Sum Wone
Year 11 Biology

Exemplar A Level.

Cell Microscopy
SHE Report

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Introduction

Microscopes have been the window to cellular biology ever since the first alleged compound microscope was invented by Hans and Zacharias Janssen, in the 16th century (Poppick, 2017). This microscope caused little magnification and an indistinct image (Poppick, 2017). Although it was an essential foundation for future developments, it brought about no momentous scientific discoveries (Poppick, 2017). In 1655, Robert Hook (Poppick, 2017) improved the design of the compound microscope and his use of it led to the discovery of cells (National Geographic Society, 2019), opening the scientific field of cellular biology. Soon after Hook's discovery, Antoine van Leeuwenhoek designed a high-powered, single lens microscope which didn't distort the image like previous compound microscopes (Cox, 2013). He used this to discover micro-organisms (Cox, 2013). The traditional light microscope continued to develop but was reaching its limit in the 20th century (Cox, 2013). The invention of the electron microscope in 1931 opened new doors for biologists (Cox, 2013). From then on, microscopes have constantly been improved due to scientific developments and the collaboration of scientists from many departments.

Communication and Collaboration

Scientists from many different fields of science collaborate and communicate to innovate new microscope designs.

In 2015, Elisabeth Hilman developed a 3D highspeed microscope, SCAPE, which allows the imaging of moving live samples (CUSEAS, 2015). She was a part of institutes such as the Zuckerman Institute (CUSEAS, 2015), which consisted of scientists from many departments of science. This allowed Hilman to collaborate with a broad team of scientists to develop her technology, such as neuroscientist Rany Bruno, biochemist and molecular biophysicist Richard Mann, physcologist and cell biophysicist Wesley Grueber and paediatrician Kimara Targroff, all of which were beginning using SCAPE to conduct research (CUSEAS, 2015).

Another example of the collaboration between different fields of science for advancements in cell microscopy is shown in the development of electron cryo-microscopy, a technique that "fires beams of electrons at proteins frozen in solution to reveal their structures" (Flemming, 2019). Scientists from many different fields have collaborated to provide essential assistance in the creation and development of this type of microscopy. Physicists have supplied technology that can increase speed of cryo-EM devices, chemists have created fluorescent probes that illuminate recipients for longer and computer scientists have developed image processing methods (Flemming, 2019). Jennifer Lippincott-Schwartz, a cell biologist, says "The acceleration in imaging has come about through this incredible synergy" (Flemming, 2019). This clearly demonstrates the importance of collaboration from a variety of scientific fields in scientific efforts.

Development

Developments of new technologies in science have assisted in the improvement of microscopes and advances in cell biology.

The development of imaging tool cryo-EM, a technique that "fires beams of electrons at proteins frozen in solution to reveal their structures" (Flemming, 2019), has allowed advancements in cell biology due to its revolutionary ability to show the arrangement of biomolecules at near-atomic

resolution (Flemming, 2019). “New techniques have come on board over the last ten years that allow us to see things inside cells that we couldn’t resolve before,” says cell biologist Anne Ridley concerning cryo-EM (Flemming, 2019). Already cryo-EM has been used to develop understanding of cell biology. By capturing 3D footage of the interactions between different organelles, biologists can develop understanding of cross communication between organelles (Flemming, 2019). This demonstrates the importance of development of technologies for advancements in scientific understanding.

Impact

Today, microscopes widely impact our lives. This increasingly advanced visual access to the building blocks of life, cells, is essential in the research and testing of medicine, materials and investigation in forensic science (Taylor, 2018).

Microscopes are used to identify sources of infections and diagnose diseases in hospital laboratories, allowing patients to receive correct prescriptions and treatment, improving the population’s health (Taylor, 2018). Microscopy is also an essential technology in materials research, which allows the strength of structures to be examined, improving the safety of individuals using these structures (Thomas, 1999). Forensic scientists also use microscopes to examine trace evidence, such as fibres, to convict criminals, once again improving the safety of the public (Michelle, 2017).

Current developments in science and the collaboration of scientists from many different fields of science continues to improve the technology of microscopy. Future developments could include improving the accessibility of this technology, specifically for students, improving education and broadening research.

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