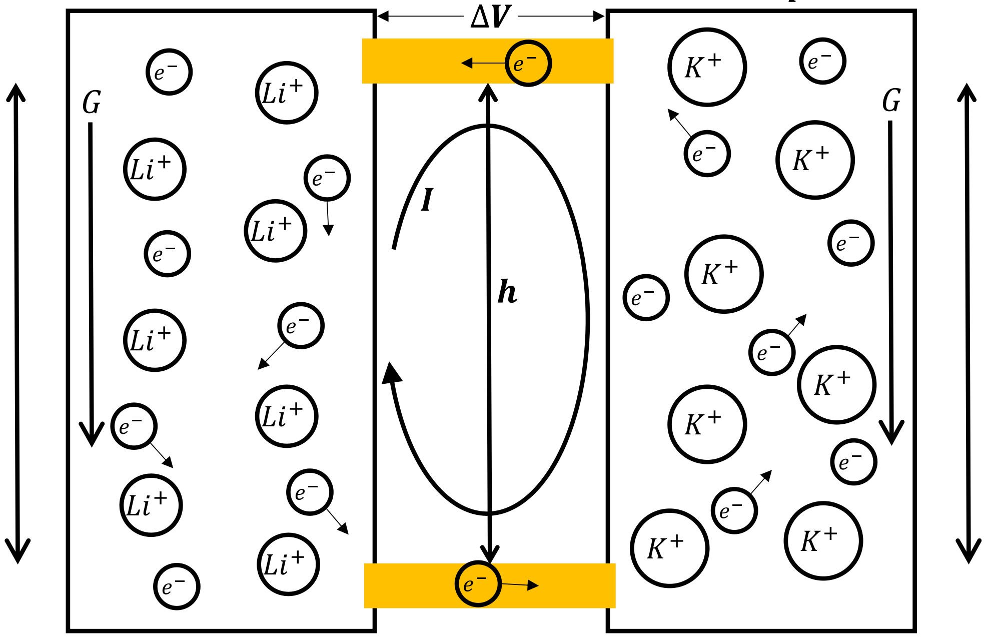
How Heat Is Converted to Electricity under Gravitational Forces Acting on Ions?

Hello, everyone! Welcome to the Gravity-to-Electric Energy Movie!

In a previous video, we talked about something pretty fascinating—how forces like gravity or centrifugal force, which create acceleration, can actually turn heat energy into electric energy. And in today's video, we're diving deeper and breaking it down in a simpler way so it's crystal clear how that works.

$$\Delta V = \frac{(m_{K^+} - m_{Li^+})Gh}{2q} > 0$$



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Let's start with something we all kinda know: under Earth's gravity, lighter molecules tend to float upward, while heavier ones sink downward. It's just like how a hot air balloon rises—because the gas inside is lighter.

Now, take a look at this chart. The yellow dots show the light molecules, and the blue ones are the heavy ones. To make things easy to see, we've lined them up neatly by height, instead of showing a messy random spread.

