin an experiment with a question you want answered.*
- How do you answer the question? *To answer a question, you create a hypothesis, make a materials list, write a procedure, collect data, analyze the results, and come to a conclusion.*
- What is a hypothesis? *A hypothesis is a prediction we make that tells what we think will happen in the experiment.*
- What is a procedure? *A procedure is a set of instructions that tells us how to do the experiment.*
- How do you know your data is reliable? *To make sure our data is reliable, we need to repeat the experiment to make sure our numbers are similar.*

Elaborate

Teacher Note

Students will be designing their own experiments to test the effects of force in this portion of the lesson. Some students may need you to provide them with questions. Have various materials on hand for students to use.

Materials

For each student

- RM 4

For student groups

- various materials to test the effects of force, such as:
  - ramps
  - golf balls
  - toy cars
  - tennis balls
  - table tennis balls
  - marbles
  - books
  - towels
  - foil
  - waxed paper
  - sand paper
  - horseshoe magnets
  - bar magnets
  - ring magnets
  - magnetic wands
  - metric rulers
  - meter sticks
  - push-pull spring scales or pull spring scales, 5 N or 10 N

Differentiation Strategy

G/T: Students who readily grasp the concept may think of their own questions to test.

ELL: Make sure your ELL students work with a partner or a small group of proficient speakers.

Teacher Instruction

- Divide class into groups of three students.
- Allow groups to design and conduct experiments using *RM 4: Designing an Experiment*.

  Examples of experiments may include the following:

  - Does friction affect magnetism?
    - Students may choose to test this question by following a similar set of instructions as was used in Experiment B of Explore. Students may use two horseshoe magnets positioned 10 cm away from each other on tile. While holding one magnet in place at 0 cm, the other magnet would be moved 1 cm at a time from 10 cm toward the magnet at 0 cm. This experiment would then be repeated on carpet to see if friction affected the distance between the two magnets when attraction was first observed.
  - Is magnetism more powerful than gravity?
    - Students may choose to test this question by following instructions similar to the previous experiment. The only difference would be that the metric ruler would be vertical. The magnet resting at 0 cm would not be held in place. Instead, the magnet being moved closer to the magnet at 0 cm would be held in place after each 1 cm move forward. Students

would determine whether magnetism is more powerful than gravity based on whether the magnet being moved toward 0 cm could eventually pick up the magnet resting on the floor.

- Does friction affect how far an object will roll?
  - Students could create ramps of equal height and size and cover each with a different material, such as carpet, sand paper, or waxed paper. A ball or toy car could be rolled down the ramps with various coverings. Students could measure how far the object rolls after it reaches the bottoms of the ramps. Alternately, students could use only one ramp but set it up on different surfaces such as carpet, tile, or concrete. Again, students could measure how far the object rolls after exiting the ramp.

- Host a whole-group share out after the groups have completed their experiments.

Facilitation Questions

- What question did you choose to test? *Answers will vary.*
- How did you test your question? *Answers will vary.*
- Was your hypothesis supported by your data? *Answers will vary.*
- Did you repeat your experiment? If so, why? *Answers will vary.*
- What was your conclusion? *Answers will vary.*

Science Notebook Entry

Teacher Instruction

- Post the following prompt where all students can read it:

  Describe a time in your life when you experienced friction. Was it a good experience or a bad experience? Would it have been better if you had experienced more or less friction?

Use Project Share ePortfolio Blog tool to elicit student responses and allow for continued conversation. Refer to the “ePortfolio Blog” video in your Science Academies for Grades K–4 Project Share group.

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Answers may include the following:

- *Slipping on a wet floor and bruising your leg or breaking your arm*
- *Putting snow chains on tires to avoid slipping on ice*
- *Sliding into base during a ball game to avoid being tagged out*
- *Hydroplaning on a wet road due to a lack of tread on tires and having a wreck*
- *Sledding down a snow-covered hill to experience speed*
- *Sliding down a playground slide or water slide and not getting stuck*

Evaluate

Teacher Instruction

- Instruct students to work in groups and to use their knowledge of designing an experiment to test force to complete *RM 5: Designing an Experiment Assessment.*

