

## Nothing to Sneeze At *Modified transcript with vocabulary*

Transcript of “Nothing to Sneeze At” produced by Luke Groskin, 5/1/2014	Vocabulary
<p>LUKE GROSKIN: It begins with a dusting of pollen. Or perhaps a pinch of pepper. For some, a simple glance at the sun can trigger a desperate dash for a tissue. This is, of course, a sneeze—an act that was once believed to be the explosive release of our very soul. And when viewed in the right light, a sneeze can take on a whole new dimension.</p>	
<p>LYDIA BOUROUIBA: And if you forget the fact that it is a sneeze, it’s actually a pretty beautiful process. I think that they’re all quite beautiful, actually.</p>	
<p>LUKE GROSKIN: Dr. Lydia Bourouiba is an assistant professor at MIT, and a researcher of <b>applied mathematics</b>.</p>	<p><b>Applied mathematics:</b> a branch of mathematics that applies mathematical methods to other fields, such as science, engineering, computer science, and industry</p>
<p>LYDIA BOUROUIBA: And, actually, it’s really the new frontier to try to use more physics and mathematics to try and understand biological problems.</p>	
<p>LUKE GROSKIN: Problems such as how diseases spread.</p>	
<p>LYDIA BOUROUIBA: We have a lot of work that is done at the cellular level—so, interactions between cells, viruses, and tissues—and then a lot of work that is done at the population level, looking at average behaviors or using large <b>statistical models</b>...</p>	<p><b>Statistical models:</b> complex mathematical equations used to make numerical predictions, based on the statistical study of real-world phenomena</p>
<p>LUKE GROSKIN: ...to predict rates of infection or <b>mortality</b>. But it turns out, there’s actually very little research into <b>modeling</b> that moment when my germs become your germs.</p>	<p><b>Mortality:</b> death <b>Modeling:</b> representing real-world occurrences using predictive mathematical equations</p>
<p>LYDIA BOUROUIBA: There is no history of physical studies that really examined this problem of what is really contact and <b>transmission</b>, and [that has gotten] the physical picture right to describe what’s happening when you’re actually sneezing. And so, thinking about all these things, that’s when I realized actually <b>fluid mechanics</b> could help, because when you think about it, a sneeze or a cough is obviously a fluid.</p>	<p><b>Disease transmission:</b> passing of a disease from an infected or sick person to an uninfected person  <b>Fluid mechanics:</b> a branch of physics that deals with fluids in motion</p>

<p>LUKE GROSKIN: With the help of an MIT colleague, Dr. John Bush, Dr. Bourouiba set about <b>quantifying</b> the physics of sneezes and coughs.</p>	<p><b>Quantifying:</b> describing numerically</p>
<p>JOHN BUSH: If you saw someone sneeze with the naked eye, you would see drops flying out, and they'd go at whatever their initial speed is, and that determines their range. So, in particular, large drops go farther than small drops. Basically, there was no consideration whatsoever of the gas phase.</p>	
<p>LUKE GROSKIN: They call this the <b>multi-phased</b> cloud.</p>	<p><b>Multi-phased:</b> made up of more than one of the phases of matter, including solids, liquids, and gases</p>
<p>LYDIA BOUROUIBA: This is really try to highlight the fact that it's not just droplets being <b>emitted</b>, but there [is] really this background, <b>turbulent</b> hot and moist air that is swirling around, <b>advecting</b> these droplets further away.</p>	<p><b>Emitted:</b> produced or expelled</p> <p><b>Turbulent:</b> moving unsteadily, violently, or chaotically</p> <p><b>Advecting:</b> transferring by the flow of a fluid</p>
<p>LUKE GROSKIN: And to find out how important this cloud is to the spread of diseases, Dr. Bourouiba needed to visualize sneezes and coughs in their finest detail.</p>	
<p>LYDIA BOUROUIBA: You need to, basically, have a camera that is not as light sensitive, so basically, [a] black and white camera. And then we illuminated the droplets so that the scattered light from the droplets would be projected to the camera. So you have an individual standing there sneezing, and then you laugh a lot.</p>	
<p>LUKE GROSKIN: Sneeze after sneeze, Dr. Bourouiba collected data, which she could then use to model the act.</p>	
<p>LYDIA BOUROUIBA: So, the analysis relies on image processing techniques and <b>algorithms</b> that have to be developed to really track both the cloud and the droplets' <b>trajectories</b>.</p>	<p><b>Algorithm:</b> a procedure for making mathematical or computational calculations</p> <p><b>Trajectory:</b> path followed by a thrown or projectile object</p>

LUKE GROSKIN: Turns out, we grossly underestimated the effect of the multi-phased cloud.	
JOHN BUSH: You think of the cloud as being turbulent, that is to say, very disordered, <b>vigorous motion</b> . If characteristic speed in that cloud is larger than its settling speed, then it will be dominated more by that internal cloud motion than by its settling speed.	<b>Vigorous motion:</b> moving with strength or energy
LUKE GROSKIN: Translation?	
JOHN BUSH: The smaller drops go much [farther] than the large drops...	
LUKE GROSKIN: ...because the cloud keeps them afloat.	
LYDIA BOUROUIBA: And right now, the finding shows that these clouds, particularly under usual conditions of temperature and <b>buoyancy</b> , has a tendency to go higher in the room and get sucked into the ventilation system. I could be in this end of the building, and somebody could be in contact with my <b>pathogens</b> through <b>infiltration</b> in the ventilation system without me actually meeting that person.	<p><b>Buoyancy:</b> the tendency to float in air, water, or another fluid</p> <p><b>Pathogen:</b> something of biological origin that causes disease or sickness</p> <p><b>Infiltration:</b> the act of filtering or permeating through something</p>
LUKE GROSKIN: It's a little disturbing, no?	
LYDIA BOUROUIBA: I am definitely more aware of sneezers and coughers all around.	
JOHN BUSH: But it definitely does impact the sort of design of places where pathogen transport is critical, particularly, again, hospitals, classrooms, and airplanes.	
LUKE GROSKIN: And like all good research should do, a stream of questions flows from this new model of sneezing.	
LYDIA BOUROUIBA: If, for example, we were to change the <b>ambient</b>	<b>Ambient:</b> from nearby or in close vicinity

conditions indoors—temperature and moisture—by how much would we extend the horizontal versus vertical range of the cloud? Once you have an individual that is sick, what happens? And how is that different? And then by adding obstacles...	
LUKE GROSKIN: ...such as an elbow or a tissue...	
LYDIA BOUROUIBA: ...now we can assess their effect.	
LUKE GROSKIN: However, Dr. Bourouiba and Dr. Bush have proven once and for all that math doesn't need to be a dry subject.	
JOHN BUSH: And then people aren't aware of what the applications are, but if you actually use it for describing physical systems, you realize what a powerful tool it is.	
LUKE GROSKIN: For Science Friday, I'm Luke Groskin.	

**Key Ideas and Details:** CCSS.ELA-Literacy Reading Informational Text Sample Questions (grade 6 standards are presented)

**CCSS.ELA-Literacy.RI.6.2** Determine a central idea of a text and how it is conveyed through particular details; provide a summary of the text distinct from personal opinions or judgments.

- What did the research of Dr. Bourouiba and Dr. Bush show?
- How are their scientific conclusions different from what was previously thought about sneezes?
- What did they have to observe in order to show that sneezes travel farther than expected?