# "Suspending a Balloon with a Hairdryer"

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I. DCPS Standards:

8.1.11 Describe the work of pioneers of physics such as Copernicus, Galileo, Kepler, Newton, and Bernoulli.
8.7.2 Observe and explain that when the forces on an object are balanced (equal and opposite forces that add up to zero), the motion of the object does not change.

II. Goal:

Students will gain an appreciation of Bernoulli's principle.

III. Objectives:

Students will demonstrate qualitative knowledge of Bernoulli's principle.

Prerequisite Knowledge: **Pressure** exists everywhere within a fluid, because each part of the fluid exerts an outward force on all the other parts in contact with it (and vice versa). This pressure is not uniform; it varies from place to place. The pressure within a fluid at a given location can depend on several factors. One of those factors is the fluid's speed. **Bernoulli's principle** indicates that (among other things) pressure within the fluid decreases as the speed of the fluid increases.

IV. Essential Questions:

What are the primary forces acting on the balloon while it is suspended? How is Bernoulli's principle demonstrated?

V. Materials: Hairdryer; inflated balloon.

VI. Differentiating Instruction: This activity should pose no problem to speakers of English.

VII. Rationale: This activity provides an illustration of Bernoulli's principle and fluid behavior.

VIII. Activity Procedure: The instructor or student volunteer turns on the hair dryer, holding it so that it blows upward. Another volunteer takes the inflated balloon and suspends it in the stream of air. This volunteer can then try to gently nudge the balloon out of the air column. The balloon tends to be pushed back into the air column; its position is rather stable.

IX. Evaluation and Assessment: The instructor discusses what was seen. Which has higher pressure, the column of air moving from the blow dryer or the air around it? [Higher speed means lower pressure by Bernoulli's principle.] Thus we have a lower pressure region of air surrounded by a higher pressure region. How does that explain the behavior of the balloon? [It's pushed back from the higher pressure region; these are more or less horizontal forces.] What forces act on the balloon to keep it from moving very much vertically? [Gravity is pulling it down, but the momentum from the blown air pushes it up (in a somewhat bumpy fashion). Frictional air resistance we neglect here.] Students write their own statement in their lab notebooks saying what they have learned about Bernoulli's principle.