Materials

For each student

- RM 5

RM 5 Answer Key

1. What did the students do correctly?
   - *The layout of the experiment was done well. A question, hypothesis, materials list, procedure, data, and results were all part of the plan.*
   - *The students repeated the experiment to record more data.*
   - *The students used the same size books, ramp, toy car, and meter sticks.*
   - *The students measured and recorded their data in a table.*
2. What could the students have done better?
   - *The students should have used the same number of books to place under each ramp. They were testing to see if the car would travel farther on carpet or tile. The height of the books should not be a factor in the experiment.*
   - *The same student could have released the car to make sure it was done the same way each time. Judging by Trial 3 on tile, it looks as if someone may have pushed the car instead of releasing it since the distance traveled was much greater than in Trials 1 and 2.*
3. Based on the experiment, is the students' hypothesis supported by their data and did they design the experiment to find a true answer to their question? Why or why not?
   - *The students' hypothesis is not supported by their data according to the results.*
   - *The students did not design the experiment to find a true answer to their question because they had two differences: the type of flooring and the height of the ramp.*
   - *In order to find a true answer, the students would need to redo the experiment using the same ramp height on both types of flooring.*

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RM 1: Experiment A

Question: Is more force needed to move an object resting on carpet than an object resting on tile?

Hypothesis/Prediction: (More/Less) force is needed to move an object on (carpet/tile) because ____.

Materials

- carpeted area
- tiled area
- large, heavy book
- string
- masking tape
- meter stick
- push-pull spring scale or pull spring scale, 5 N

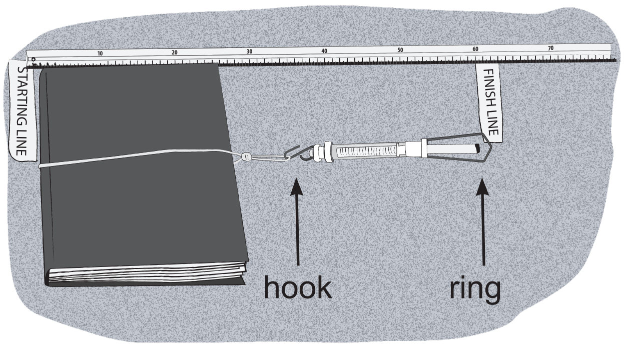
Procedure

Part A

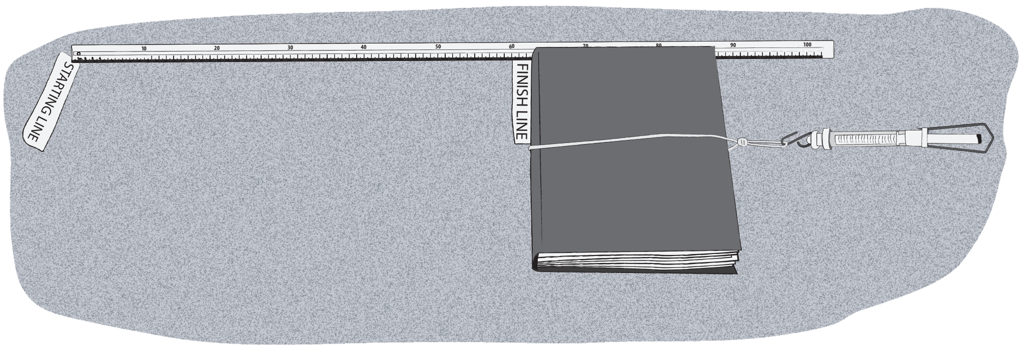
1. Place a piece of masking tape on the carpet and label it “Starting Line.”
2. Use the meter stick to measure 60 cm from the starting line.
3. Place another piece of masking tape on the carpet 60 cm from the starting line and label it “Finish Line.”
4. Place a large, heavy book with its spine resting on the starting line.
5. Tie a string around the book and make a loop for the spring scale hook.
6. Place the spring scale hook in the loop of the string.
7. Make sure you can see the side of the spring scale showing newtons.

RM 1: Experiment A continued

8. Use the ring of the spring scale to pull the book with a steady force until its spine reaches the finish line.



Before



After

9. Observe the measurement on the spring scale from the time you begin pulling the book until the time you stop. You may notice that a greater force is needed to get the book moving.
10. Record the amount of force in newtons that you used to pull the book.
11. Place the book and spring scale back at the starting line.
12. Repeat steps 8–11 two more times.
13. Allow each person in your group to pull the book three times.

