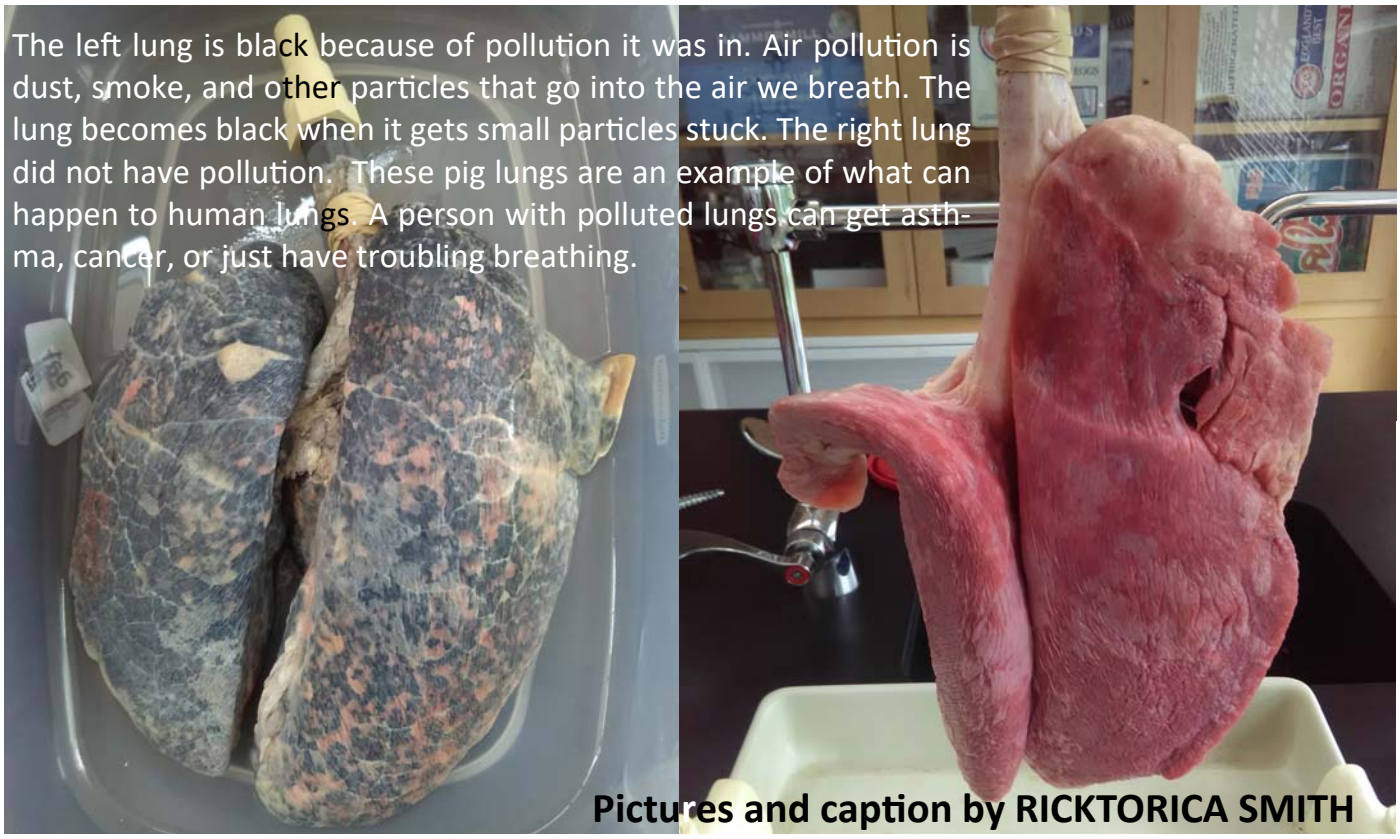


The left lung is black because of pollution it was in. Air pollution is dust, smoke, and other particles that go into the air we breath. The lung becomes black when it gets small particles stuck. The right lung did not have pollution. These pig lungs are an example of what can happen to human lungs. A person with polluted lungs can get asthma, cancer, or just have troubling breathing.

Pictures and caption by RICKTORICA SMITH

Particle Pollution's Effects on the Lungs

by NATALIE LEONFFU

You'd never think that breathing air could prematurely kill you. Within the air, there are particles that we breathe. But let's ask the question everyone wants to know: *How* do these particles harm us? Particle pollution harms the lungs' structure and function by causing inflammation, or swelling, that interferes with a person's ability to maintain homeostasis.

