What drives collective behavior in cells?

Digital Storytelling video made as part of UW Libraries Storytelling Fellows: Video Storytelling workshop in 2024. Watch the video here.

The swivel of a school of fish. The roaring stampede of wildebeests.The accordion movement of a traffic jam.The elegant murmur of starlings. All across nature, we see organized behavior emerging.

This also happens inside our body, in our cells! For example, the collective behavior of actin filaments is important for endocytosis, a process that cells use to take things in from their environment.

Actin is a protein that forms long, structural filaments that scaffold together to make a variety of things happen in the cell. These actin structures help the cell membrane move or create invaginations that lead to endocytosis.

In other words, these actin filaments can form complex structures, even without an architect telling them where to go and what to build! Every actin filament is acting according to its own set of rules. It grows or stops growing according to other local proteins nearby. It can start branching depending on its proximity to a branching protein. It can form all these complex and functional structures. Collectively, actin filaments can make amazing things happen!

This is what we study in our lab, the Akamatsu Lab. We study how these actin filaments self-organize to produce the architecture and force needed for endocytosis. We use genetic tools to create cells with specific tagged proteins, so we can use microscopy to see how and when they are involved in endocytosis.

For the things we can't see with a microscope, we use computational models that help us better understand how proteins interact at a molecular level and can produce the force needed to internalize an endocytic pit.

And we 3D print our proteins, not just because it's fun, but because it allows us to see how everything fits together. We are constantly amazed how the proteins seem to fit smugly like a hand in a glove.

Using all these different tools, our lab hopes to understand how individual proteins can work together to give rise to cellular processes. And while that won't help you get out of that traffic jam, maybe thinking about how cool cells are will keep you distracted for a little bit.