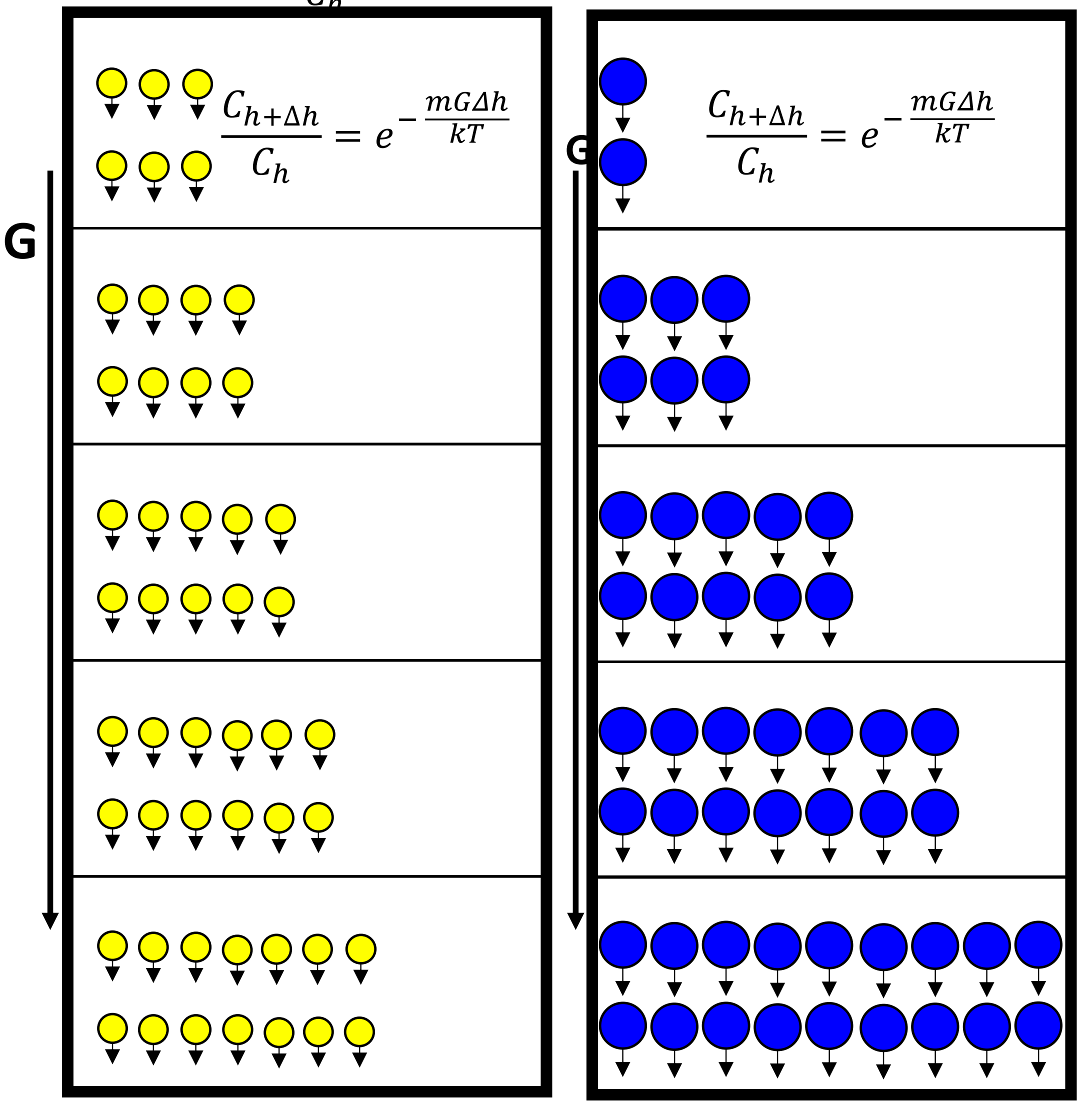
You'll notice that light molecules also change with height, but only slightly—while heavy molecules show a much bigger difference, with a lot more gathering at the bottom than at the top. This kind of pattern, where concentration changes with height, can actually be described using something called the Boltzmann equation—that formula you see right here in the diagram.

And here's the key: the equation tells us that molecules with different masses spread out differently at different heights.

