Instruments in Shannon ABC Laboratories.

LC/MS (Liquid Chromatography)

Liquid chromatography separates the sample components and then introduces them to the mass spectrometer. The MS creates and detects charged ions. The LC/MS data may be used to provide information about the molecular weight, structure, identity and quantity of specific sample components.

Example of uses:

- peptide mass fingerprinting
- toxicology screening
- detection of residual chemical compounds
- confirmatory identification of small organic molecules
- confirmation and quantitation of contaminants in pharmaceutical and food samples

SFE (Supercritical Fluid Extraction)

Supercritical Fluid Extraction is the process of separating one component (the extractant) from another (the matrix) using supercritical fluids that is CO_2 as the extracting solvent. CO_2 is the king of extraction solvents for botanicals (is a nontoxic, inexpensive, nonflammable, and nonpolluting supercritical fluid solvent for the extraction of natural products).

HPLC (High performance Liquid Chromatography)

HPLC is a form of liquid chromatography to separate compounds that are dissolved in solution. Compounds are separated by injecting the sample mixture onto the column. The different components in the mixture pass through the column at different rates due to differences in their interaction between the mobile liquid phase and the stationary phase.

<u>Example of uses:</u>

- identifying, quantifying and purifying the individual components of the mixture

HPTLC (High Performance Thin Layer Chromatography)

HPTLC gives even greater resolution and separation of components than normal TLC. It uses chromatographic stationary phases of even better separation efficiency and employs state of the art instrumentation for all steps in the procedure from precise sample application, standardized reproducible chromatogram development and software-controlled evaluation. HPTLC shows visually at a glance the similarities and differences between samples and references. Therefore, it can be used for analysis of raw materials & finished products, for the determination of purity (adulteration/fraud) and stability studies (shelf life). It can also be used for process development i.e. samples can be analysed at different stages of a process. By using reference standards, compounds can be quantified precisely.

Example of uses:

- Pharmaceutical - Quality Control; Content Uniformity Test; Identity and purity checks; stability tests
- Herbals – Identification; Stability tests; Detection of adulteration; Assay of marker compounds
- Clinical - Lipids; metabolism studies; drug screening; doping control
- Food and Feed - Quality Control; Analysis of additives e.g. vitamins; pesticides; stability tests
- Cosmetics - Identity of raw material; Analysis of preservatives, colouring materials etc; screening of illegal ingredients
- Biotechnology - Characterization of enzymes (product profiles); Proteomics (coupling HPTLC to Mass Spectrometry); Process development and optimization;
- Process monitoring - Cleaning validation,
- Environment - Water; soil; residue analysis
- Forensics - Molecule investigation; dyestuff analyses

ICP-MS (Inductively Coupled Plasma Mass Spectrometry)

ICPMS has become one of the most important techniques for elemental analysis. At the heart of the ICPMS instrument is the torch, where Inductively Coupled Plasma (ICP) atomises and ionises the sample at extremely high temperatures. These ions are then sorted according to mass and charge by the Mass Spectrometer (MS) part of the instrument. It is the coupling of these two unique instruments that gives ICPMS its exceptional qualities in terms of detection, sensitivity and accuracy. The Inductively Coupled Plasma minimises interferences by offering exceptional ionisation, while modern mass spectrometers such as the quadrupole allow superb resolution.

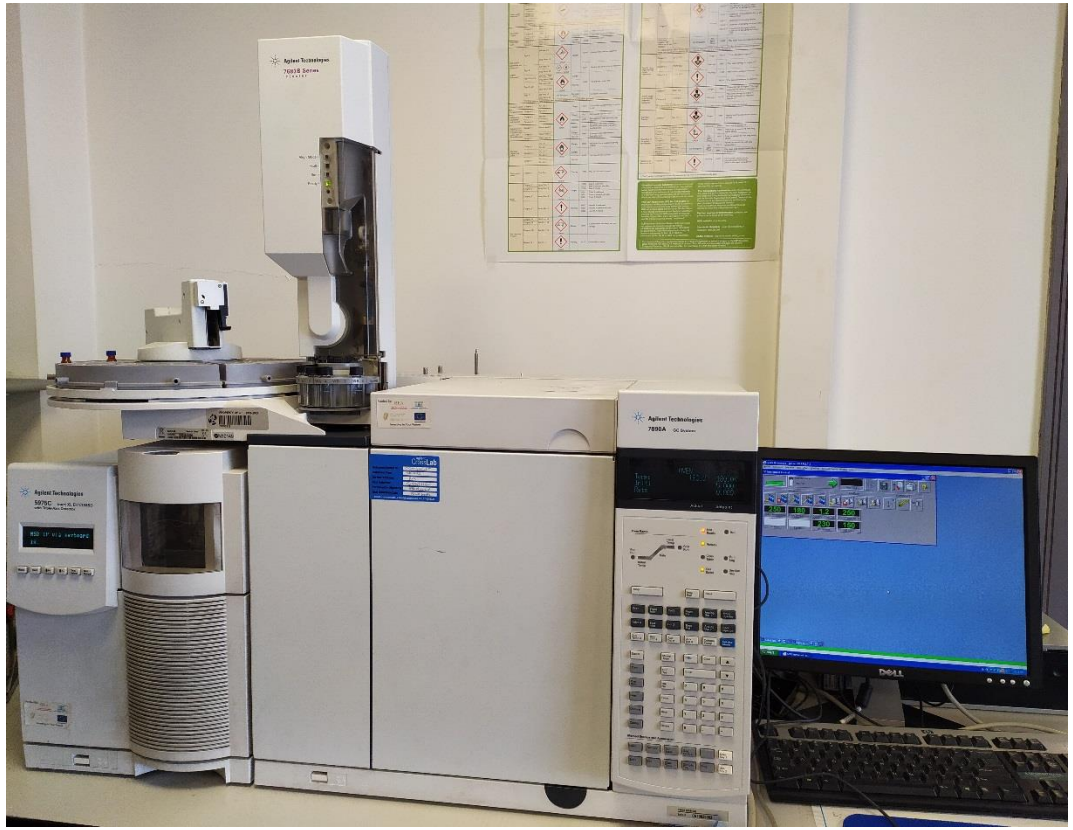
ICPMS has applications across a number of industries from pharmaceutical to food and environmental as it has now become the benchmark standard method for elemental determination in most sectors.

