On the descent of coffee filters: a theoretical perspective

- Note: no pre-lab this week

L. A. Iscool and I. L. Fisickx

Abstract. Coffee filters fall more slowly than rocks in most situations. We present an extension to the traditional Newtonian view of objects to include free-falling coffee filters. Coffee filters (which are sometimes made of Rayon) are puffs of fluff, roughly conical, with a diameter of about 10 cm and a mass between 0.5 g and 1.0 g. If you drop them, they fall.

It has been observed, however (Galileo and Snerd 1998), that if you drop a rock and a coffee filter simultaneously from the top of a tower, the rock lands first. Evidently air resistance slows the coffee filter more than the rock. We suggest that its effect is greater because the coffee filter is lighter.

Our reasoning is this: Each air molecule, on impact, imparts a small force to a falling object. Using the traditional force formula $F = ma$ (Newton 1687), we see that each collision effectively reduces the gravitational acceleration of any object falling through air by an amount that is inversely proportional to that object’s mass (i.e. $a = F/m$). Thus the light coffee filter is slowed more than a comparably sized (and heavier) rock. Therefore we should modify the formula for the distance $s$ fallen in time $t$. Instead of the traditional

$$s = \frac{1}{2} gt^2 \quad (1)$$

where $g$ is the acceleration of gravity, we suggest that the correct model for falling coffee filters is

$$s = \frac{1}{2} kt^2 \quad (2)$$

where $k$ is an acceleration smaller than $g$. Though the truth of our theory seems self-evident, we await confirmation from experiment.

1. Please provide adequate data to either prove or disprove this theory.
2. Is this true for multiple coffee filters arranged in a stack so that the geometry does not change (only the mass changes)?