



3-5 Nature of Science
3-5 Physical Science

Southern Nevada Regional Professional Development Program

Ramps and Marbles

INTRODUCTION

Balls, marbles, oranges are all things that can be rolled. Have you ever observed what takes place when you roll an object? How about if you rolled it down a hill? What happens if you roll two objects that were of different masses down the hill?

WHERE'S THE SCIENCE?

Isaac Newton was an English scientist and mathematician. One of his contributions to science is Newton's Three Laws of Motion. Newton's Second Law of Motion is one whose formula you may be familiar with: $F=ma$, but what does that all mean? Newton's Second Law of Motion deals with the relationship between the mass of an object, the size and direction of the force acting upon the object, and the object's acceleration. For example, in the following lessons the students investigate how far two different-sized marbles move an index card when rolled down a ramp. They note that the marble with the most mass will push the index card the greatest distance while the marble with the smallest mass doesn't move the card as far.

MATERIALS (for pairs of students)

All Lessons

- Ruler with a groove down the middle
- Baggie containing one marble (not very small or very large), two 3"x5" index cards, and one 20 gram mass piece (tyke-sized Lego blocks work well)
- Meter sticks or tapes
- Large pieces of butcher or poster paper
- Science notebooks
- Class *Question Board* with sentence strips or sticky notes

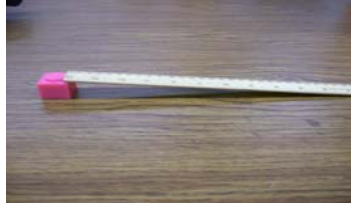
Lesson 2 (Lesson 2B is a more guided version of Lesson 2)

- Variety of different sized marbles (Also use for Lesson 2B)
- Variety of different mass pieces (Also use for Lesson 2B)
- Any additional materials students may need as stated in their plans (Lesson 2 only)

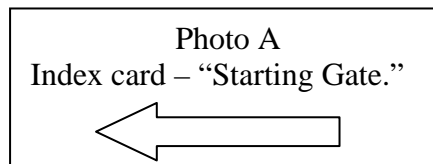
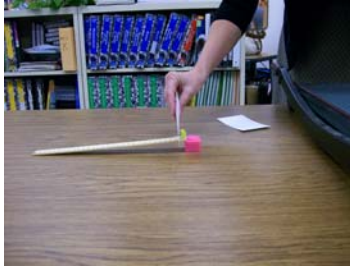
PROCEDURES

Lesson 1:

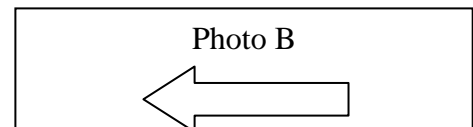
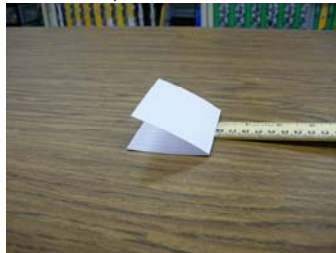
1. Hold up a marble and ask how it can be moved. Some suggestions may be to throw, bounce, or roll it. Explain that today the students are going to observe what happens when a marble is rolled.
2. Have students work in pairs and roll a marble on their desk tops. Tell them to record in their science notebooks what they observe. Bring students back together as a whole group and share their observations.
3. Show students the materials that they will be using for today's lesson. Each pair of students will have a baggie that contains one marble, one 20 gram mass piece, a grooved ruler, and two index cards.
4. Model for students how to set up the ruler as a ramp. Rest one end of the ruler on the gram piece (See photo).



5. Demonstrate what to do with the two index cards. One card will act as the “starting gate” to hold the marble at the top of the ramp (See photo A).



The second index card will be folded in half to look like a giant arrow. This index card will be placed at the other end of the ramp (See photo B).