Examples of uses:

- Heavy metal analysis in soil and water
- Mineral analysis in food products
- Quality control in food and pharmaceutical analysis
- Biomass screening

GC-MS (Gas chromatography–mass spectrometry)

GC–MS is used to detect compounds using the relative gas chromatographic retention times and elution patterns of components of a mixture in combination with the mass spectral fragmentation patterns, which is the characteristic of a compound's chemical structures. A typical GC–MS system performs the following functions: 1) separation of individual compounds in a mixture by gas chromatography; 2) transfer of separated components to the ionizing chamber; 3) ionization; 4) mass analysis; 5) detection of the ions by an electron multiplier; and 6) data acquisition, processing, and display by a computer system.



Example of uses:

- smaller and volatile molecules such as benzenes, alcohols and aromatics,
- simple molecules such as steroids, fatty acids, and hormones.
- it can also be applied towards the study of liquid, gaseous and solid samples.
- ability to separate complex mixtures, to quantify analytes and to determine trace levels of organic contamination.

AAS (Atomic Absorption Spectrophotometry)

Atomic absorption spectrophotometry analyses the concentration of elements in a liquid sample based on energy absorbed from certain wavelengths of light. AAS typically include a flame burner to atomize the sample, a monochromator, and a photon detector.

<u>Example of uses:</u>

- food and beverage, water, clinical, and pharmaceutical analysis

Fourier transform infrared (FTIR) and Raman spectroscopies

The instrument used for accurate -fingerprint identification and study of composition and properties of various materials from metalorganics to complex biological samples. FTIR spectrometer with automatic beam splitter and operating in three IR ranges: near-IR, mid-IR and Far IR.

Built in ATR for easy sampling and spectral deconvolution

FT Raman with 1024 nm laser, virtually fluorescence free

<u>Example of uses:</u>

- Polymers, rubbers
- Forensic samples
- Pharmaceuticals
- Pigments and paints
- Food flavours and oils
- Compost and soils
- Organometallics and crystallinity analysis
- A FTIR-GC interface for definitive identification of compounds in complex mixtures coming soon

FPLC (Fast protein liquid chromatography)

FPLC is a form of medium-pressure chromatography that uses a pump to control the speed at which the mobile phase passes through the stationary phase.

Examples of uses:

- molecules purification
- molecular mass determination
- fraction separation

Cell Culture Suite

Shannon ABC have two independent cell culture suites providing the necessary conditions for maintaining healthy and free of contamination cell lines. Laboratories are dedicated to conducting a wide range of scientific research using *in vitro* cultured mammalian cells.

Cell culture suites are fitted with state of the art equipment required for the routine culture of cells: class II safety cabinets, CO_2 incubators, inverted fluorescence microscope, centrifuges, cell counter.

<u>The scientific potential of the Cell Culture Suite includes:</u>

• study of physiological and pathological processes occurring in cells

• evaluation of the effect of natural or synthetic substances on cells, including the analysis of:

- cytotoxicity
- proliferation
- apoptosis
- metabolic activity
- intracellular oxidative stress
- secretion of cytokines and growth factors

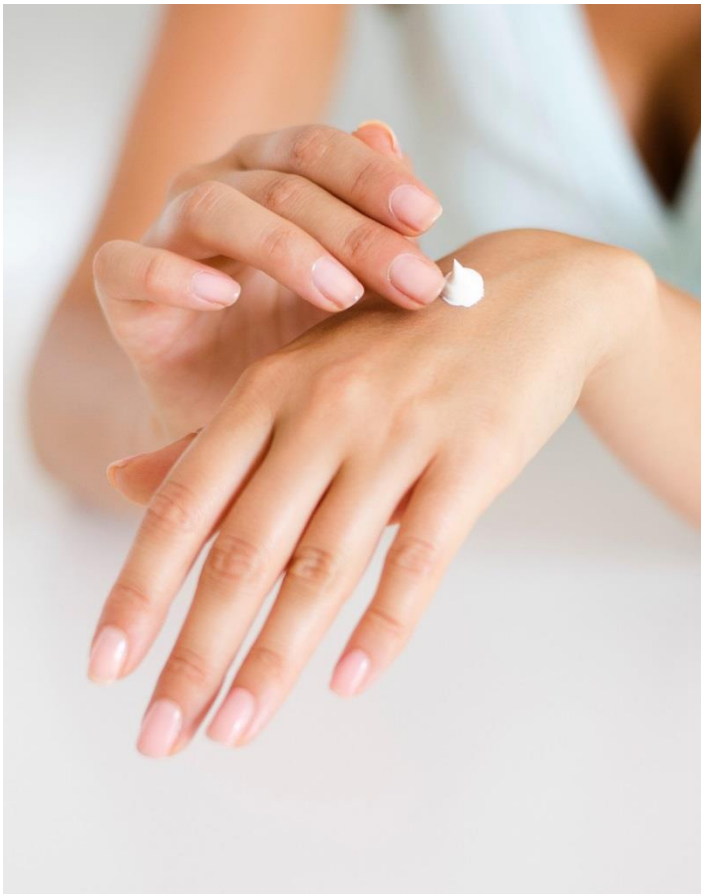
Skin analysis/Cosmetic Suite

Skin analysis studies at Shannon ABC will enable cosmetics and nutraceutical companies to market their product's efficacy using scientifically proven, quantitative data and ensuring compliance with Commission Regulation (EU) No 655/2013. Shannon ABC has a reserve panel of approximately 100 volunteers that can be involved in efficacy testing of cosmetic products. Studies range from 24 hours to 12 weeks, depending on company requirements, end point measures required and products tested.

