**Gameophagy: The World’s First Autophagy Video Game**

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In March 2020, my lab (and the rest of the world) shut down. This, coupled with the fact that creating genetically modified microbes on one’s basement is generally frowned upon, put quite the damper on my molecular biology research. However, I was also an amateur programmer with a desire to improve, giving me an avenue to stay busy during the quarantine. So how might I do that? Analyze the transcriptional profile of autophagy genes under various conditions? Perform homology searches to identify novel counterparts to the human autophagy proteins? “No”, I thought to myself, “I’ll make a video game”. And so it was that Gameophagy was born. Over the next few weeks, I cobbled together a maze of python code that resulted in the monstrosity you see below (figure 1). It was rough, but it captured the basics of autophagy. Players had to click the mouse (spawn the PAS) and complete a full circle (expand the phagophore), ending at roughly the same spot that they began before the timer ran out. Doing so would complete the autophagosome, trapping any cargo inside. The player then clicks and drags to send the autophagosome off to the vacuole/lysosome for degradation.

Bubble chart

Description automatically generated with low confidence

I presented this early iteration (virtually) in our weekly lab meeting to the delight of my lab and posted it on the Autophagy subreddit where it generated some amusement, but not much was done with it beyond that. Fast forward to 2021 and I developed the inkling to update my pet project. I discussed with Dan Klionsky about how I could improve the game. As usual he was not short for suggestions. I gradually implemented many updates to the game. The game now has a detailed instructions page and science pages which describe every detail of the game from a cell biology lens. After an autophagosome is delivered to the lysosome/vacuole off of the screen, building blocks are released. Mitochondria now fission over time, incentivizing the player to move quickly. However, it was clear the game could use an artistic touch. I brought in illustrator and graphic designer, Emily Grush, to help me improve the look of the game. Here Emily and I discuss the challenges of balancing esthetics with scientific accuracy.

**Figure 1:** Screenshot of gameplay from the original version of Gameophagy.

**WDH:** What scientific background, if any, do you have?

**ERG:** High school chemistry which I passed with a C+.

**WDH:** What’s your artistic background?

**ERG:** I currently work as a graphic designer for a real estate company. I also write and create illustrations on the side. My medium is primarily digital, using the Adobe Creative Suite as well as Procreate to illustrate children’s book style work.

**WDH:** How have you found scientific illustrations to differ from your usual medium?

**ERG:** They differ in a lot of ways, but they both have the same goal: to tell a story. I’d say the most significant difference is the emphasis on precision. With design and illustration (especially design) there’s a religious mantra of “less is more”. In scientific illustration though, the story you’re telling must be direct, detailed, and above all – accurate (or as accurate as the visual interpretation can be).

**WDH:** Do you have some examples of when the scientific constraints became important?

**ERG:** Absolutely. For the cargo, I was doing simple “glow up” work of taking the designs from the original game (fig1) and creating more unity with colors and line textures. The scientific stakes were raised however soon after settling on a unified look. For example, the original phagophore was not double membraned. The PAS was also changed significantly, going from a circle to the cluster of blobs (fig). The “blobs” were referenced from David Goodsell, who did a fantastic job of representing the cluster of proteins that PAS actually is. The autophagosome also saw changes, as it originally did not have Atg8 attached to its exterior.

Windows and Mac versions of Gameophagy are available for download at <https://github.com/wxhawkins/Gamophagy>.