



Go Beyond: Understanding the Invisible PPM

What does the biosphere breathing look like?

Many scientific measurements of liquids or gases use the unit "parts per million," (ppm). If we have a mixture of one million molecules, say carbon dioxide, nitrogen, and oxygen and 200 of those total molecules are oxygen, then the mixture of molecules is 200ppm oxygen. But how can we understand this type of unit in a way we can sense? By using a gas that we can smell.



Perfume. Credit: Stock photo

Materials: a plate and a gas (or rapidly vaporizing liquid) with a strong odor that is non-toxic to breathe, e.g. perfume.

1. Close the doors and windows of your room. Calculate the volume of the room you are in, using the unit cubic meters.
2. Record the volume of perfume (or other liquid/gas) you will be using for the experiment. If you are using a liquid, you may need to determine this number at the end of your experiment by subtracting remaining fluid from the amount of fluid you started with. **Do not use a liquid or gas other than perfume unless you have been advised to do so by a science teacher!** You do not want to use anything that could make you sick.
3. Without doing a complete calculation, make some guesses: what do you think the ratio of normal air to perfume will be after 10 minutes? How long do you think it will take for the perfume to diffuse to the farthest side of the room?
4. Have one person hold the bottle of perfume while the others spread out to different distances in the room. Once all participants have taken their places. Everyone *except for* the person holding the perfume (the recorder) should close their eyes.
5. Without announcing when the experiment has begun, the recorder should empty the gas onto a dish on the floor or spray a measureable amount of perfume into the air.
6. As each participant is able to smell the perfume, he or she should raise a hand. Once a person raises his or her hands, he (she) may then open his (her) eyes. As soon as a person raises a hand, the recorder writes down the time and that person's name.
7. Once everyone's eyes are open, the recorder should announce how long it took the odor (in other words, the perfume gas) to reach each person. Was the diffusion faster or slower than you expected?
8. Based on the volume of the room, calculate the ratio of regular air to perfume. Be sure to record all observations and calculations. Convert this ratio into parts per million (e.g. the volume of air becomes 1 million cm^3).