The Shannon ABC skin analysis suite utilises non-invasive tools to determine measurements of skin such as elasticity, moisturisation/hydration, skin barrier efficacy, skin sebum/oil production and wrinkle reduction. The skin testing tools are produced by Courage + Khazaka (C+K) in Germany.

The tools currently in Shannon ABC are:

- Cutometer® dual MPA 580
- Corneometer® CM 825
- Sebumeter® SM 815
- Tewameter® TM 300
- Visioline® VL 650 (Quantirides)
- Visiopor® PP 34 N
- Mexameter® MX 18
- Sebufix® F 16



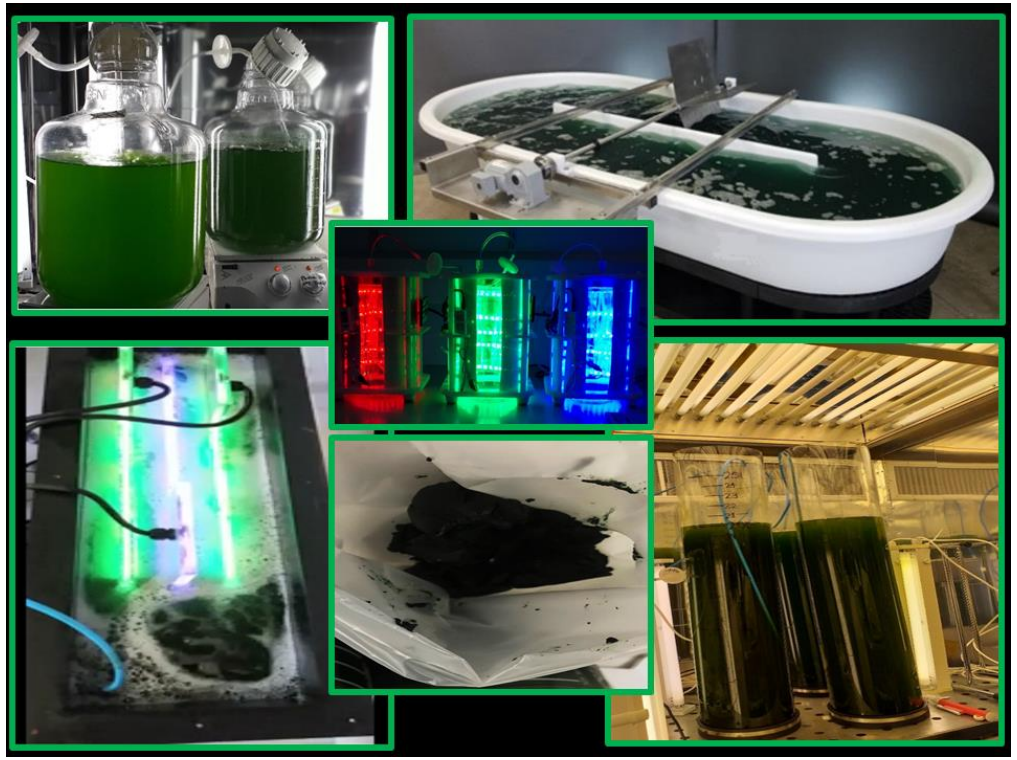
Food-Grade Microalgae Cultivation Suite

This is a state-of-the-art Food-grade microalgae cultivation facility for the cultivation of microalgae, diatoms, and cyanobacteria at different scales starting from 1 L to 3300 L culture volume.

This is the indoor facility with a control growth environment including the control of temperature, pH, LED light intensity and quality, light/dark cycle, air, and CO_2 concentrations for photosynthetic organisms.

This facility also consists of two custom-designed 100 L photobioreactors with LED lighting technology for the enhancement of microalgal pigment production.

This facility uses flocculation, continuous-flow centrifugation, and filtration methods for biomass harvesting.



Examples of uses:

- R&D development
- large-scale microalgal biomass production

Skin probes system

Skin probe testing utilises non-invasive skin testing probes to determine measurements of skin such as elasticity, moisturisation, skin barrier efficacy and skin sebum/oil production.

<u>Examples of uses:</u>

- *in vivo* validation of cosmetic products
- measurement of different skin parameters:

- hydration

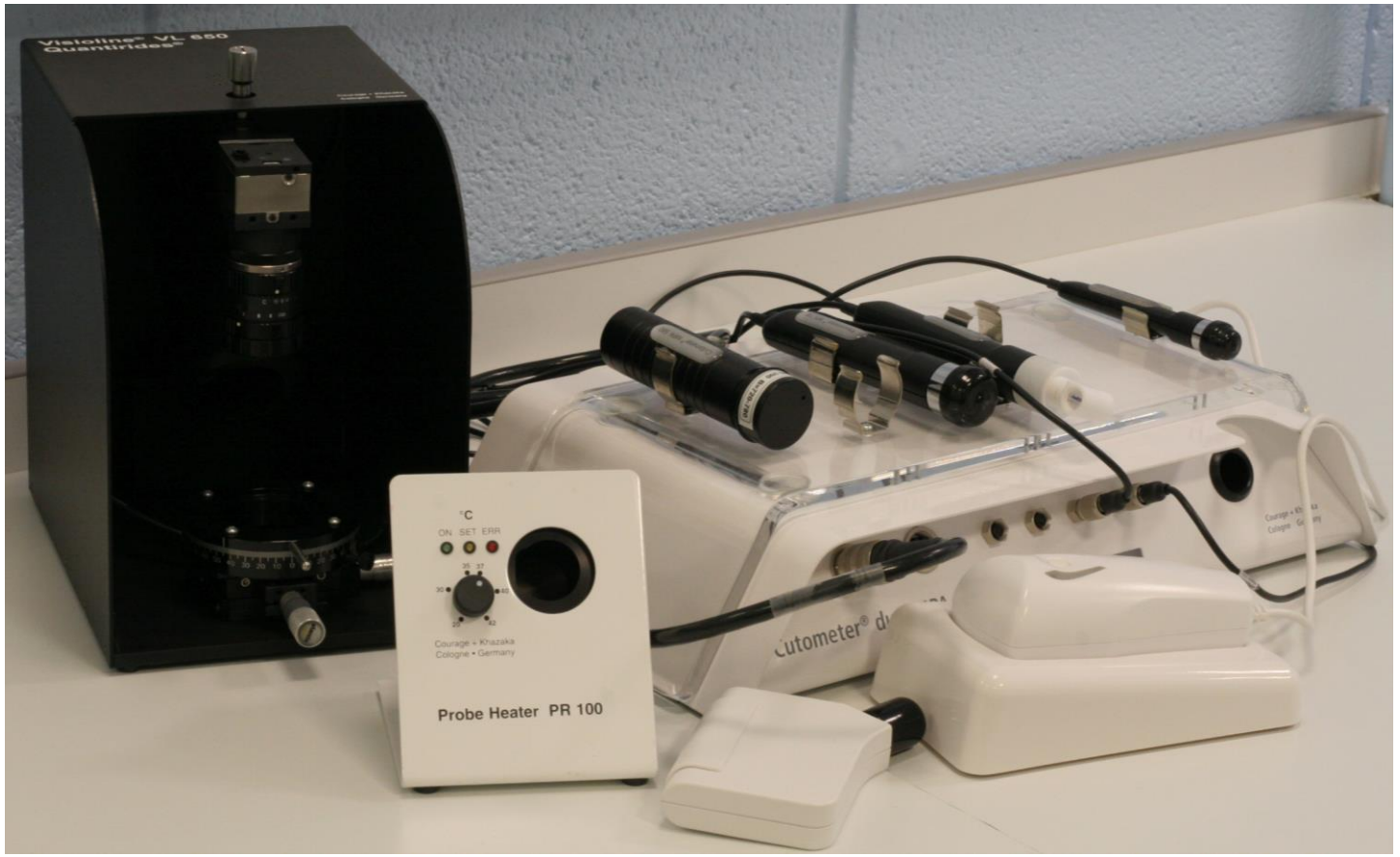
- Transepidermal Water Loss (TEWL) and skin barrier function

- elasticity

- wrinkle reduction

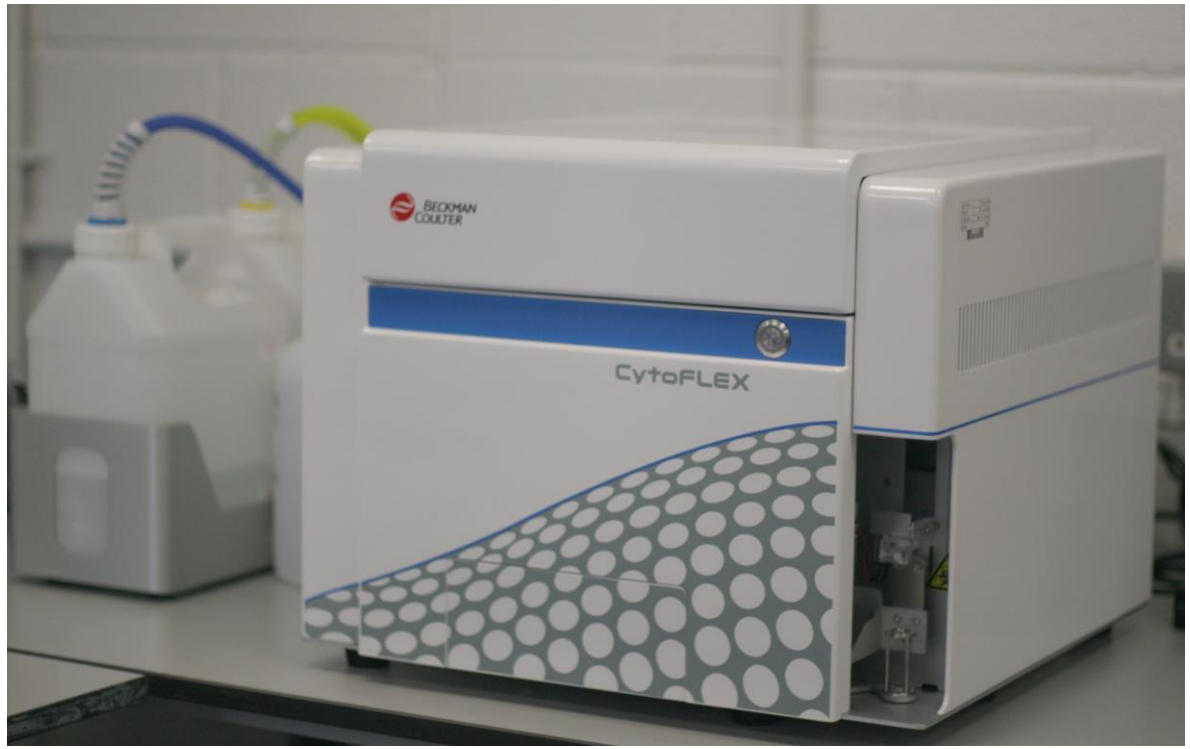
- melanin content and erythema level

- acne lesions



Flow cytometer

Flow cytometer is a instrument used to detect and measure physical and chemical characteristics of a population of cells or particles. The sample is focused to ideally flow one cell at a time through a laser beam and the light scattered is characteristic to the cells and their components. Cells are often labelled with fluorescent markers so that light is first absorbed and then emitted in a band of wavelengths. Tens of thousands of cells can be quickly examined and the data gathered are processed by a software.