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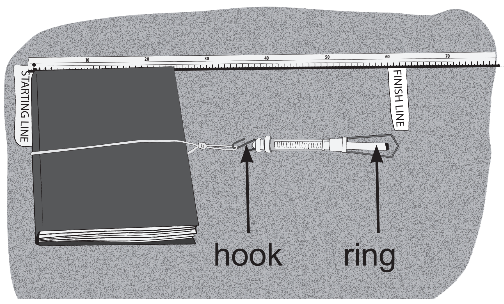
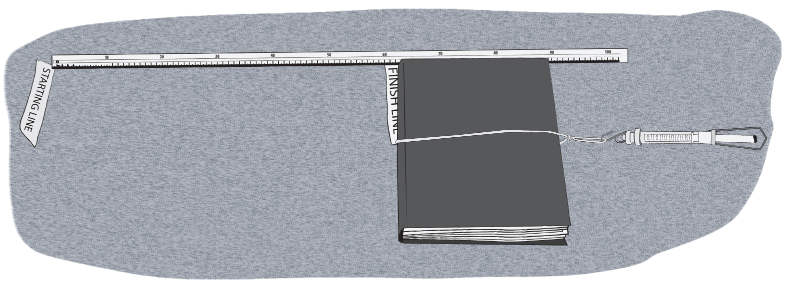
RM 1: Experiment A continued

Part B

1. Find an area of floor that is covered with tile.
2. Place a piece of masking tape on the tile and label it "Starting Line."
3. Use the meter stick to measure 60 cm from the starting line.
4. Place another piece of masking tape on the tile 60 cm from the starting line and label it "Finish Line."
5. Place a large, heavy book with its spine resting on the starting line.
6. Tie a string around the book and make a loop for the spring scale hook.
7. Place the spring scale hook in the loop of the string.
8. Make sure you can see the side of the spring scale showing newtons.
9. Use the spring scale to pull the book with a steady force until its spine reaches the finish line.



Before



After

10. Observe the measurement on the spring scale from the time you begin pulling the book until the time you stop. You may notice that a greater force is needed to get the book moving.

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RM 1: Experiment A continued

11. Record the amount of force in newtons that you used to pull the book.
12. Place the book and spring scale back at the starting line.
13. Repeat steps 9–12 two more times.
14. Allow each person in your group to pull the book three times.

Data

		Amount of Force Used (newtons)		
Experiment		**Trial 1**	**Trial 2**	**Trial 3**
A	Pull the large, heavy book 60 cm on carpet.			
B	Pull the large, heavy book 60 cm on tile.			

Conclusion

__________________ of force was needed to pull the large, heavy book on __________________

because ____

____

____.

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RM 2: Experiment B

Question: Are some magnets stronger than others?

Hypothesis/Prediction: The (horseshoe/bar/ring) magnet is strongest because ________

____.

Materials

- smooth surface such as a desk or tabletop
- horseshoe magnet
- bar magnet
- ring magnet
- small paper clip
- metric ruler

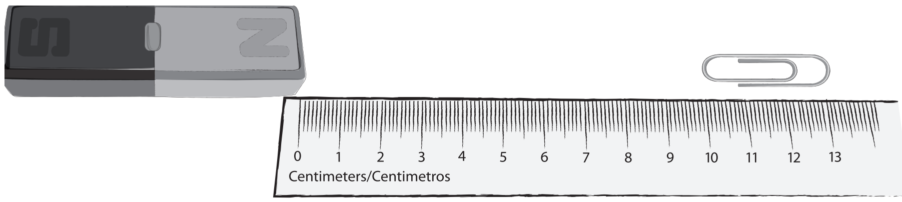
Procedure

1. Place the metric ruler on the desk or tabletop.
2. Position the horseshoe magnet at 0 cm.
3. Place the paper clip with its front edge at 10 cm.

