Make some noise to fight malaria!

Prof. Jon Cooper's group - Biomedical Engineering Research Division

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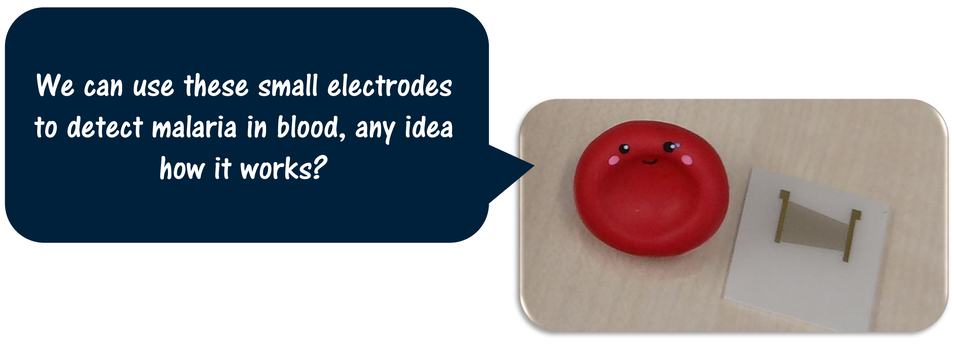
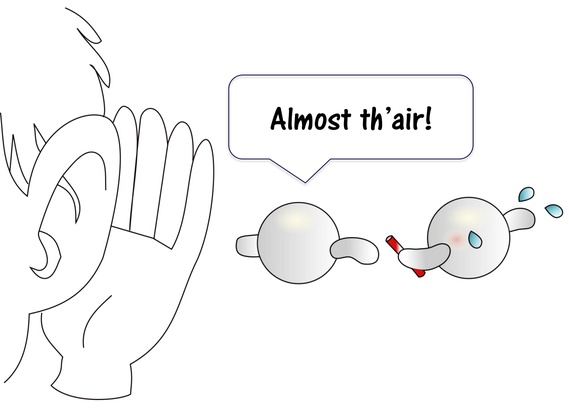
Aim of the activity

Malaria is one of humankinds' oldest and deadliest foes. The project highlights how sound-based microsystems can be used as portable and low-cost diagnostic tools to fight this deadly disease.



What is sound?



Sound is produced when a force causes an object or substance to vibrate. These vibrations cause air molecules around to move and bump into other air molecules. The process propagates until they run out of energy. Propagating vibrations interact with objects or substances in their path. We use this phenomenon to mix, separate, heat and displace fluids and particles. Our aim is to use sound-based microsystems to detect diseases using small droplets of biological fluids (blood, saliva, urine).

Sound in the biomedical field, a bit of history…

1794 — Demonstration of the ability of bats to navigate using echo reception from high frequency sounds

1880 — Discovery of the piezoelectric effect in certain crystals (reversible generation of electrical charge by applying mechanical forces)

1910s — Development of underwater navigation using Sound Navigation and Ranging (SONAR) during WWI

1940s — Ultrasound used for therapy; *e.g.* heating and disruptive effects are used to destroy some damaged areas

1958 — Publication of "Investigation of Abdominal masses by pulsed ultrasound" by Prof. Ian Donald from Glasgow

1968 — Publication of the first paper related to foetal malformation diagnosed using ultrasound

A short history of the development of ultrasound in obstetrics and gynecology. Woo (2002)

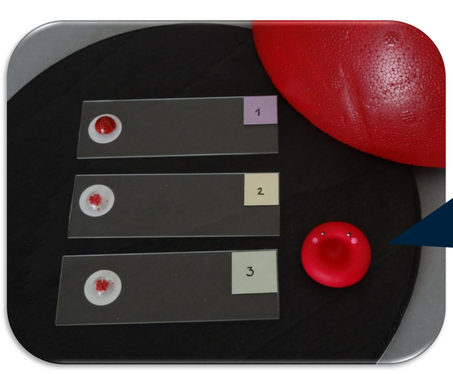
Sound and malaria detection

Malaria is an infection causing changes in the physical properties of red blood cells; infected red blood cells have a lower density than normal red blood cells. When sound is applied to a droplet of blood, normal and infected cells behave differently allowing for their separation. Infected red blood cells are concentrated at the periphery of the droplet, which makes their detection easier.

Outline of the activity

1 Understand what blood is made of and the role of blood cells

3 Spot the differences between normal and infected red blood cells



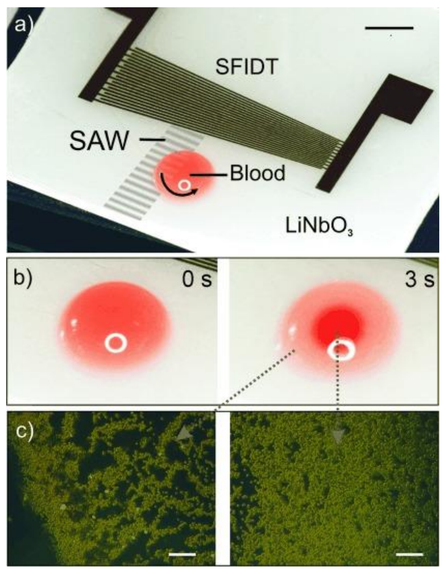
Now that you know how sound acts on infected cells can you identify which patient has malaria?

2 Prepare slides to observe particles of similar size as blood cells

4 Use resonating forks to induce the motion of objects of different densities

Want to know more?

Rare-Cell Enrichment by a Rapid, Label-Free, Ultrasonic Isopycnic Technique for Medical Diagnostics. Bourquin et al., Angewandte Chemie, 126:5693-5696 (2014)



Related work: *Clotting blood using surface acoustic waves*. Jimenez et al., Poster **W223j**

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