What's in the air you breathe? - Amy Hrdina and Jesse Kroll
Take a deep breath.

In that single **intake of air**, your **lungs swelled** with roughly 25 sextillion **molecules**, ranging from **compounds** produced days ago, to those **formed** billions of years in the past. In fact, many of the **molecules** you're breathing were **likely exhaled by** members of **ancient civilizations** and **innumerable** humans since.

But what exactly are we all breathing? Roughly 78% of Earth's atmosphere **is composed of** nitrogen **generated by volcanic** activity deep beneath the planet's **crust**. The next **major ingredient** is oxygen, **accounting for** 21% of Earth's air. While oxygen molecules have been **around as long as** Earth's oceans, oxygen gas didn't appear until **ocean-dwelling microorganisms** evolved to produce it. Finally, 0.93% of our air is argon, a molecule formed from the **radioactive decay of** potassium in Earth's **atmosphere, crust**, and **core**. Together, all these **dry gases** make up 99.93% of each breath you take.

Depending on when and where you are, the air may also **contain** some **water vapor**. But even more **variable** is the remaining 0.07%, which contains **a world of possibilities**. This small **slice of air** is composed of **numerous small particles** including **pollen, fungal spores**, and liquid **droplets**, alongside trace gases like **methane** and **carbon dioxide**. The specific cocktail of **natural** and **man-made compounds** changes dramatically **from place to place**. But no matter where you are, 0.07% of every breath you take likely contains **man-made pollutants**— potentially including **toxic compounds** that can **cause lung disease, cancer**, and even **DNA damage**.

There's **a wide variety of known pollutants** but they all **fall into** two **categories**. The first are **primary** pollutants. These toxic compounds are **directly emitted from** a man-made or **naturally occurring source**. However, they don't always come from the places you'd expect. Some large factories **mostly generate water vapor,** with only small **quantities** of pollutants mixed in. **Conversely,** burning **wood** or **dung** can create polycyclic aromatic hydrocarbons; **dangerous compounds** that have been **linked to several types of cancer**, as well as **long-term** DNA damage.

In all cases, pollutants **interact with** regional weather **patterns** and **topography**, which can **keep compounds local** or **spread** them kilometers away. When these **molecules** travel through the air, a **transformation occurs**. Natural compounds called **oxidants**, formed by

oxygen and **sunlight, break down** the pollutants. Sometimes, these reactions make pollutants **more easily washed out by rain.**

But in other cases, they result in even more toxic **secondary pollutants.** For example, when factories burn coal, they release high **concentrations** of **sulfur oxides.** These molecules **oxidize** to **form** sulfates, which **condense** with **water vapor** in the air to form **a blanket of** fine **particles** that **impair visibility** and cause severe **lung damage.** This so-called **sulfurous smog** was well-known in 20th-century London and continues to **plague** cities like Beijing.

Since the **advent of cars,** another secondary pollutant has **taken center stage. Exhaust** from **fossil fuel-burning vehicles** releases nitrogen oxides and hydrocarbons which react to form **ozone.** And while some ozone in the **upper atmosphere** helps **shield us from ultraviolet rays,** on the ground, this gas can form alongside **secondary particles** and create **photochemical** smog.
This brown fog can be found covering **densely packed cities,** making **seeing difficult** and **breathing hazardous.** It also contributes to climate change by **trapping heat in** the atmosphere.

In recent decades, **industrial activity** has **contributed to** a huge **spike** in various trace gas emissions, **fundamentally changing** the air we all breathe. Many places have already **responded** with **countermeasures.** Most cars produced since the 1980's are **equipped with** catalytic **converters** that reduce the emission of carbon monoxide and nitrogen oxides. And today, places like Beijing are **battling** smog by **electrifying** their **energy infrastructure** and **limiting automobile emissions** altogether.

But while **moving away from** fossil fuels is **essential,** there's no **universal remedy for** air pollution. Different regions need to **respond with** unique **regulations** that **account for** their local pollutants. Because no matter where you live, we all share the same air.