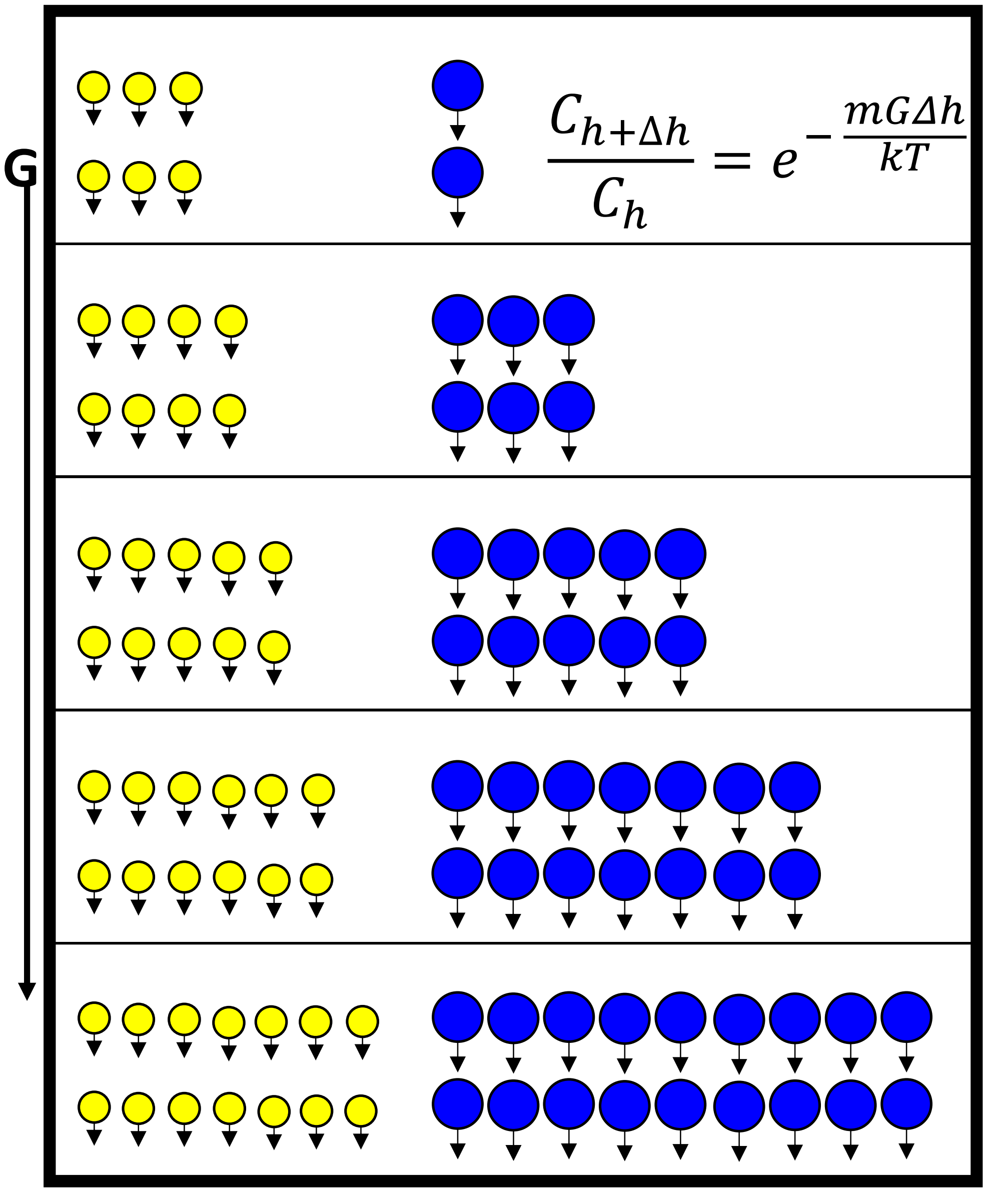
$$\frac{C_{h+\Delta h}}{C_h} = e^{-\frac{mG\Delta h}{kT}}$$

$$\frac{dC_h}{dh} = -\frac{\boldsymbol{m}GC_h}{kT}$$

$$\frac{C_{h+\Delta h}}{C_h} = e^{-\frac{\varepsilon_{h+\Delta h}-\varepsilon_h}{kT}} = e^{-\frac{mG\Delta h}{kT}}$$

