



Marble Racers Lesson Plan

Overview In this lesson, students create racetracks for marbles and experiment by making changes to their designs to improve the way the marbles travel down the course.

Grades: Preschool and K-3

Length of Lesson: Approximately 45 minutes

Related Video: “Careering Off Course” episode

Learning Goals:

After completing this lesson, students will be able to:

- Make a prediction or hypothesis.
- Understand how to make changes to an experiment in order to achieve desired results.
- Observe, discuss, compare and contrast results.
- Understand that changes in angles can cause objects to fall at different speeds.
- Describe the impact that different changes have on results.
- Describe and present findings.

Related Goals from the Space Racers™ Curriculum:

Scientific Inquiry:

Exploration and Investigation: We obtain information and learn about the world through exploring objects and investigating how things work. Conducting scientific investigations, engaging in hands-on experiences, and asking open-ended questions can foster greater conceptual understanding of our world.

- Explore new things as a way to broaden one’s understanding of the world.
- Use prior knowledge and experiences to develop specific questions that will lead to information, solutions, and answers.
- Form theories/hypotheses/predictions to explain how and why things happen.
- Design and carry out simple cooperative investigations that apply learning from past experiences and support new discoveries.
- Discuss the findings of investigations.

Observation: Looking carefully is one way to learn about things around us.

- Take note of a variety of properties and describe as accurately as possible (e.g., number, shape, size, length, color, texture, weight, motion, temperature, other physical characteristics, etc.).
- Scan/analyze an object or event from multiple positions in order to capture different perspectives.
- Make comparisons to identify similarities and/or differences.
- Develop questions and predictions based on observations.
- Communicate findings verbally or by using pictures, graphs, charts, and/or representations.

Marble Racers Lesson Plan

Experimentation: Sometimes more can be learned by actually doing something to things and taking note of what happened. We use scientific testing and experimentation to seek reasons and evidence in an attempt to prove or disprove our ideas and hypotheses, to discover new information, and to draw conclusions.

- Form hypotheses/make predictions using prior knowledge and past experiences.
- Perform tests and observe any new findings.
- Collect data: e.g., ask questions, make observations, perform simple measurements using standard and/or non-standard units of measure, make estimations, etc.
- Analyze data: e.g., compare, contrast, sort, classify, etc.
- Describe things as accurately as possible in terms of their number, shape, texture, size, weight, color, motion, etc.
- Draw conclusions/discover new information; compare conclusions to original hypotheses.
- Communicate findings using pictures, graphs, charts, representations, and/or words.
- Model safe behaviors while experimenting.

Materials:

- empty paper towel and/or toilet paper rolls--approximately 1 per student (*Note: For Activity 1, one roll is needed for demonstration purposes. For Activity 2, three rolls are needed for each group of 3-4 students.*)
- tape
- marbles
- easel paper or large sheets of paper with adhesive backing (like a post-it note)
- an empty cup, basket, or other container to catch the marbles
- "Sample Diagram of a Marble Racetrack"
- "Photograph of Marble Racetracks"
- paper (1 sheet per student) and crayons

Prep:

- Cut the paper towel and toilet paper rolls in half lengthwise, leaving one or two intact for use in the first activity.
- View the "Sample Diagram of a Marble Racetrack" and the "Photograph of Marble Racetracks" and print them out if desired.
- Optional- Create a sample racecourse using paper towel &/or toilet paper rolls.

Lesson Activities:

Activity 1: Dropping Marbles

1. Hold up a marble and a paper towel roll (uncut). Place a cup directly under the tube.
2. Ask your students what they think will happen if you drop the marble. (*Possible answers: It will fall into the cup, it will get stuck in the tube, etc.*)
3. Drop the marble into the tube. Ask your students to describe what happened.
4. Ask students to give you some suggestions of what you could do to slow down the speed of the marble as it falls through the tube toward the cup. (*Possible answers: Angle the tube, squeeze the tube, etc.*)
5. Follow one of the suggestions from your students and see if that action helps to slow down the speed of the marble.

Marble Racers Lesson Plan

6. If your students haven't suggested changing the angle of the tube, tilt the paper towel roll, so that it is almost horizontal, but still pointing down toward the cup. Ask your students if they think that a marble going through the tube when you hold it like this would drop faster or slower than the first time. Ask them to explain their predictions.
7. Drop the marble into the top of the tube and hold the tube in place until the marble falls out the other end.
8. Ask students to describe what happened. Did the marble go faster or slower than when the tube was completely vertical? (*Slower.*) Ask them to explain why. (*The angle at which you were holding it caused it to slide down slower.*)
9. Ask students to think of some real-world examples of this. (For example, a playground slide that is less steep will usually take longer to go down than the same-sized slide that has a steeper angle.)

Activity 2: Designing a Marble Racetrack

1. Explain that today you are going to be creating racecourses for marbles. If you made a sample racetrack in preparation for this lesson, show it to your students as an example.
2. Divide your class into groups of 3-4 students each. Give each group the following:
 - three pre-cut paper towel and/or toilet paper rolls (6 halves)
 - a large sheet of paper or a section of wall on which to tape their racetrack
 - tape
 - a cup or other small container (to catch the marbles at the bottom of the track)
3. Ask each group to create a racetrack for their marbles to race down. Instruct students to make their racetracks by taping the paper towel and/or toilet paper rolls to a large sheet of paper or the wall.