<u>Examples of uses:</u>

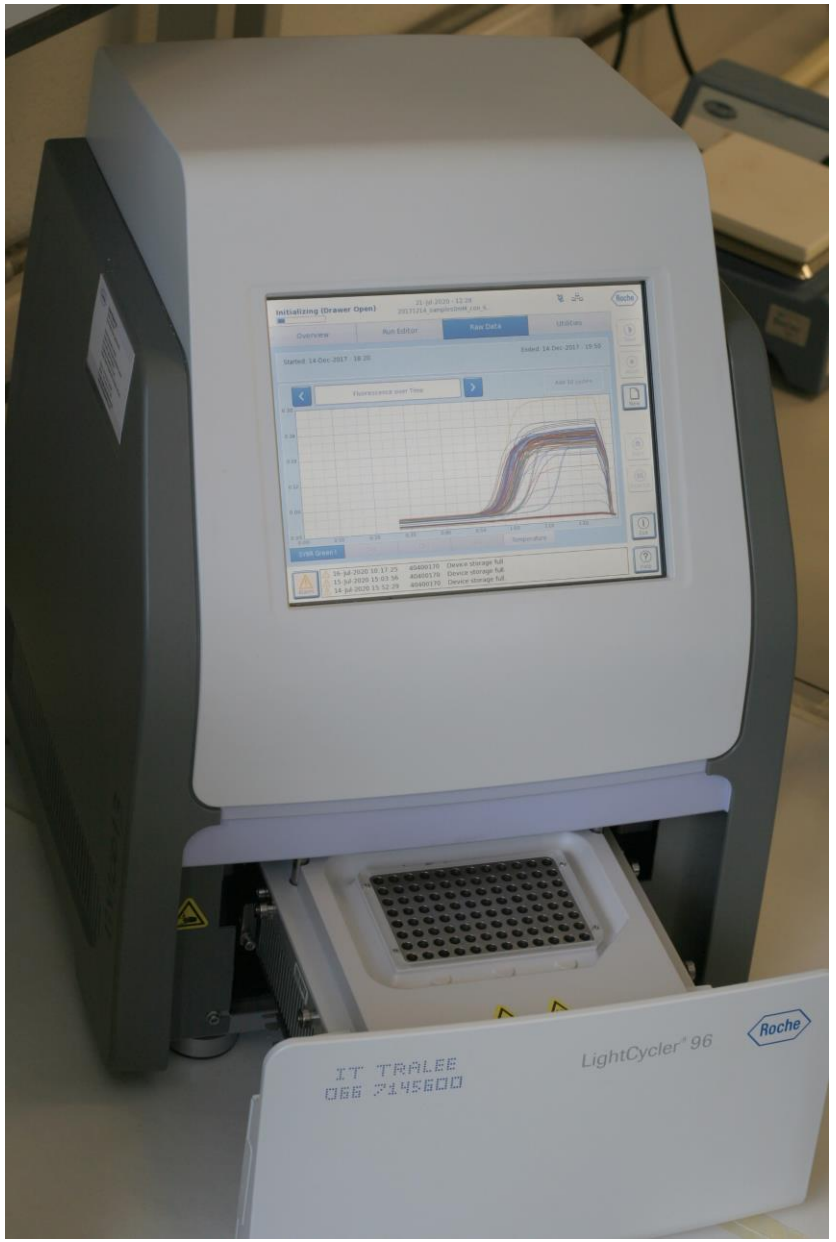
- cell counting and sorting
- determining cell characteristics and function
- detecting microorganisms
- biomarker detection
- protein engineering detection
- diagnosis of health disorders

Thermal cycler

The thermal cycler is a laboratory apparatus most commonly used to amplify segments of DNA via the polymerase chain reaction (PCR). Thermal cyclers may also be used to facilitate other temperature-sensitive reactions, including restriction enzyme digestion or rapid diagnostics. The device has a thermal block with holes where tubes holding the reaction mixtures can be inserted. The cycler then raises and lowers the temperature of the block in discrete, pre-programmed steps.

<u>Examples of uses:</u>

- Real-time qPCR
- heating and cooling the DNA samples for genotyping
- maintenance of the temperature during biochemical reactions such as DNA cloning for sequencing, DNA amplifying, and DNA-based phylogeny