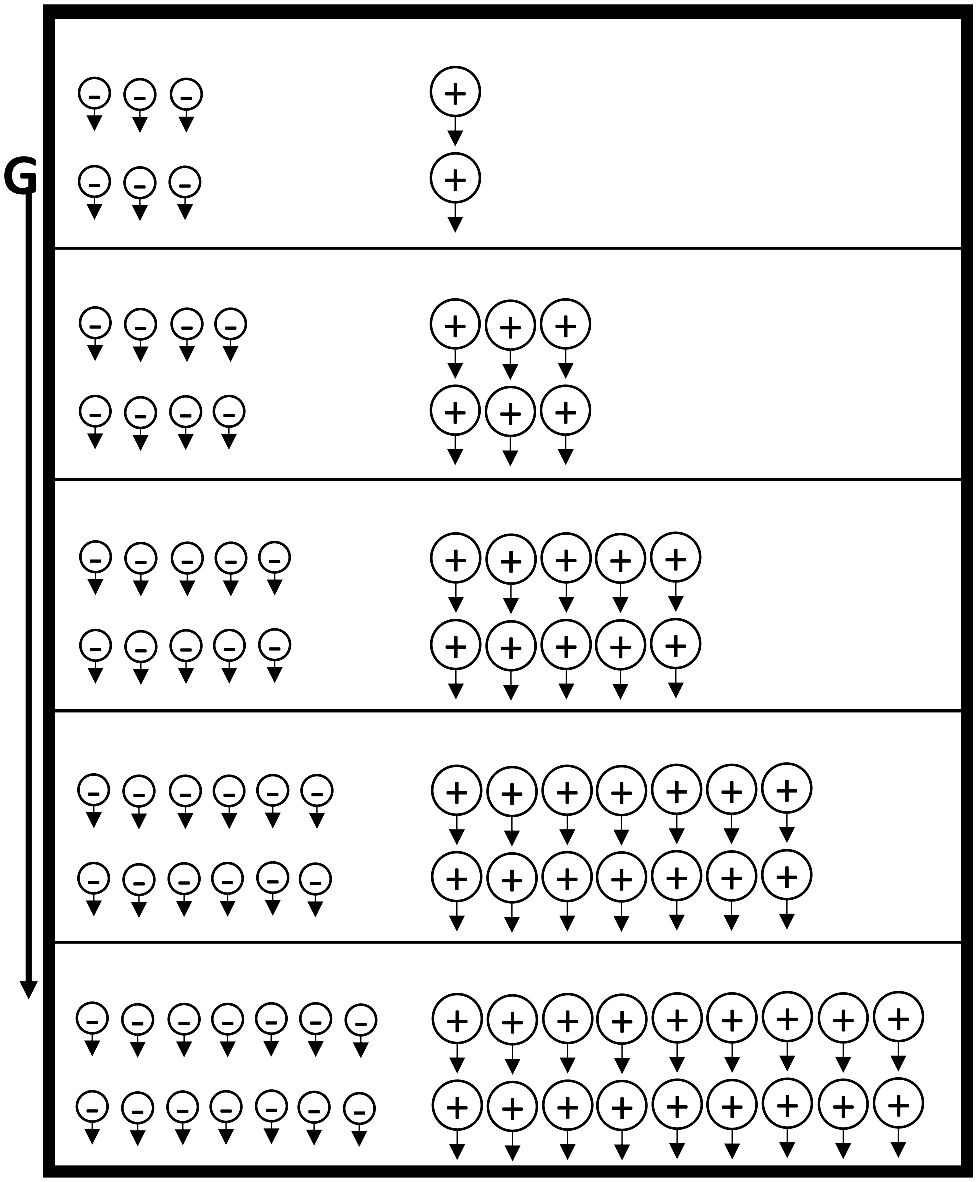


Now, if we mix these gases together and assume they don't interact, the distribution still follows that formula. So, if we have equal numbers of light and heavy molecules, in the end, the lighter molecules will be more common than the heavier ones at higher altitudes, and the heavier molecules will outnumber the lighter ones down low.

