The Queen's Quirky Croquet

As she meets the Queen and King of Hearts in an unusual garden, Alice is invited to play a most unusual game of croquet. In this activity, children will experiment with inclined planes and balls. As they play a game of marble croquet, they'll start to observe the mathematical relationships between the height of an incline, the size of a marble, and the distance the marble (and the 'cup wicket' it pushes) will travel.

Did You Know?

- ♣ A ball rolling down an incline or "slope" gains momentum; some call that "energy" and "speed."
- ♦ *Force* is the power put on another object.
- ♠ Croquet was first played in the seventeenth century in England. Played on a green, the game uses mallets, 4-inch balls, and wickets that are shaped like an upside-down "u."

To Get Ready:

Each pair of students will need a copy of the observation chart on the last page of this activity to mark their findings.

To create the 'cup wickets,' cut out arches from the rims of the cups.

To create a measuring tape for students, cut pieces of masking tape to 36" in length. Students can mark one inch segments on the tape.

What you'll need:
(for each student)

- ♣ Rulers (with a groove down the middle)
- ♦ Marbles – large and small
- ♠ One inch blocks for stacking to different heights
- ♥ Wide masking tape
- ♣ Paper or styrofoam cups with an opening cut out of the rim
- ♦ Observation graph found on last page of this activity

To Start, Ask:

What comes to mind when you think of croquet?

Try It!:

- ♣ Start by creating a ramp for the marbles to travel down. Stack the blocks and put one end of the ruler on top of the blocks to create an incline. Measure and record the height of your incline.
- ♦ Create a measuring tape for recording the distance the marble travels by placing a line of masking tape at the bottom of the ruler and extending it out in the direction that the marble will roll.
- ♠ At the bottom of the ruler, you will place your wicket, which is actually the upside-down cup with an opening that will catch your marble. What do you think will happen when the marble rolls into the cup?
- ♥ Put your marble at the top of the ruler, and let it go. What happens to the cup? Try it again, being sure to release the marble from the same spot on the ruler.
- ♣ Repeat your experiment several times and measure the distance that the cup travels each time. Record your measurements on your observation chart found on the last page of this activity. Be sure to put the cup on the same starting spot each time.
- ♦ Now try changing the height of the incline by adding a block. Measure your new height, repeat your experiment , and record the distance that the cup moves. Try adding another block. How does it change the distance that the cup travels?
- ♠ Experiment with other variables. How is the distance traveled different when you use a larger marble? What happens if you release the marble at different points on the ruler?

Questions to think about and ask:

- Do you notice any relationship between the height of the ruler or the blocks and the distance that the marble and cup travel?
- Does the size or weight of a marble affect how far it will roll or how hard it hits the cup?
- Does the distance that the marble travels always increase as the incline is raised higher?

Assess What Happened (Students reflect):

After they've finished their graphs, ask students to write a paragraph about why they think the marble is traveling further when it starts from a higher point. If students have discovered that there is a high point at which the marble distance decreases (this usually happens at a height of eight or more inches) ask them to write about why they think that is happening.

Connect it to Standards:

"As a result of activities in grades K-4, all students should develop abilities necessary to do scientific inquiry," ...including the ability to "use data to construct a reasonable explanation." (National Research Council Science Education Standards)

Connect it to the Story!

Following the Tea Party escapades, Alice made her way into a beautiful garden with bright flowerbeds and cool fountains. She found that the gardeners, who looked like playing cards, were painting all of the roses red. Things only became crazier as Alice met the Queen of Hearts who shouted, "Off with her head!" After some convincing from the King of Hearts, Alice's life was saved and she was invited to play a game of croquet. "Alice thought she had never seen such a curious croquet-ground in all of her life: it was all ridges and furrows; the croquet balls were live hedgehogs, and the mallets live flamingoes, and the soldiers had to double themselves up and stand on their hands and feet to make the arches." Can you imagine playing such a quirky game of croquet?

Career Corner:

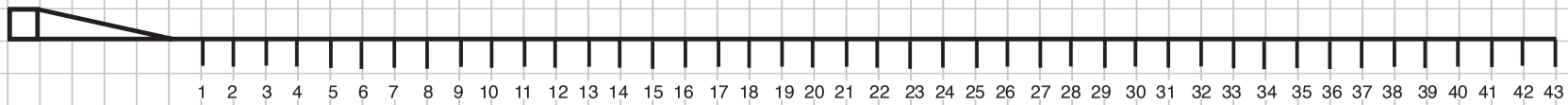
Civil Engineers use technology to design bridges, harbors, and even the roads and freeways that you drive on everyday. If you enjoy technology and design, you might consider a career in civil engineering.

Marble Trials

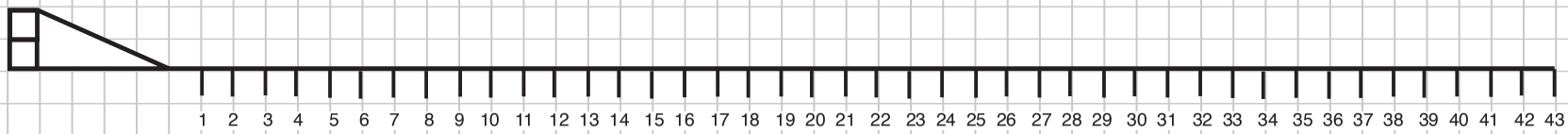
Mark an "o" where the small marble stops.
Mark an "x" where the large marble stops.

☐ = 1 inch

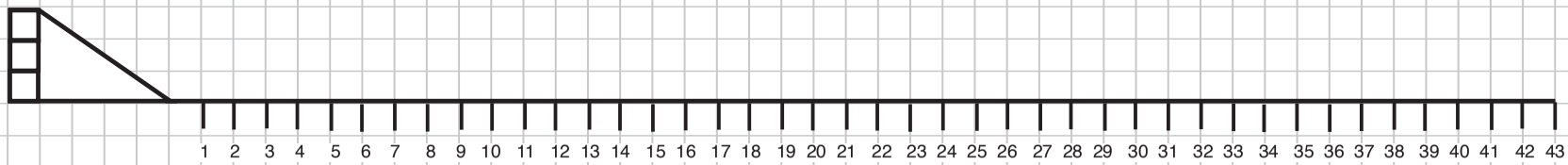
Trial #1



Trial #2



Trial #3



Trial #4