

# SciGirls Activity 11

## Soccer Kicks



### Icebreaker

Explore relationships between mass and momentum in this fun ball-bouncing activity!



#### You'll need:

- several sports balls: basketball, baseball, tennis ball, golf ball
- a hard-surface floor, and a high ceiling if you are indoors!
- a meter stick or tape measure
- optional: safety glasses

### SciGirls Skill: Experimenting

#### Guide your girls as they

- 1) Hold the basketball at shoulder level. Measure the distance from the bottom of the ball to the floor.
- 2) Drop the ball, and measure where the bottom of the ball bounces up to on the first bounce. Repeat several times.
- 3) Hold the basketball at shoulder height, then rest a second ball (smaller, such as a baseball or golf ball) on top of the basketball. Release the two balls together—the idea is to keep the small ball on top of the basketball when they bounce. Caution: To guard against injury, safety glasses are encouraged.
- 4) Measure or at least estimate the height the small ball achieves on the bounce. Determine the position of the bottom of the basketball in this arrangement. Repeat as necessary.
- 5) Repeat with the other small sports balls on top of the basketball, one at a time.



**SciGirls Suggestion:** You might ask the girls to predict which of the sports balls will fly the highest into the air before they begin. Ask them to think about whether their prediction is based on the bounciness of the little ball, or on how squishy it is, or on how heavy it is.

## Investigation

### Soccer Kicks

We're Dana and Alicia, and we get our kicks playing soccer! We're strong players, but Dana wants to figure out how to really boot the ball the length of the field. Our question? If your legs are bigger than your friend's, can you always kick the ball farther than she can?



For each group of 4 girls, you'll need:

- a soccer ball
- a long tape measure (metric if possible), 30 meters or 100 feet
- a yard-long flexible tape, such as used in sewing
- a large, flat grassy surface outdoors
- cones or markers (small paper plates with bamboo skewers work well)
- a notebook



Find out more about Dana and Alicia's investigation at [pbskidsgo.org/dragonflytv/show/soccerball.html](http://pbskidsgo.org/dragonflytv/show/soccerball.html)



Check out this investigation on the SciGirls DVD. Select "Soccer Kicks" from the main menu.



## SciGirls Want to Know

If your legs are bigger than others', can you always kick the ball farther than they can?

### Guide your girls as they

- 1) Measure the length of the kicking leg of all girls in the group, from hip to heel. Record this in inches.
- 2) Measure the circumference of the kicking leg of all girls in the group, measured around the mid thigh. Again, record this in inches.
- 3) Go to a large grassy playing field, and set a marker on the ground as the kick-off spot. For the marker, use a sports cone, or poke a bamboo skewer through a small paper plate.
- 4) Choose the first kicker. Send the other girls in to the field with cones or markers, so they can mark where the kicked ball *first* lands (not where it rolls to).
- 5) Have the first girl kick. If she is a right-footed kicker, she should stand just behind the ball, feet together, then take one step forward with the left foot, and kick with the right. She should try to kick the ball into the air, not along the ground. Allow her at least 5 kicks; ignore any kicks that don't get the ball into the air. Mark the landing spot of each kick in the field.
- 6) Use the long tape to measure the distances from the kick-off spot to the markers. Calculate that kicker's average kick distance.
- 7) Repeat, allowing the other girls to kick.



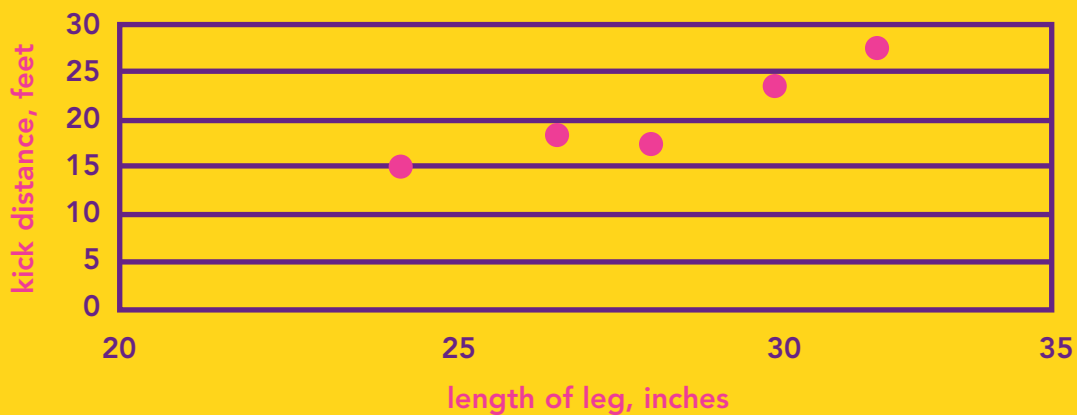
### SciGirls Secret

There are a lot of factors that can influence the outcome of this investigation, such as kicking technique, soccer experience, overall body mass, and physical strength of the girls. Still, use this beginning investigation strategy to acquaint girls with both the challenges and the excitement of doing a scientific study of a favorite sport.



## SciGirls Synthesize Data and Analysis

- 1) Calculate the average kick distance for each girl.
- 2) Make a graph of average kick distance as a function of the length of the girls' legs. Make a second graph, showing average kick distance as a function of the circumference of the girls' legs.
- 3) If you are working with a large group of girls, you may have them collect data in small groups of four, but then pool all the data together into one graph.



## Keep Exploring!

Expand this investigation by allowing the kicker to take more than one step to approach the ball. How does this change affect the results? Do the same girls who kicked the farthest the first time still kick farthest? What happens to everybody's kicking distance when they are allowed to take several approach steps?