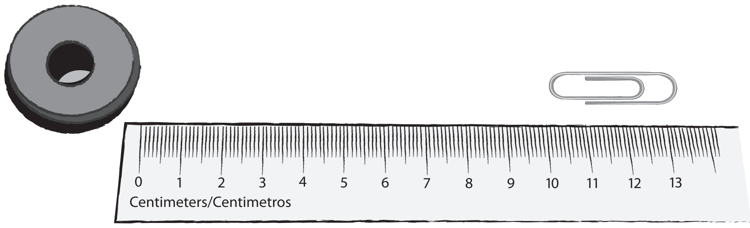
4. Move the paper clip closer to the magnet 1 cm at a time while holding the magnet in place.
5. Remove your hand from the paper clip after every move. This will allow the paper clip to interact with the magnet more freely. Hold the magnet in place throughout the experiment.
6. Observe and record the distance at which the paper clip freely moves toward the magnet and attaches to it.
7. Repeat steps 2–6 two more times.

RM 2: Experiment B continued

8. Repeat steps 1–7 using a bar magnet.



9. Repeat steps 1–7 using a ring magnet.



Data

	Distance at Which Paper Clip Moved toward Magnet (cm)		
Type of Magnet	**Trial 1**	**Trial 2**	**Trial 3**
horseshoe			
bar			
ring			

Conclusion

The ________________ magnet was strongest because ____________________________

____

____

Grade 4

RM 3: Experiment C

Question: Is more force needed to move heavier objects?

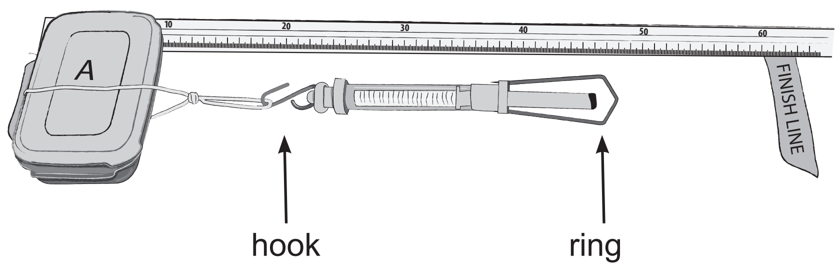
Hypothesis/Prediction: (More/Less) force is needed to move objects with (more/less) mass because____.

Materials

- empty square or rectangular plastic container, labeled “Container A”
- square or rectangular plastic container filled with gravel, rocks, or dry beans, labeled “Container B”
- string
- meter stick
- push-pull spring scale or pull spring scale, 5 or 10 N, depending on the mass of Container B

Procedure

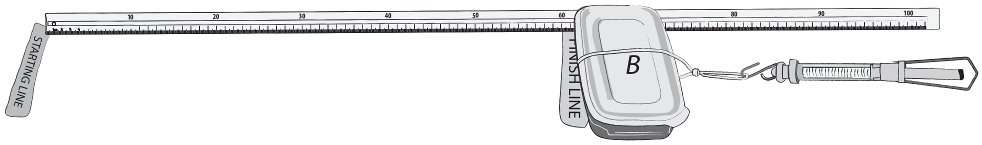
1. Find an open area of floor.
2. Place a piece of masking tape on the floor and label it “Starting Line.”
3. Use the meter stick to measure 60 cm from the starting line.
4. Place another piece of masking tape on the floor 60 cm from the starting line and label it “Finish Line.”
5. Tie a string around Container A and make a loop for the spring scale hook.



6. Place the spring scale hook in the loop of the string.
7. Make sure you can see the side of the spring scale showing newtons.
8. Place Container A with its back edge resting on the starting line.

RM 3: Experiment C continued

9. Use the spring scale to pull Container A with a steady force until its back edge reaches the finish line.



10. Observe the measurement on the spring scale from the time you begin pulling Container A until the time you stop. You may notice that a greater force is needed to get the container moving.
11. Record the amount of force in newtons that you used to pull Container A.
12. Repeat steps 8–11 two more times.
13. Allow each person in the group to pull Container A three times.
14. Repeat steps 5–13 with Container B.

Data

	Amount of Force Used (newtons)		
Experiment	**Trial 1**	**Trial 2**	**Trial 3**
Pull Container A 60 cm.			
Pull Container B 60 cm.			

