

Module 5: Cells, Tissues, & Organs

Description: Cells accumulate to form groups of moving parts whose dynamics are distinct from single cell behavior and, depending on the level of organization, different methods must be used. This process, known as emergence, can be seen in the ability of individual cells, such as cardiac cells, to work collectively as tissues. Cellular processes like phagocytosis also provide an example of how individual cells can work together towards a common goal.



Macrophage undergoing frustrated phagocytosis (credit Dr. Kovari)



Macrophages spreading, captured with phonescope

Protocols:

- [Frustrated phagocytosis](#)

Frustrated phagocytosis

Goal: Using a 3D printed, van Leeuwenhoek-inspired phone-microscope and sample holder with an IgG (antibody protein) coated coverslip, students capture videos of mouse macrophages undergoing frustrated phagocytosis.

Materials

- flask (3-5mL) of macrophages in media
- scraper
- gloves
- safety goggles
- 1-1000uL micropipette
- 1-1000uL micropipette tips
- light duty wipes
- 1.5mL microcentrifuge tubes
- DI water
- 70% EtOH
- IgG coated coverslips (2-4)
- vacuum grease
- waste bag/beaker
- LED strip lights
- timelapse app
- 3D printed phonescope v2 (see above)
- 3D printed sample holder

Procedure

1. Set up and maintain a sterile workstation.
 - a. Wear gloves and eye goggles while working
 - b. Clean workspace with DI water, then with 70% EtOH
 - c. Keep workspace clear while working
2. Gather materials.
3. Setup phonescope v2
 - a. Connect your smartphone to a TV monitor (wirelessly or otherwise)
 - b. Line up the bead in phonescope v2 with the back camera
 - c. Position LED strip lights above back camera, with a wipe as a light diffuser
 - d. Adjust height of your phone to adjust the focus
4. Use vacuum grease to adhere an IgG coverslip to the bottom of the sample holder.
5. Uncap the flask and use the scraper to scrape the bottom and suspend the macrophages in the media.
 - a. Scrape gently, back and forth a few times
6. Mix the media in the flask with the micropipette and transfer ~1mL into a 1.5mL microcentrifuge tube.
7. Place the sample holder with IgG coverslip on top of phonescope v2 and start timelapse/video recording.
8. Transfer ~1mL of macrophages suspended in media into the sample holder and observe while recording 1 image/30s for ~20 minutes.