Goel, Aakash. "The HP Spectre: What's Inside This Ultra-Thin Laptop" *Engineering.com.* May 5, 2016.
https://www.engineering.com/story/the-hp-spectre-whats-inside-this-ultra-thin-laptop
Part of my goals for my project was to make my designs as lightweight and compact as possible rather than it being a bulky object like a normal desktop. To aid in that, I turned to looking at the design of the 2016 HP Spectre 13" at the time, the thinnest laptop in the world. It used what was known as a Hyperbaric (high static pressure) cooling system, where rather than using the fans to push hot air out, they draw cool air in, and the only way the air can escape is through the heatsink. "This cooling system is theoretically more effective because of the nature of convective heat transfer, which is linearly proportional to the difference in temperature between the surface and fluid and, to a certain extent, is more effective with higher fluid velocities."

"Airtop 3 Specifications" *Compulab*. 2020.
https://fit-iot.com/web/products/airtop3/airtop3-specifications/
Some of my concept designs for the higher TDP laptops were inspired by the Compulab Airtop 3, which is a completely fanless desktop PC that is able to cool over 200W of heat completely passively. It does this by using the chimney (or stack) effect to naturally convect air through the cooling tubes, all while being incredibly small compared to even small form factor PCs. Unfortunately, a design based off of the Airtop, which uses over 20 heatpipes, would be eye wateringly expensive as just the heatpipes and vapor chambers could cost over $1000. It did get me thinking about how airflow would work in my design as I would also have to consider how the machine would intake and exhaust air, leading to the research into the HP Spectre.

"Air flow and velocity due to natural draft". *Engineering Toolbox.* 2003.
https://www.engineeringtoolbox.com/natural-draught-ventilation-d_122.html
I used this source to learn more about the Chimney effect that was being used in the Compulab Airtop 3. I found a couple of equations that I could find useful for inducing the chimney effect, along with how to calculate the thermal heat transfer given multiple variables. The important part here is increasing the delta in air temps between the ambient and the heat dissipating element, which drives a pressure differential between the top and the bottom of the chimney, allowing for the air to rise and "suck" cool air in from the bottom. Some of the variables, such as air pressure, density, and ambient temperature can be held constant for my purposes.

Matt. "Transform a laptop into a stunning desktop media PC (for CHEAP)" *Youtube: DIYPerks.* August 15, 2017 https://www.youtube.com/watch?v=e3fnsGHe8eE
One of my inspirations for this project was this video from DIY perks where he turns an old broken laptop into a function desktop. The concept is what I want to take from this as it confirms to me that the idea of turning a laptop into a desktop is at least feasible. The main part that I plan to improve upon for my project is the design of the computer. I want

to shy away from the rustic and DIY look into maybe something more professional or modern. I also want to focus on making the design more compact, especially in slimness.

Matt. "DIY Dual Screen Laptop! (100% DIY)" *Youtube: DIYPerks.* September 26, 2019. https://www.youtube.com/watch?v=J2aY6cvk-WI
Another of my inspirations for my project was another video from DIY perks. In this case, he uses a salvaged laptop display in order to

"LVDS (Low-Voltage Differential Signaling)" *SemiconductorEngineering.* https://semiengineering.com/knowledge_centers/communications-io/off-chip-communications/i-o-enabling-technology/lvds-low-voltage-differential-signaling/
With this source, I learned a bit about the signalling protocol of LVDS and why it is used everywhere. Although electrically, most LVDS connectors use the same protocol and electrical work, each panel can be different in pinout or which pins are being used as some can be 1080p60hz or 4k120hz for example. This means that I'll need to find a specific LVDS board and pinout for my specific panel. LVDS itself is very power efficient, and will likely not need much power delivery overhead when it comes to finding a board and powering it.

Sebastian, Linus. "We made our own monitor for under $100" *Youtube: Linus Tech Tips.* October 13, 2019. https://www.youtube.com/watch?v=8mFUTpvetjM
This video is another showcase of the LVDS Control board working with a bare panel. For my purposes, I think I can improve upon this design by going with a metal construction in order to make the display stronger. I also intend to make the monitor portable, which may require me to design my own stand rather than using a COTS monitor stand like what is used in the video.

"Thermal Design Power (TDP) in Intel Processors" *Intel.* https://www.intel.com/content/www/us/en/support/articles/000055611/processors.html
After understanding the heat dissipation part of computers, I also had to consider what and how to use the TDP rating of the processors involved. TDP or Thermal Design Power, isn't the maximum amount of power that an Intel processor is using, but rather, the amount of heat rating for the cooling solution that it will be used with. In theory, for a 15W chip, the CPU can be pulling more than 15W, but the amount of heat that it is outputting, depending on how efficient it is, can be less than "15W" Usually, if a cooling solution is not effective enough for a CPU, then it will actively try to draw less power, usually be reducing clock speeds and turbo boost. For me, I don't expect the use case to require a turbo boost, and one of the laptops in question has such a low TDP (relatively), 15W, that hopefully any cooling solution will work.

u/North-Pineapple-2688. "Why 2 DIEs on intel mobile processors?" *Reddit.* November 2020. https://www.reddit.com/r/intel/comments/k0ij0j/why_2_dies_on_intel_mobile_processors
After disassembling both laptops and looking at their cooling solutions, I was confused why the Intel CPU had 2 dies on it despite Intel making their CPUs with a monolithic

design, IE: there should only be 1 die. As it turns out, the second die is the PCH (platform controller hub) ie: the chipset.

Hestia "SIMPLE DEFINITION: WHAT IS THE DIFFERENCE BETWEEN POWER ADAPTOR AND LED DRIVER" *Torchstar*. July 22, 2016. https://www.torchstar.us/frontnews/index/view/id/149#:~:text=Simple%20Definition%3A%20What%20is%20the%20Difference%20between%20Power%20Adaptor%20and%20LED%20Driver,-By%20Hestia%20on&text=LED%20power%20sources%20that%20were,to%20as%20LED%20power%20supplies.

For the display driver control board that I was using, I wanted to power it using a power supply that was integrated into the build. On Amazon, I came across something called an "LED Driver", which looked a lot like an AC-DC power supply in that it had an L/N/E on the input, and a +/- on the output. These power supplies were slimmer, but longer than the traditional power brick that I was planning to use, which actually would've made them great for my application, if only I knew whether they could work or not. From this source, I learned that the main difference between LED Driver and LED power supply was that the driver was constant current, while the power supply was constant voltage.