Conclusion

__________________ force was needed pull Container (A/B) 60 cm because ________________

____

____

____

____.

Grade 4

RM 4: Designing an Experiment

Question: ____

Hypothesis: ____

____

Materials

Procedure

1. ____
____

2. ____
____

3. ____
____

4. ____
____

5. ____
____

6. ____
____

Grade 4

RM 4: Designing an Experiment continued

7. ______________________________

8. ______________________________

9. ______________________________

10. ______________________________

Data

Results (Explain the data.)

Conclusion (Evaluate your hypothesis.)

Grade 4

RM 5: Designing an Experiment Assessment

Read the following experiment.

A group of students wants to know if a toy car will travel farther on carpet or tile. Their teacher asks them to design an experiment to answer the question. Here is what the students wrote.

Question: Will a toy car travel farther on carpet or tile?

Hypothesis/Prediction: A toy car will travel faster on tile because it is smoother than carpet and will have less friction.

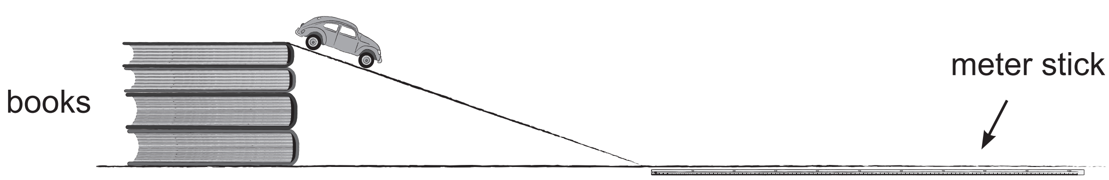
Materials

- toy car
- 4 books, same size
- ramp
- carpeted area
- tiled area
- 2 meter sticks

Procedure

Part A

1. Find an area of floor covered with carpet.
2. Stack four books of the same size squarely on top of each other.
3. Set the ramp on the edge of the books.
4. Lay the meter sticks on the floor on either side of the ramp.
5. Place the toy car at the top of the ramp.
6. Release the toy car and record in the table the distance it travels.
7. Repeat steps 5–6 two more times.

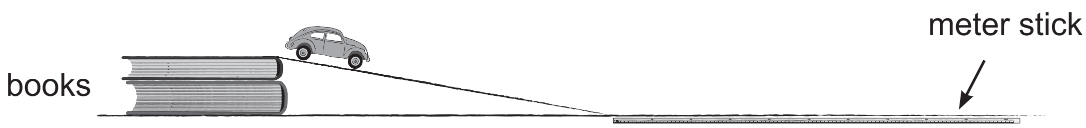


Grade 4

RM 5: Designing an Experiment Assessment continued

Part B

1. Find an area of floor covered with tile.
2. Stack two books of the same size squarely on top of each other.
3. Set the ramp on the edge of the books.
4. Lay the meter sticks on the floor on either side of the ramp.
5. Place the toy car at the top of the ramp.
6. Release the toy car and record in the table the distance it travels.
7. Repeat steps 5–6 two more times.



Data

		Distance Car Traveled in Centimeters (cm)		
Type of Flooring	**Height of Ramp**	**Trial 1**	**Trial 2**	**Trial 3**
carpet	4 books tall	2	36	34
tile	2 books tall	27	28	35

Results: The toy car traveled farther on carpet.

Conclusion

1. What did the students do correctly?

____

____

____

____

Grade 4

RM 5: Designing an Experiment Assessment continued

2. What could the students have done better?

3. Based on the experiment, is the students' hypothesis supported by their data, and did they design the experiment to find a true answer to their question? Why or why not?

NOTES

NOTES

Lesson Summaries

Force and Motion

Grade	TEKS	Lesson Summaries
4		**Engage:** **Explore:** **Explain:** **Elaborate:** **Evaluate:**
3		**Engage:** **Explore:** **Explain:** **Elaborate:** **Evaluate:**
2		**Engage:** **Explore:** **Explain:** **Elaborate:** **Evaluate:**
1		**Engage:** **Explore:** **Explain:** **Elaborate:** **Evaluate:**
K		**Engage:** **Explore:** **Explain:** **Elaborate:** **Evaluate:**