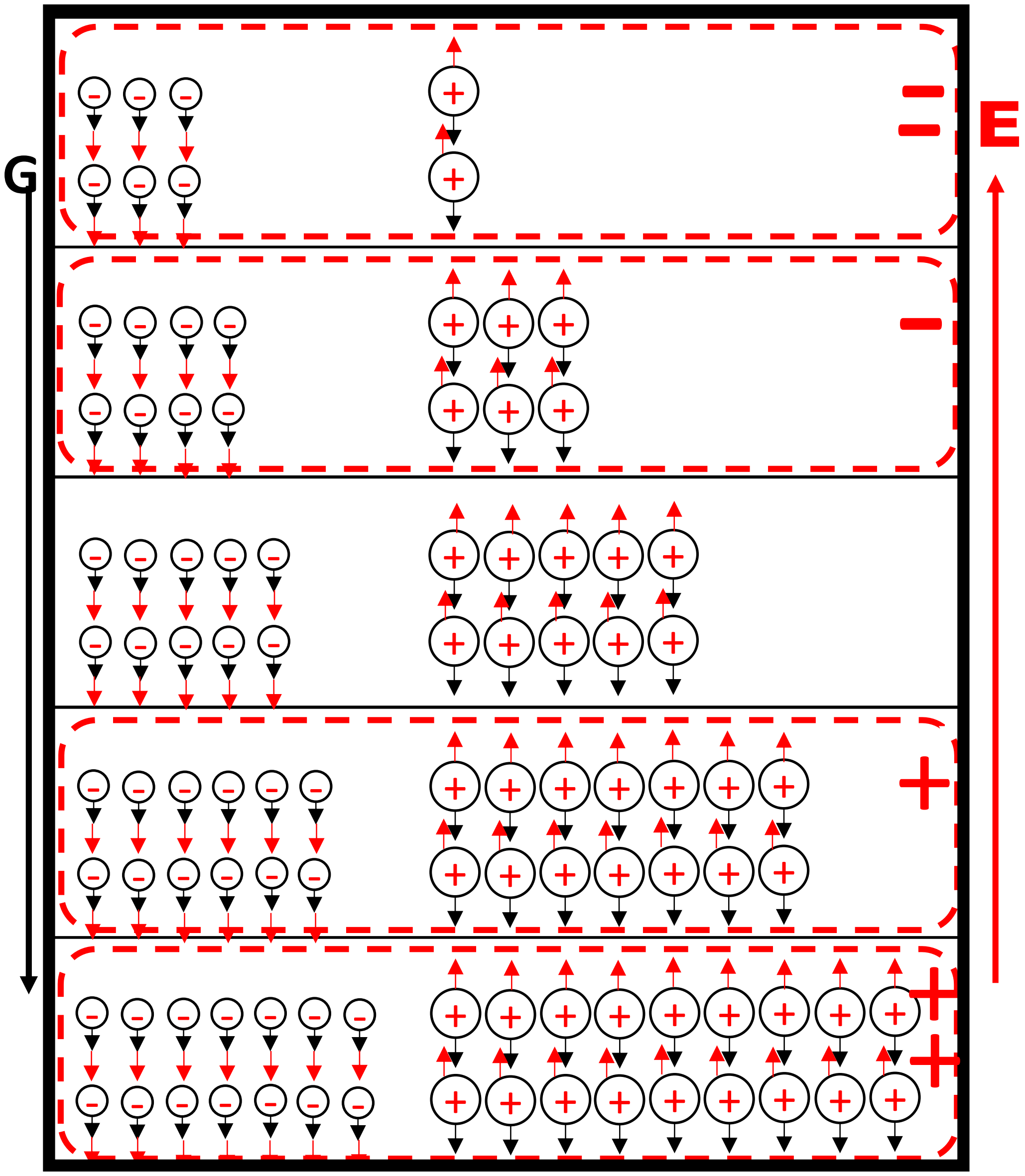


Now comes the really exciting part!