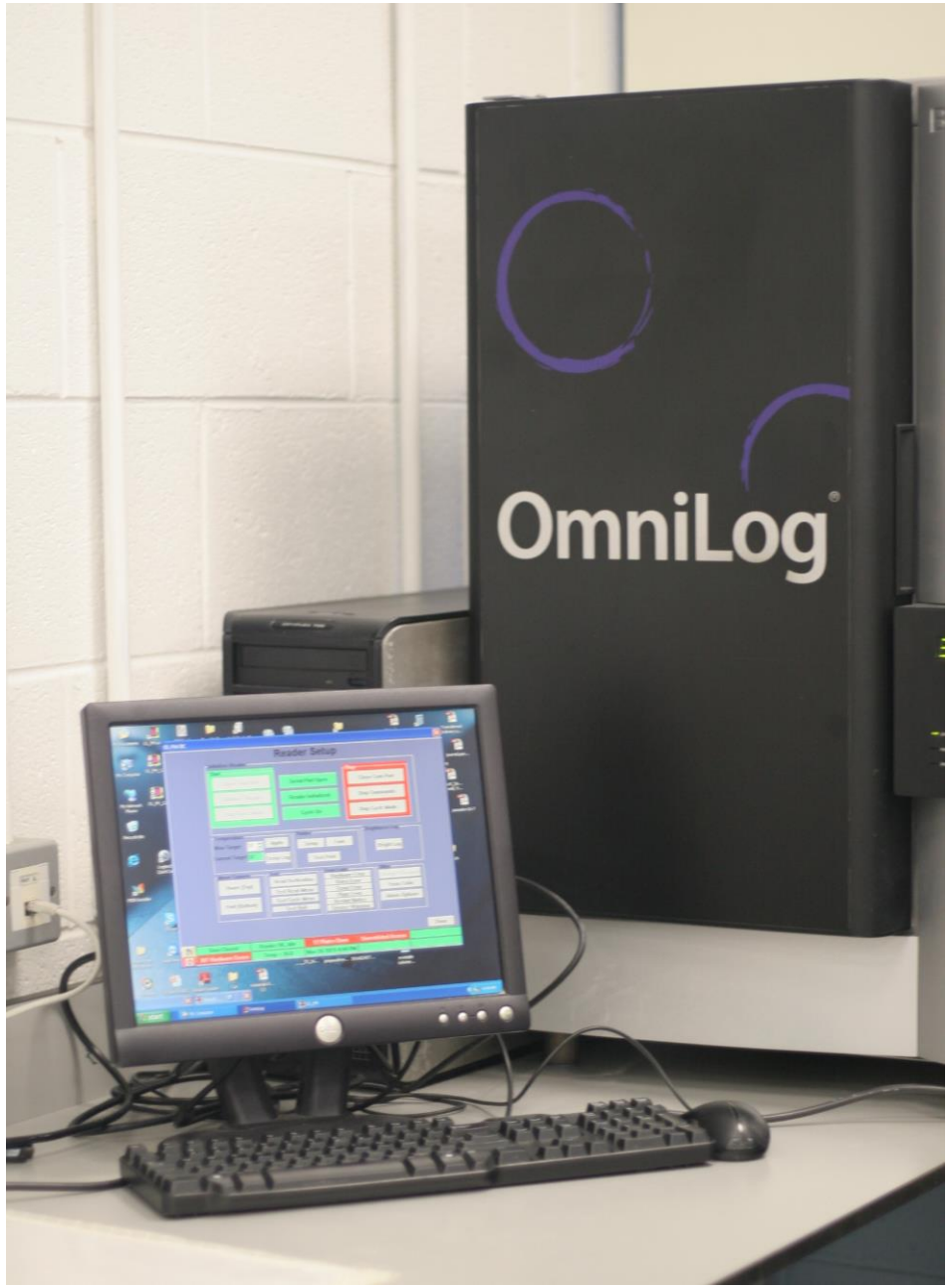


Phenotype MicroArray

Phenotype MicroArrays are preconfigured 96-well plates containing different classes of chemical compounds designed to test for the presence or absence of specific cellular phenotypes. MicroArrays make it possible to quantitatively measure thousands of cellular phenotypes all at once. The technology enables to evaluate nearly 2000 phenotypes of a microbial cell in a single experiment. Through comprehensive and precise quantitation of phenotypes, researchers are able to obtain an unbiased perspective of the effect on cells of genetic differences, environmental change, and exposure to drugs and chemicals.

Examples of uses:

- determination of a cell's metabolic and chemical sensitivity properties
- discovery of new targets for antimicrobial compounds
- optimization of cell lines and culture conditions in bioprocess development
- characterization of cell phenotypes for taxonomic or epidemiological studies



SEM (Scanning Electrone Microscope)

A scanning electron microscope is a type of electron microscope that produces images of a sample by scanning the surface with a focused beam of electrons. The electrons interact with atoms in the sample, producing various signals that contain information about the surface topography and composition of the sample.

<u>Example of uses:</u>

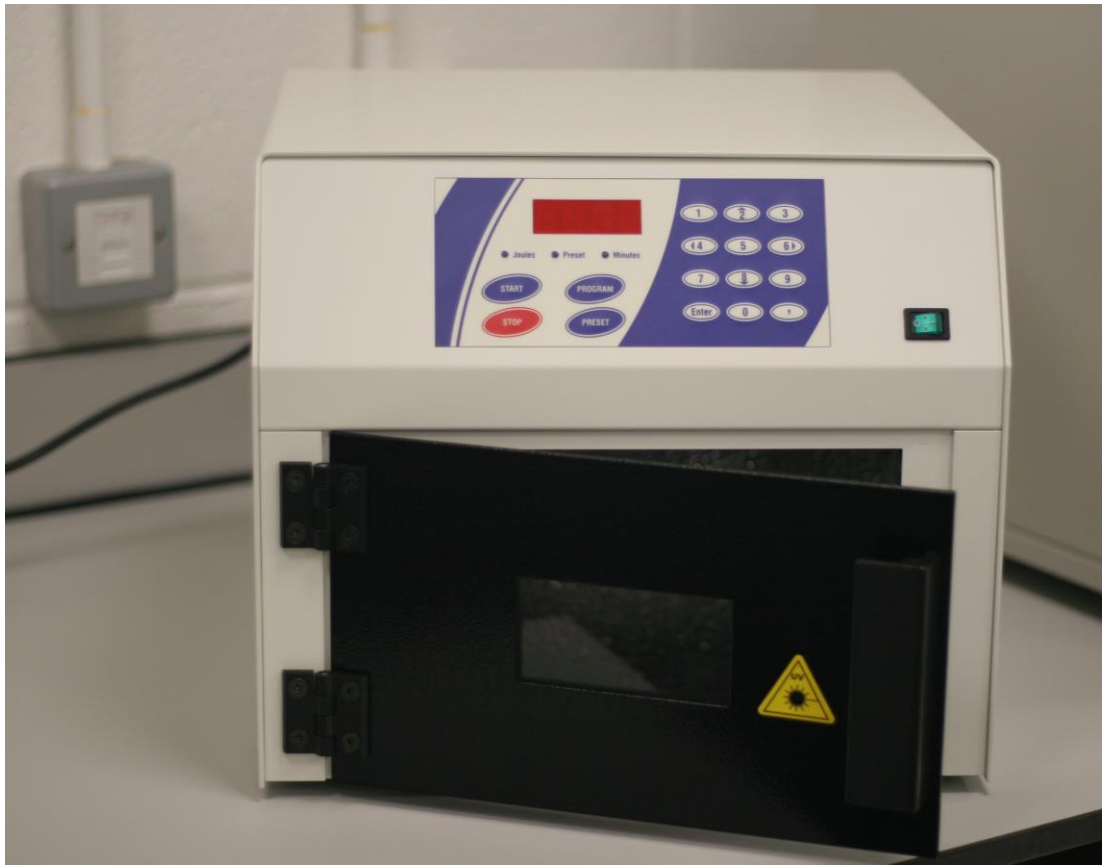
- determination of topography, morphology and composition of tested material
- materials science for research, quality control and failure analysis

UV Crosslinker

UV crosslinker is a complete, microprocessor controlled UV irradiation system

Examples of uses:

- crosslinking of DNA and RNA by covalently binding nucleic acids to nitrocellulose or nylon membranes for Southern, Northern, dot or slot blots procedures
- elimination of PCR contamination
- UV sterilization
- testing of the sun protecting agents
- study of the effects of cells exposure to UV light



Automated cell counter

Automated Cell Counter is a benchtop assay platform equipped with state-of-the-art optics, full autofocus, and image analysis software for rapid assessment of cells in suspension. It uses trypan blue staining combined with an auto-focus mechanism and image analysis algorithm to obtain accurate cell and viability counts.

