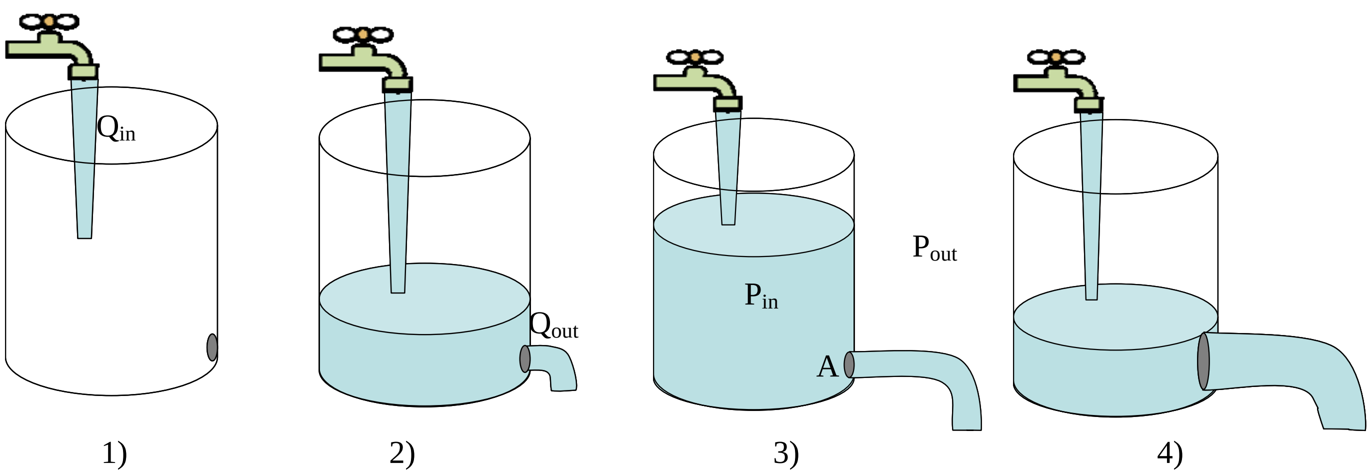
Imagine that you are trying to fill up a bucket of water that has a hole at the bottom of it.

1. Initially, the bucket is empty. You turn on the faucet, and water flows at a rate of Q (volume/time). Let's call this Q_{in}. The bucket begins to fill up.
2. But, water can also flow out of the hole at the bottom. Let's call this flow Q_{out}. The water in the bucket exerts a pressure on the hole at the bottom of the bucket. This pressure pushes water out of the hole at the bottom. As more water is added to the bucket, the pressure on the hole increases causing Q_{out} to increase.
3. At some point in time, Q_{in} will equal Q_{out}. When this happens, the bucket reaches a steady state because the amount of water in the bucket will be constant: Just as much water flows in as flows out.
4. A small hole will resist the flow of water more (allow less water to flow) than a big hole. If the size of the hole in increased, the bucket will hold less water at steady state and the pressure on the hole will be decreased. But Q_{out} will remain the same.

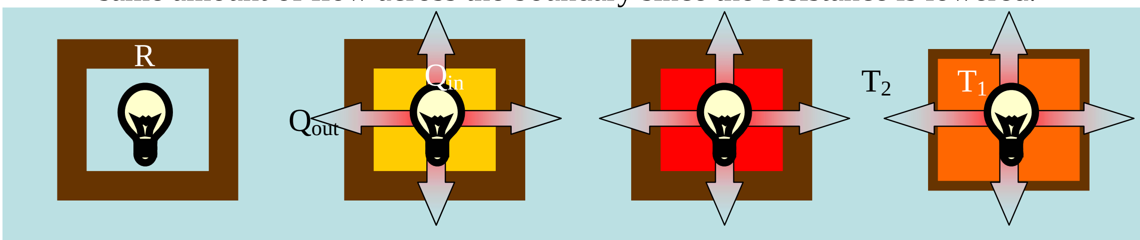


At steady state: $Q_{in} = Q_{out} = K \bullet A \bullet \Delta P$ where $\Delta P = P_{in} - P_{out}$ is the pressure difference between the water in the bucket and the outside air, A is the area of the hole and K is a constant that has to do with the density of water and its ability to flow (viscocity).

This is similar to what happens with your heated box. Like the faucet, the light bulb provides a constant flow of heat energy into the box.

1. Initially, the temperature inside the box is the same as the temperature outside the box. The light is turned on, and heat begins to flow Q_{in} (BTU/hr) from the light bulb.
2. But heat can flow through the walls of the box Q_{out}. As the temperature in the box rises, there is a heat pressure from the temperature differences inside and outside the box that forces heat out of the box. As more heat is added to the box, the heat pressure increases also increasing Q_{out}.
3. At some point in time, Q_{in} will equal Q_{out}. When this happens, the box reaches a steady state because the temperature in the box will be constant: Just as much heat flows in as flows out.

4. If a thinner material is used, heat can flow across the boundary more easily decreasing the flow resistance. At steady state, the temperature in the box will be decreased (less heat pressure, like less water pressure from a larger hole) for the same amount of flow across the boundary since the resistance is lowered.



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At steady state: $Q_{in} = Q_{out} = \frac{A \bullet \Delta T}{R}$ where $\Delta T = T_1 - T_2$ is the temperature difference between the temperature in the box and outside, A is the surface area of the box, R is box material resistance to heat flow.