PROJECTILE MOTION

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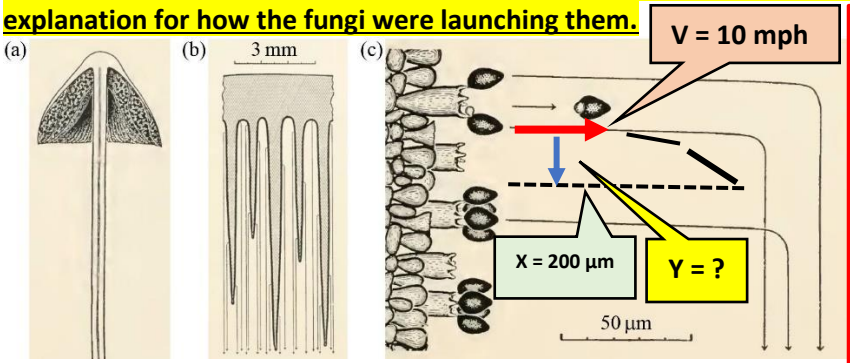
Fungi Physics: How Those Spores Launch Just Right

To spread forth and multiply, fungi — including the familiar button, portobello and shiitake **shoot their spores into wafting breezes.** A new paper published Wednesday helps explain how **fungi aim the spores in the right direction.** Scientists at Duke Universityconstructed larger spores out of plastic spheres and then used an inkjet printer to build water droplets, which are key to the launching mechanism. For more than a century, the spore-firing prowess of fungi, employed by thousands of species, has been an enthralling enigma for mycologists, the scientists who study fungi. Early in the 20th century, a British-Canadian mycologist named Arthur Henry Reginald Buller **— "the Einstein of mycology," Dr. Money called him — sketched the trajectories of the spores, and even largely came up with the correct explanation for how the fungi were launching them.**



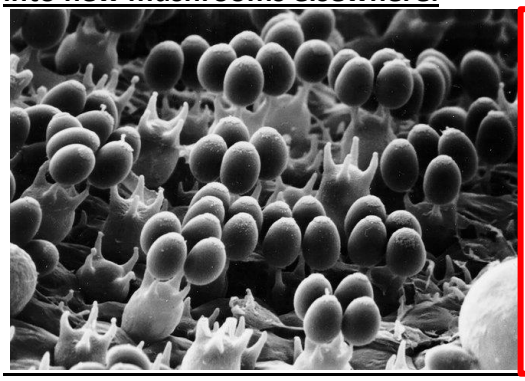
INTRODUCTION: **As the article states the spores are shot out horizontally at 10 mph and go horizontally about 200 µm as a projectile.**

QUESTIONS: **(a) Convert 10 mph to m./s.? (b) Find time for spores to go 200 µm horizontally ?, (c) Find vertical distance Y spores drop while moving 200 µm horizontally?**

HINTS: **see below**

In the early 20th century, Arthur Henry Reginald Buller make **sketched the the path of spores ejected by the gills of mushrooms**. On mushrooms, spores grow along the gills on the underside of the caps. The size varies, but a **typical spore is about 10 microns, or 1/2,500th of an inch, in width,** and it is attached at the end of a stalk called a sterigma. In a single day, a mushroom releases billions of spores. If the spores were merely dropped, many of them would waft back into the parent mushroom and get stuck. **"When a spore launches, it has to go far enough that it clears its apparatus,"** said Anne Pringle, a professor of botany and bacteriology at the University of Wisconsin and a collaborator on the new research.

So a **mushroom fires the spores away from the vertical gill — but not so far that they fly into the next gill over. The speed is not that fast — less than 10 miles per hour — and the distance is usually just a few hundred microns** before air friction slows down the microscopic spores. But **the acceleration is explosive, exerting thousands of times the force of gravity. Scientists call spores launched in this manner ballistospheres**. **At the same time they are traveling away from the gills gravity pulls them down and the spores catch a ride on air currents to spawn into new mushrooms elsewhere.**



Close-up image of the gill of a gray shag mushroom with spores waiting to be launched.

HINTS: **0.447 m./s = 1 mph , assume friction = 0 , g = 9.8 m./s.2**
$x = v\,t$, $y = v_0 t + (1/2)\,g\,t^2$, µm = 10^{-6} m. ,

ANSWERS: **(a) v = 4.47 m./s., (b) t = 40.24 X 10^{-6} s. , (c) y = ~7.9 X 10^{-9} m**

COMMENT: **In graphic (b) the vertical gills are shown to be about 700 µm apart. Note 3mm (millimeters) = 3000 µm. Thus, with spores going just 200 µm horizontally is reasonable so the spores do not go across to next gill and get attached.**

The **energy for propelling the spores turns out to come from the surface tension of water — the forces that cause a drop of water to roll up into a bead on a water-repellent surface.**