Particle pollution damages both how the lungs look and how they function. When looking at examples of pig lungs that were and were not contaminated with particle pollution, we could see how bad pollution is for the lungs. The unpolluted lung was pink and red. When blowing up the lung, it expands to be about two times its original size. In addition, it's easy to blow up. Meanwhile, the polluted lung was grey with some pink spots and a bit of blue and green; overall it was highly discolored. It's also not easy to blow up this polluted lung and it can't expand as much. It even rejects the pump a bit.

Asthma, lungs, and particle pollution. What are they and how are they connected? Asthma is a condition that restricts airways leading into the lungs, making it hard to breathe. Lungs are a pair of breathing organs that help bring needed oxygen into the body. Particle pollution consists of tiny particles that are in the air. There are different types, including many in vehicle exhaust. Breathing particle pollution can cause a variety of illnesses including asthma. It can lead to hospitalization and even early death.

In our particle pollution experiment, we showed how much particle pollution we breathe in without realizing. The data shows that the closer you were to the road the more particle pollution you inhaled. The most particle pollution we detected was about 560 small particles and about 218 large particles at a distance of 0.6 meters from the road. At the farthest distance from the road, 3.65 meters, we had about 93 small particles and about 46 large particles. Particle pollution is a serious health

risk as we breathe it in without realization. But all this talk about particle pollution, what actually is it? Particles in the air come in different sizes. Large particles will get stuck in our nostrils or at the beginning of our throat. Our bodies will then naturally sneeze or cough to release them back into the air. There's also ultra-small particles. These particles will slip through the alveoli at the end of our lungs' airways and move into our bloodstream. These may cause future problems in our bodies, but they don't cause lung problems because of their size. However, the small but not ultra-small particles do the most damage to our lungs. They're small enough to get to the airways, but big enough that they get stuck in them, clogging them up. This can lead to illnesses and early death.

Homeostasis is the ability to maintain stable conditions inside our bodies. A person with asthma isn't able to maintain homeostasis because their airways get clogged. We did an experiment to investigate this. To recreate the restricted airway of asthma, we had participants breathe through a straw while exercising. These individuals dropped in the amount of oxygen in their bloodstream, increasing their pulse and breathing rate immensely in an attempt to compensate. When allowed to breathe normally, as in an unrestricted airway, there only was a drastic change in their pulse when they first started exercising. After each minute, their pulse lowered as it got used to the exercise. Their oxygen levels stayed the same through the whole thing as well.

Asthma is a condition that results in difficulty breathing; it can be caused by an overreaction to inhaled particles. This is a problem because it makes it harder to get the oxygen our cells need to produce energy. All of our cells produce energy through a process called cellular respiration.

Cellular Respiration Equation:

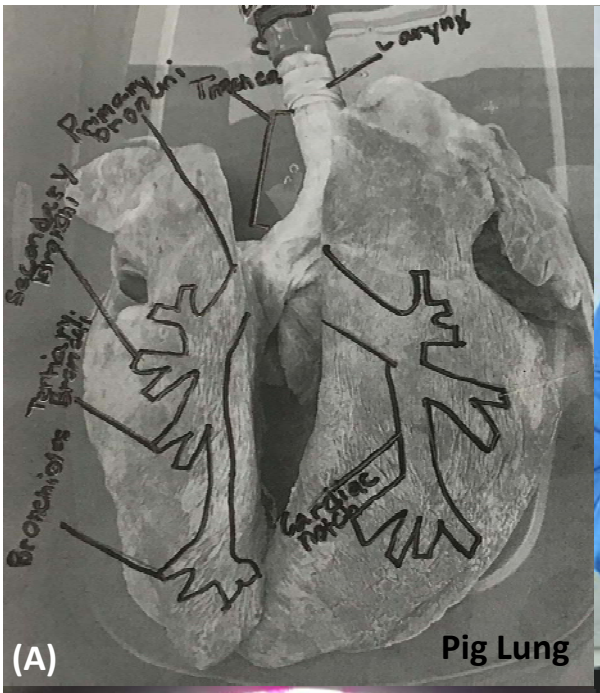
glucose + oxygen → carbon dioxide + water + energy
(sugar)

