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PROFESSOR: Now, let's talk briefly about different types of ventilation and different ways that they can mix or not mix the air in a room.

So the first type, which is what we've mainly been talking about, is so-called mixing ventilation.

So this is when the colder air is forced from above-- or in other cases, the warmer air is forced from below-- in such a way that there's an unstable thermal gradient, so that the buoyancy forces end up contributing towards mixing.

And then you can see that if a person's in the room, the natural thermal plume rising around that person of warmer air, as well as the respiratory plume sketched here in yellow from all the breathing-- both of them are kind of rising and then well mixed in the room before they're finally removed by the outlet of the ventilation.

And so that is the situation we've been mainly talking about of the well-mixed room.

But it's worth considering that in some other cases, the ventilation specifically is set up to reduce mixing.

So especially in rooms that have high ceilings, it can be advantageous to set up a stratified ambient, where the thermal plume from the body is rising as well as the respiratory plumes and are collecting in the upper area of the room where they're being gently sucked out as the colder air is being pumped in now from below.

So that's actually a stable thermal gradient.

And so at least the buoyancy forces are not leading to any large scale convection, although there certainly are still boundary layer flows and plumes from the people and from their motion, as I have described earlier.

One advantage here is that if a mask is worn, then the respiratory droplets coming from breathing, which are sketched here in yellow, are kind of brought closer to the thermal plume and forced to rise more.

So it basically causes the little droplet-- let's say, the infectious aerosols from the breath to be more likely swept to the upper reaches, where they might sit at the higher levels of the room and then be sucked out.

So that can actually be a situation where a less well-mixed room can be better.

On the other hand, the advantage of a well-mixed room is that the pathogen in the droplets is diluted throughout a larger space.

And that can be more advantageous.

But in any case, this situation with high ceilings and especially with natural ventilation, where you set up a stratified ambient, is a strategy that's been used for a long time.

In fact, Florence Nightingale, in the 1800s, recommended that hospitals should have high ceilings and good ventilation for protection against airborne pathogens.