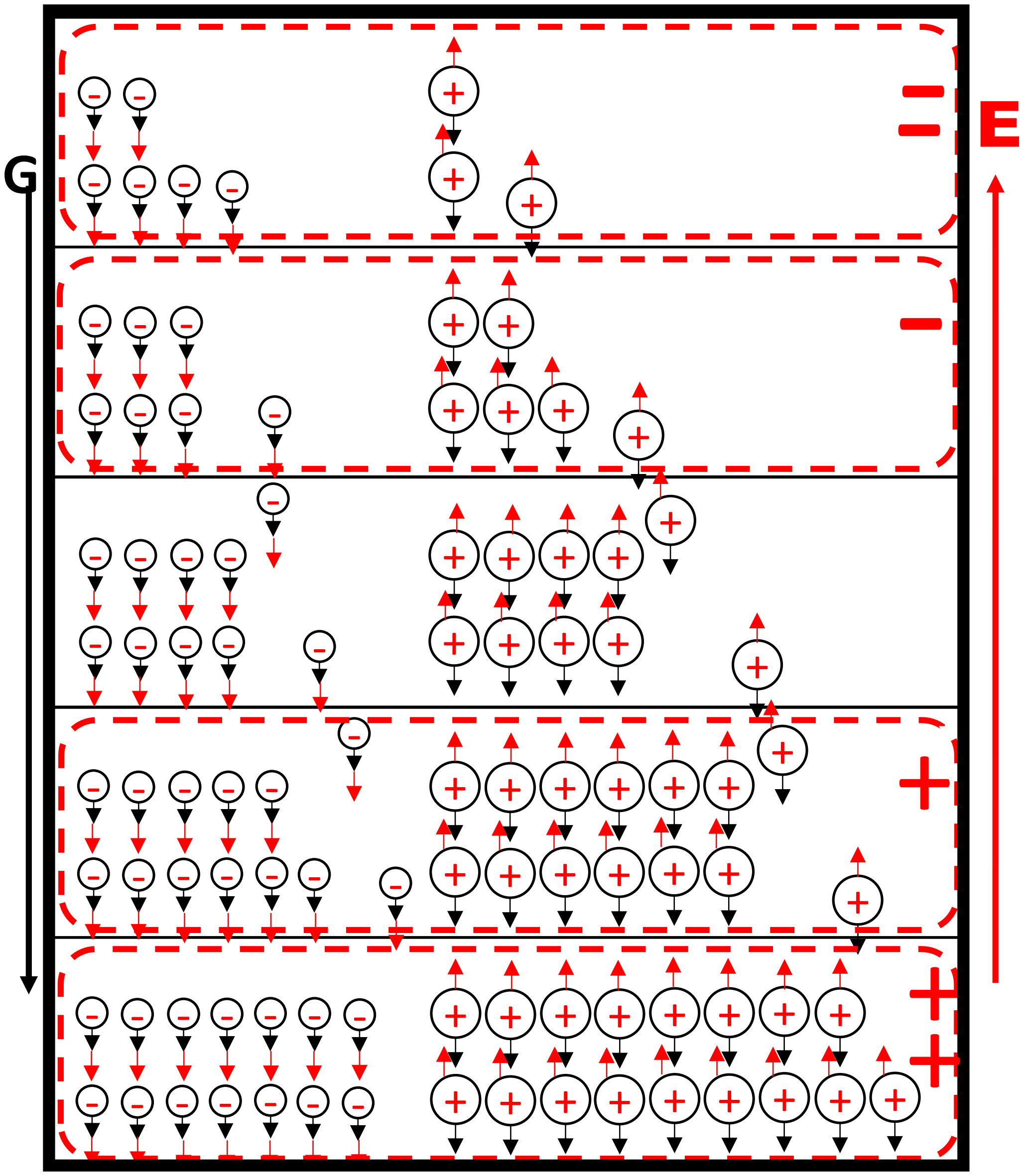
Let's play a little thought experiment: imagine we swap the light molecules for negatively charged ions, and the heavy ones for positively charged ions. What do you think would happen?



If there’s no electric field present, you’d get an imbalance: more positive ions at the bottom means the lower part becomes positively charged, and more negative ions at the top means the upper part becomes negatively charged. That imbalance naturally creates an upward electric field.



This field starts pushing positive ions upward and pulling negative ones downward, slowly canceling itself out. But here's the wild part—it never totally disappears! Because as the field weakens, gravity pulls those heavy positive ions down again, and the light negative ones float back up, recreating the field. So this electric field can actually sustain itself!