<u>Examples of uses:</u>

- determination of cell density in the suspension
- cell viability measurement

Plate reader

Plate readers are instruments which are used to detect biological, chemical or physical events of samples in microtiter plates. Sample reactions can be assayed in 1-1536 well format microtiter plates. The most common microplate format used in academic research laboratories or clinical diagnostic laboratories is 96-well. Detection modes for microplate assays are absorbance, fluorescence intensity, luminescence, time-resolved fluorescence, and fluorescence polarization.

Examples of uses:

- drug discovery
- bioassay validation
- quality control

Gel Imaging System

Gel imaging system captures images and analyze data from western blots and gels

Examples of uses:

- Western blot application
- Proteins and nucleic acids staining

Fluorescence microscope

A fluorescence microscope is an optical microscope that uses fluorescence instead of, or in addition to, scattering, reflection, and attenuation or absorption, to study the properties of organic or inorganic substances.

<u>Examples of uses:</u>

- live cell imaging (cell division, cell migration, movements and transformations of organelles, calcium imaging)
- detection and determination of the proteins localization in cell and tissue
- identification of apoptosis
- cyto- and genotoxicity study

Freeze dryer

Freeze dryer (lyophilizer) executes a water removal process typically used to preserve heat-sensitive materials. Freeze dryers work by freezing the material, then reducing the pressure and adding heat to allow the frozen water in the material to sublimate. The process does not damage the chemical structure, preserves materials, and reduces the risk of contamination.

<u>Examples of uses:</u>

- product shelf life extension
- food processing
- preservation of biological products

Mini Spray Dryer

This spray dryer is used to dry aqueous solutions or suspensions in one operating process that employs liquid atomization to produce droplets that are dried to individual particles when moved in a hot gaseous drying medium. A spray dryer consists of a feed pump, atomizer, air heater, air dispenser, drying chamber, and systems for exhaust air cleaning and powder recovery/separator.

Rotary evaporator

A rotary evaporator (or rotavap/rotovap) is a device used in laboratories for the efficient and gentle removal of solvents from samples by evaporation.

Examples of uses:

- reducing the volume of a solvent in extracts

Biological Safety Cabinets Class II

Biosafety Cabinets are the enclosed, ventilated laboratory workspace for safely working with materials contaminated with (or potentially contaminated with) pathogens requiring a defined biosafety level. BSCs protect both the user and the product in the cabinet from bacterial contamination.

Examples of uses:

- safe working with low, moderate, and high-risk biological agents
- manipulation of cultured cells (media changes, passaging cells, treatments, transfections)

CO_2 incubator

A cell culture incubator is designed to maintain a constant temperature and high humidity for the growth of tissue culture cells under a CO_2 atmosphere

<u>Examples of uses:</u>

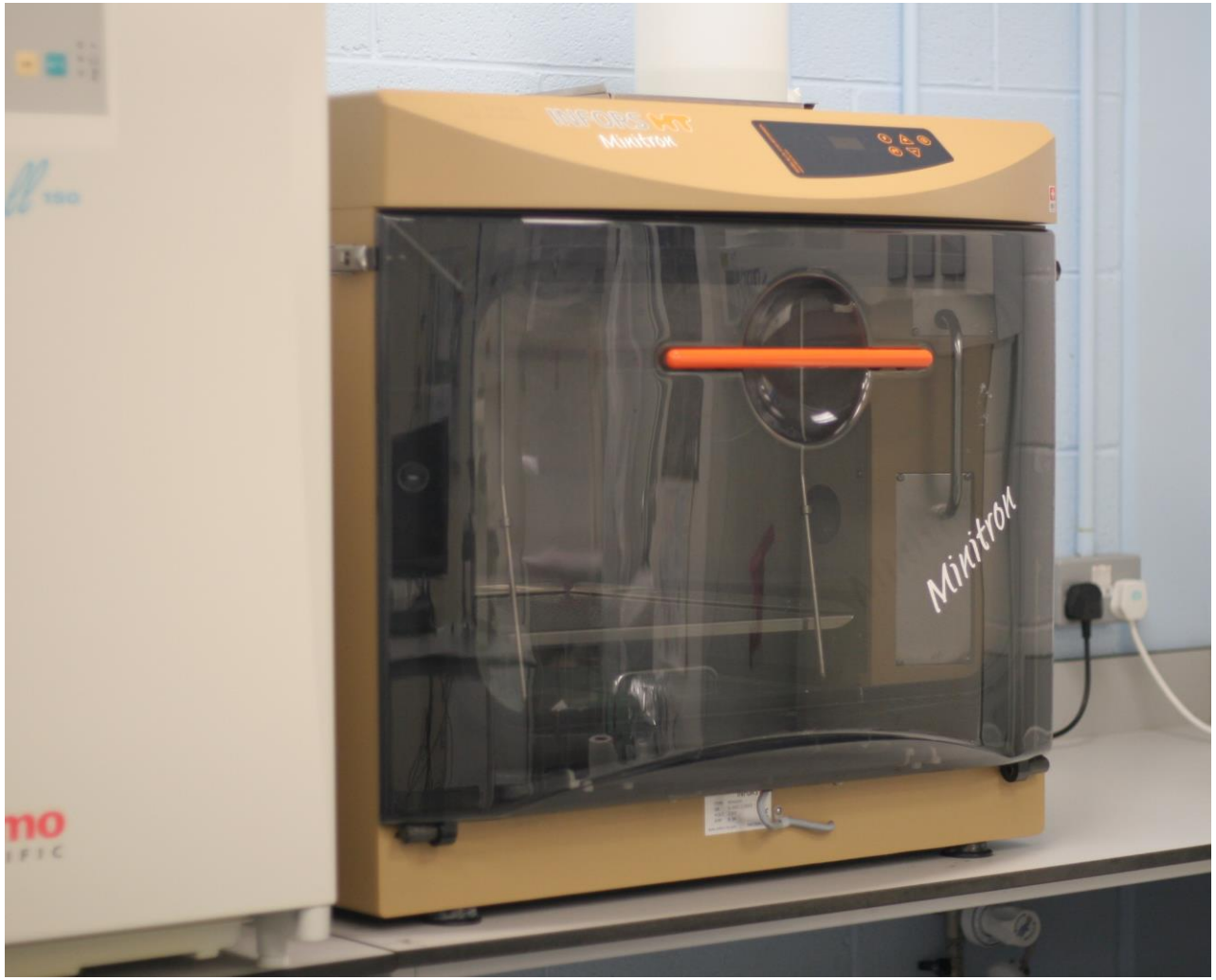
- growth and maintenance of cell and tissue cultures