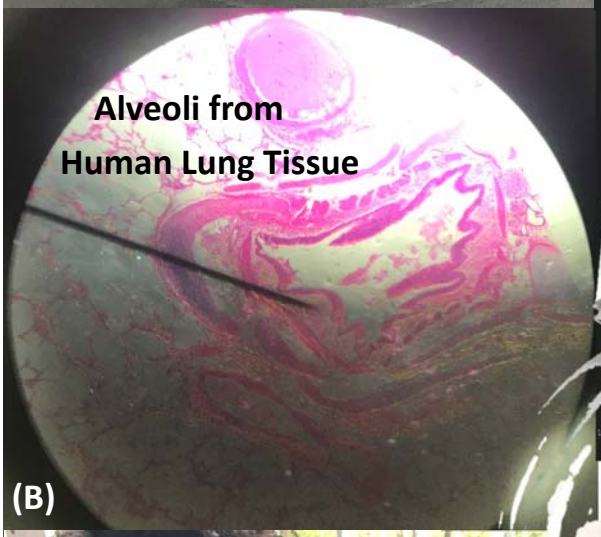
Cellular respiration takes glucose (sugar) and oxygen and turns it into energy and nutrients. So, how are all these things related? Well, asthma doesn't allow people to maintain homeostasis. Their bodies aren't able to have a stable amount of oxygen, which can be shown through drops in their oxygen saturation on the oximeter (the device we used to measure oxygen levels). Cellular respiration converts sugar and oxygen into carbon dioxide and water, releasing needed energy in the process. The people in our experiment had a hard time breathing when having restricted airways, just like people with asthma. If asthma didn't affect a person's ability to maintain homeostasis, then the pulse and blood oxygen data would have been the same for both restricted and unrestricted airway conditions. Exercising requires energy, which uses up oxygen to produce. In response, our bodies need to take in more oxygen than at rest in order to keep our bodies going. Asthma keeps people from being able to breathe correctly, so if they exercise, they have to make sure that they have an inhaler nearby to help return their airways to normal.

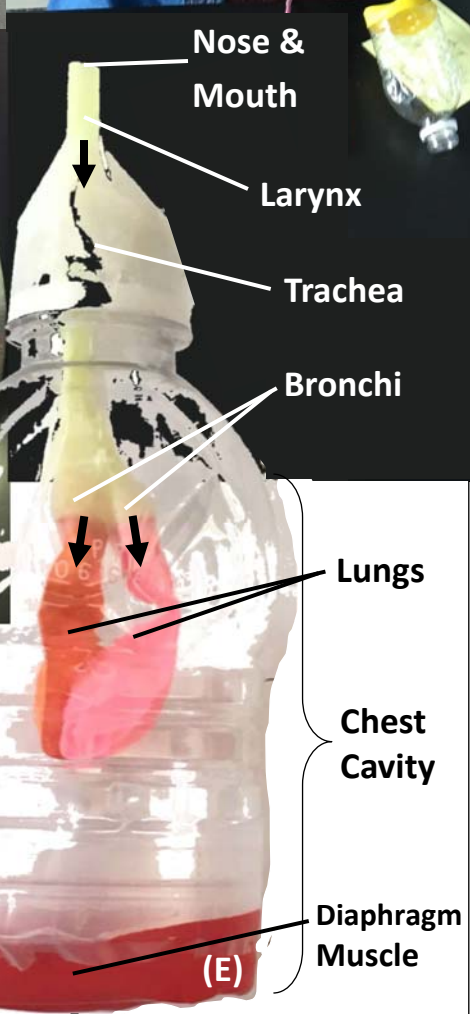
Particle pollution harms the lungs' look and function by damaging the lungs. The pollution causes swelling and interferes with a person's ability to maintain homeostasis. These are the ways particle pollution affects us. Particles will go unnoticed by many, but now you know a little more about the pollution in our air. All these health effects are caused by tiny pollution particles we can't even see.

Particle pollution getting stuck in alveoli and other parts of the lungs can cause major damage to lung structure and function.

Photographs, diagram, & caption by NOAH WALLER-SLISZ







Photograph of pig lungs taken and labeled by Bartolomei Rivas (A). Microscopic image of human lung tissue focused and captured by Kevin Galabay. (C). Johhan Alverenga-Salinas, (C) Samera Reid, and Madyson Valentin (D) work on creating physical models (E) of the lungs.

HOW BREATHING WORKS

(1) *Your brain sends conscious or unconscious signals to your diaphragm muscle to "pull down," which increases the amount of space in your chest cavity.* ***(2)*** *There's not enough air in your chest cavity, so air has to rush in from outside to fill the now bigger internal space.* ***(3)*** *This air enters through the nose or mouth and flows all the way to the tiny ends of the lungs called the "alveoli" where it meets up with tiny blood vessels to exchange oxygen and carbon dioxide with red blood cells.*