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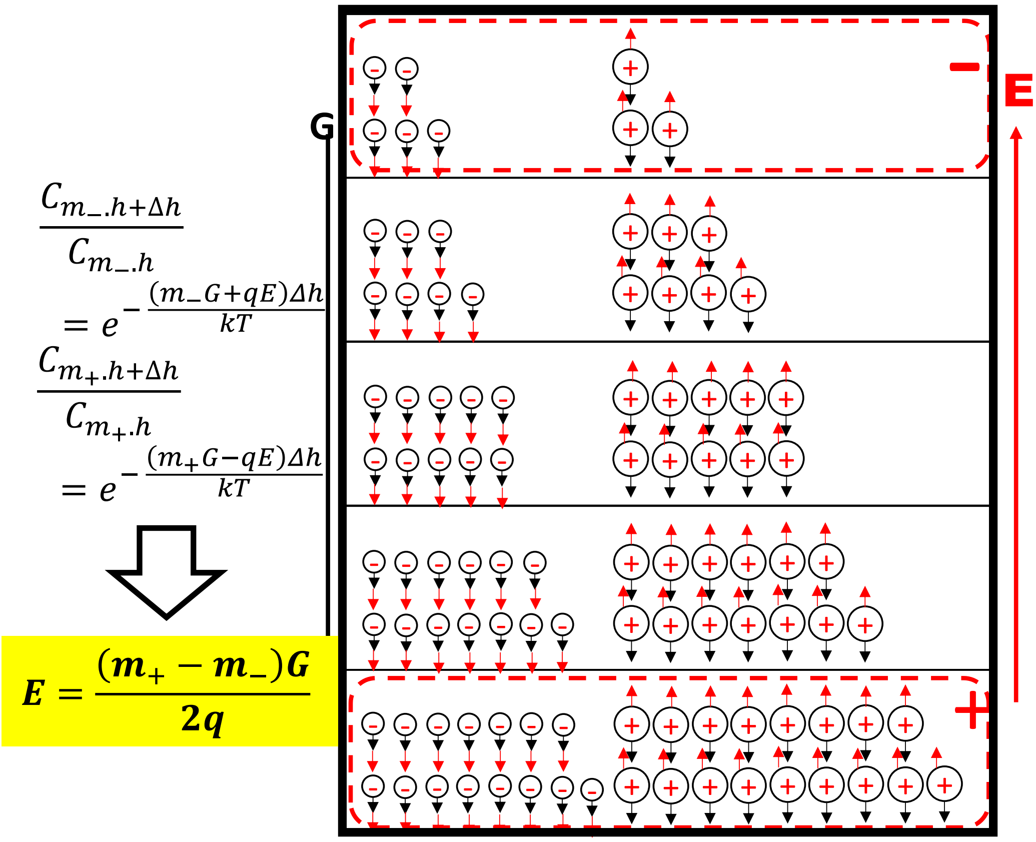

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In this steady state, the concentration of ions is affected by the field. And that’s where a modified version of the Boltzmann equation—one that includes the electric field—comes in handy. To keep things electrically neutral in the middle, the changes in positive and negative ion concentrations need to follow the same trend. By combining the equations and working through them, we can figure out how the electric field strength relates to the difference in ion masses.

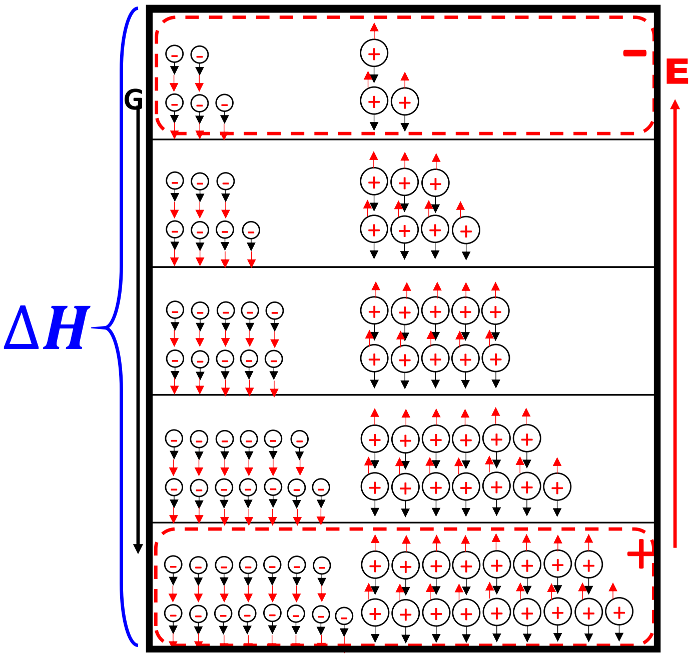
$$\frac{C_{m_-.h+\Delta h}}{C_{m_-.h}} = e^{-\frac{(m_-G+qE)\Delta h}{kT}}$$

