



## Superhydrophobic coatings & drag/friction reduction.



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### Equipment

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| <ul style="list-style-type: none"><li>➤ Clear cylinder (h&gt;60 cm)</li><li>➤ 3 identical Christmas balls</li><li>➤ nylon stockings</li><li>➤ scale (<math>\pm 0,1g</math>)</li><li>➤ siringe</li><li>➤ needle, wire, scissors</li></ul> | <ul style="list-style-type: none"><li>➤ lead shots (small)</li><li>➤ paper towels</li><li>➤ videocamera</li><li>➤ video analysis software (Tracker)</li><li>➤ computer</li><li>➤ colored adhesive tape</li><li>➤ superhydrophobic textiles spray</li></ul> |
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You have studied in the previous activities the motion of drops on superhydrophobic substrates and, with 'liquid marbles', the motion of soft superhydrophobic solids on solid surfaces. In both cases a decrease in adhesion and friction has been recorded. Now you are asked to investigate the movement of a superhydrophobic surface in a liquid, and evaluate whether also in this case motion is favored by friction reduction. One of the most simple experimental situations to reproduce may be obtained by dropping in a cylinder filled with water three spheres whose surfaces exhibit a different degree in water repellency, but with identical mass and volume (thus attaining a perfect balance between the gravitational force and buoyancy).

### Procedure

1. Take three Christmas balls (no matter the color except for silver) with identical diameter and mass. With a siringe fill them in with water and add enough lead shot to allow the ball to sink but not too fastly. The final masses of the three balls should be identical.
2. Coat two of the balls with a nylon stocking. Try to make it adhere as smoothly as possible to the ball surface and avoid any crinkles. Cut out the textile in excess and sew it close and tight.
3. Spray one of the balls so coated with a superhydrophobic textile spray and let it spray. Tape on the cylinder a 10 cm long strip of colored adhesive tape to use as a reference



when you will need to calibrate in the video analysis. Put a screen or white sheet on the back of the cylinder to enhance the contrast of background and ball. Put the videocamera on a tripod or any other stand and choose the appropriate distance to frame in the whole cylinder.

4. Start videorecording. Let the balls drop in a sequence from just above the water surface. The sinking should not be too fast. In case decrease the mass of the balls.

### *Data analysis*

With Tracker video analysis software compare the motion of the different balls and evaluate the impact of the superhydrophobic coating on friction reduction

1. Focus on the sinking ball speed. What kind of motion is this?
2. Describe the forces acting on the balls. You may use a diagram.
3. Discuss how to evaluate a drag/friction coefficient. What kind of friction actually is this?
4. Discuss results in your group and in case propose an alternative procedure to compare the motion within a liquid of balls with different coatings.