Tip:

 - Encourage students to place the rolls in alternating directions. (See the "Sample Diagram of a Marble Racetrack" and the "Photograph of Marble Racetracks" for examples.)
 - Instruct students to tape the long edge of the roll against the paper.
4. If students are taping their rolls to a piece of paper, help them hang up their paper onto the wall after they have finished creating their racetracks.
5. Ask students to place a cup or other container at the bottom of the course.
6. Instruct each group to test its racetrack by placing a marble at the top of the course and seeing if it lands in the container at the bottom. If it doesn't, have them make changes to the course so that the marble successfully makes it from the beginning to the end of the course.
7. Ask students to think about how they could make their marbles get from the start to finish faster, by keeping the same number of tracks. (*They can change the angles of the track, vary the spacing between the tracks, etc.*)
8. When students are making changes to their racetracks, encourage them to make one change at a time and then run a marble through the course after each change. Ask students to observe how the speed and path of the marble is affected by each change.
9. Encourage students to swap out one of their paper towel rolls for a toilet paper roll or vice versa. Have them predict how the change will impact how the marbles will go down the track. After they make their prediction, ask them to drop a marble at the top of the track and observe how the new paper roll impacts the way that the marble travels down the track.

Marble Racers Lesson Plan

10. Have them make other changes (changing an angle of a paper roll, changing the spacing between rolls, etc.), one a time. After making each change, ask students to predict what the results will be and then have them drop a marble down the course and discuss the results.
11. Have students increase or decrease the number of rolls in their course and see how that effects the way the marbles fall.
12. Encourage students to continue making changes to their racetracks, one change at a time, until they feel satisfied with their racetrack.

Activity 3: Careering Off Course

1. View the Space Racers™ “Careering Off Course” episode.
2. After watching the episode, ask your students to describe what Robin did in order to help the Space Racers fly off the ramp more effectively. (*She changed the angle at which the launch ramp was positioned and the direction in which it was pointing.*)
3. Ask students how Robin’s changes to the ramp angles affected the Space Racers flight. (*It helped them make smoother U-turns and also helped Robin and Eagle get to Starling’s location faster, by flying on a more direct path.*)
4. Ask students to think about how changes to the angles of the paper towel rolls on their marble racetracks affect the way the marbles fall down.

Activity 4: Marble Races

1. Have students prepare for marble racing by making any necessary changes to their racetracks in order to make their marbles go from start to finish as fast as possible. (We recommend having each group start with 5-6 paper towel or toilet paper roll halves per course.)
2. Once groups are ready, have them race their marbles, seeing which team can get their marble from start to finish in the shortest time. After each run, give teams a change to modify their racetracks before racing again.
3. As a fun option, ask students to see which team can get their marble to get to the cup at the bottom of the course in the slowest amount of time.
4. Give students some time to try out each other’s courses by having them drop their marbles down each of the racetracks. Ask students to compare and contrast the ways in which the marbles go down each course.
5. Encourage teams to work together to combine their racetracks in order to create one or more really large racetrack.
6. Have students test out the expanded racetrack(s) and observe and discuss the way that marbles go down the track(s).
7. Optional: Have students experiment with putting other small objects, such as coins and beads, down the tracks. Before placing the new objects on the tracks, ask students to predict whether they think the new object will go down the course faster or slower than the marbles did. Then have them observe and discuss what happens.

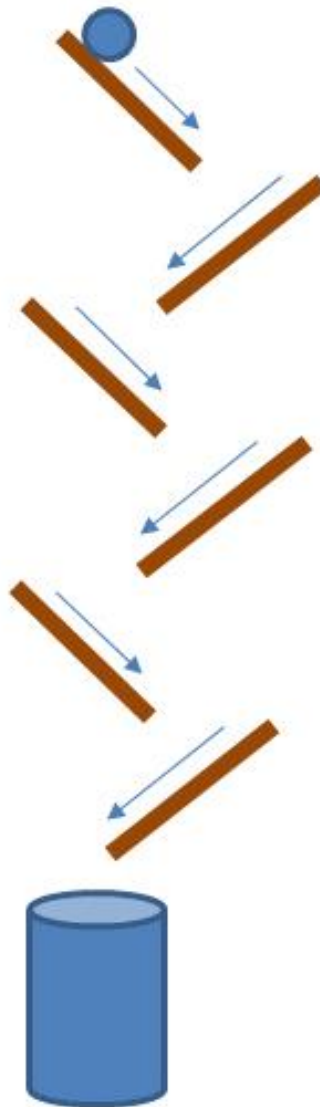
Marble Racers Lesson Plan

Wrap-up:

1. Give each student some paper and crayons and ask them to draw one or more of the racetracks created today.
2. Once students have completed their drawings, ask them to discuss their drawings and to share one thing they learned from the lesson.

Marble Racers Lesson Plan

Sample Diagram of a Marble Racetrack



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Photograph of Marble Racetracks