$$\frac{C_{m_+.h+\Delta h}}{C_{m_+.h}} = e^{-\frac{(m_+G-qE)\Delta h}{kT}}$$

$$\boldsymbol{E = \frac{(m_+ - m_-)G}{2q}}$$

Here comes the punchline! The equation tells us: the bigger the mass difference, the stronger the electric field. And amazingly, this doesn’t depend on the number of ions at all! That result actually matches what Tolman found way back in 1910—he noticed the same thing: field strength has nothing to do with ion concentration.

Now, knowing there’s an upward electric field in the space, we also get a voltage difference between different heights. (Since voltage is just electric field times height—super intuitive.)

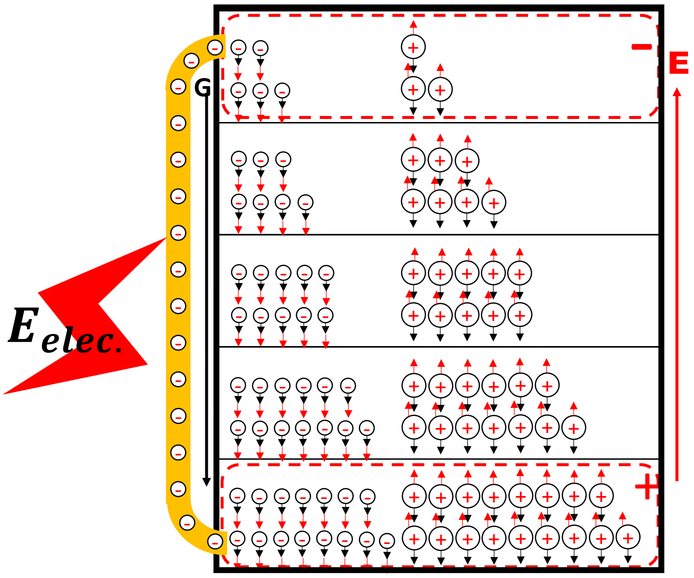


$$\Delta V = E \cdot \Delta H$$

If we assume the negative particles are electrons, and we connect a wire between the top and bottom! Electrons up top will flow down the wire, and that movement creates electric energy: voltage times charge.

$$\Delta V = E \cdot \Delta H$$

$$E_{elec.} = q \cdot \Delta V$$



$$\Delta V = E \cdot \Delta H$$
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Once electrons move downward, the top loses some and the bottom gains. That's when heat vibrations kick in and gradually push the distribution back toward balance—meaning electrons naturally get "pushed" back upward. This gives us an internal upward electron flow.

And every time an electron moves upward, it's going against the electric field, which means it gains energy—electrical potential energy, to be exact. That's the magic!

Heat vibrations push charged particles against the field, giving them energy. And by the wire, we can actually use that energy.

So in short—we're turning the random jiggling of heat into usable electrical energy.

And as long as we've got a gravitational or centrifugal field—basically, any kind of accelerating force—we can keep this energy conversion going.

Feeling like things finally clicked about how heat turns into electricity? If you've got any questions, feel free to drop a comment below—I'll do my best to answer and explain more!

(Key: Heat vibrations push charged particles against the field, giving them energy.)

For the sake of our planet, and to accelerate global technological progress, please share this video and help spread the word!

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