6. Explain that students will release the marble down the ramp and measure the distance the index card at the bottom of the ramp moves. Tell them that they will need to complete at least three tests and record the data in their science notebooks. Encourage them to record any questions that may arise.
7. After all pairs have finished, have them organize and interpret their data. This can be done on large sheets of paper which can be posted around the room. Be sure that students are making a claim and supporting it with their evidence.
8. Have pairs share out their findings. If time is a factor, you may want to choose random pairs to share out, rather than all pairs. You can ask if others came to the same conclusions. If

possible keep posters up for students to refer to over the course of their investigations.

Lesson 2: - This lesson can be done in one of two ways; the one immediately following is more open-ended

1. Begin today's lesson by reviewing what the students did previously.
2. Ask the students to choose one burning question that they recorded in their notebooks from the investigation. Hand each student a sentence strip and instruct them to record their question on it (give them a dark-colored marker to do this so that it will show up when posted).
3. Invite the students to share their questions. Post on the *Question Board* once they have been shared.
4. Student pairs should now choose one of the posted questions to investigate.
5. Once the pairs have chosen their question, instruct them to create a plan to investigate their question. Explain that they must include the question they are investigating, materials they will need, what they think will happen, and the steps they will take to do the investigation.
6. Give students the rest of the time to create their plan. If at all possible, review the plans to be sure that additional materials will be available and that they will change only one variable.

Lesson 2B - This lesson is more guided

1. Follow steps 1, 2, and 3 in **Lesson 2**.
4. Explain that today they will change one variable and examine in detail what happens. Pairs can choose one of the following materials to change: either the size of the marble or the height of the ramp.
5. Have pairs create their plans as detailed in **Lesson 2**.

Lesson 3:

1. Using their plans, ask the students to investigate. Emphasize that they are to complete at least three tests and to record all their data, conclusions, and any questions in their notebooks.

Lesson 4 - This may take a few days to complete

1. If any pairs have not completed their investigation, give them time to do so. Pairs that have finished will be given poster paper to present their findings. Tell students that they are expected to include the following information on their posters:
 - a. The question they investigated
 - b. The data they collected in an organized, visual way (for example – graph, T-chart, etc.)
 - c. A conclusion of their findings (ensure they are not restating the steps they took)
 - d. Any additional questions that they have noted

Lesson 5 - Allow several days for this to take place

1. Select a few pairs to share their investigations each day. Allow the audience to ask questions of the presenters as well as make any connections to other students' findings. The audience members should record any new information in their notebooks that they have learned.
2. Once all pairs have shared, have students refer to the new information that they learned. Share out and chart.
3. Share Sir Isaac Newton's findings. Students can compare their findings to his.

Extensions

- Research Sir Isaac Newton.
- Pan balances may be included for students who would like to check the mass of the marbles.

Vocabulary

Force - A push or pull on an object

Friction - The force that one surface exerts on another that makes them stop or slow down

Gravity - The natural force that draws objects toward Earth

Mass - The amount of matter in an object

Additional Resources

Force and Motion, DeltaScienceReaders, ISBN – 10: 1-59242-252-7/ISBN – 13: 978-1-59242-252-4

Stop Faking It! Finally Understanding Science so You Can Teach It! Force & Motion, Robertson, William C., NSTA Press, ISBN: 0-87355-209-1

http://www.bbc.co.uk/schools/scienceclips/ages/10_11/forces_action.shtml

Nevada State Science Standards

P5B1 Students know that, when an unbalanced force is applied to an object, the object speeds up, slows down, or goes in a different direction. E/S

P5B2 Students know how the strength of a force and mass of an object influence the amount of change in an object's motion. E/S

N5A1 Students know scientific progress is made by conducting careful investigations, recording data, and communicating the results in an accurate method. E/S

N5A2 Students know how to compare the results of their experiments to what scientists already know about the world. I/L

N5A3 Students know how to draw conclusions from scientific evidence. E/S

N5A4 Students know graphic representations of recorded data can be used to make predictions. E/S

N5A5 Students know how to plan and conduct a safe and simple investigation. E/S

N5B3 Students know the benefits of working with a team and sharing findings. E/L

Safety Reminders

N/A

This mini-unit was adapted from Ramps and Rulers Lesson.