CO_2 shaking incubator

CO_2 Shaking incubators combine the functions of a traditional incubator (constant temperature, humidity and CO_2 level) and a laboratory shaker in order to promote cell growth.

<u>Examples of uses:</u>

- culturing of suspension cells
- cells aeration
- studies of solubility



Inverted microscope

An inverted microscope is a microscope with its light source and condenser on the top, above the stage pointing down, while the objectives and turret are below the stage pointing up.

<u>Examples of uses:</u>

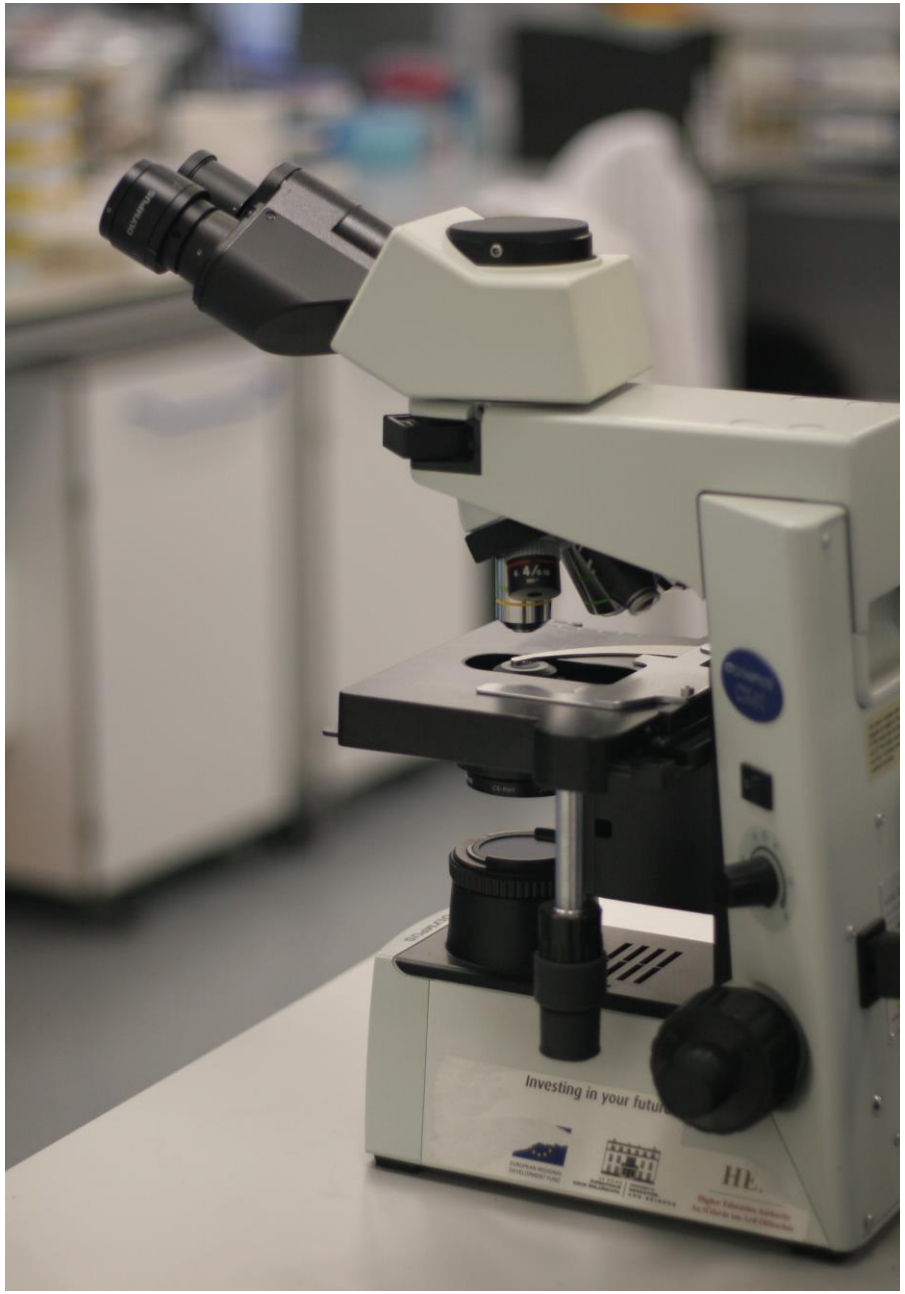
- observing living cells or organisms at the bottom of a large container (e.g., a tissue culture flask)
- cell culture monitoring
- micromanipulation (e.g., IVF)

Light microscope

A light microscope is an instrument that uses visible light and magnifying lenses to examine small objects not visible to the naked eye, or in finer detail than the naked eye allows.

Examples of uses:

- observing cells or organisms
- cell staining
- cell counting

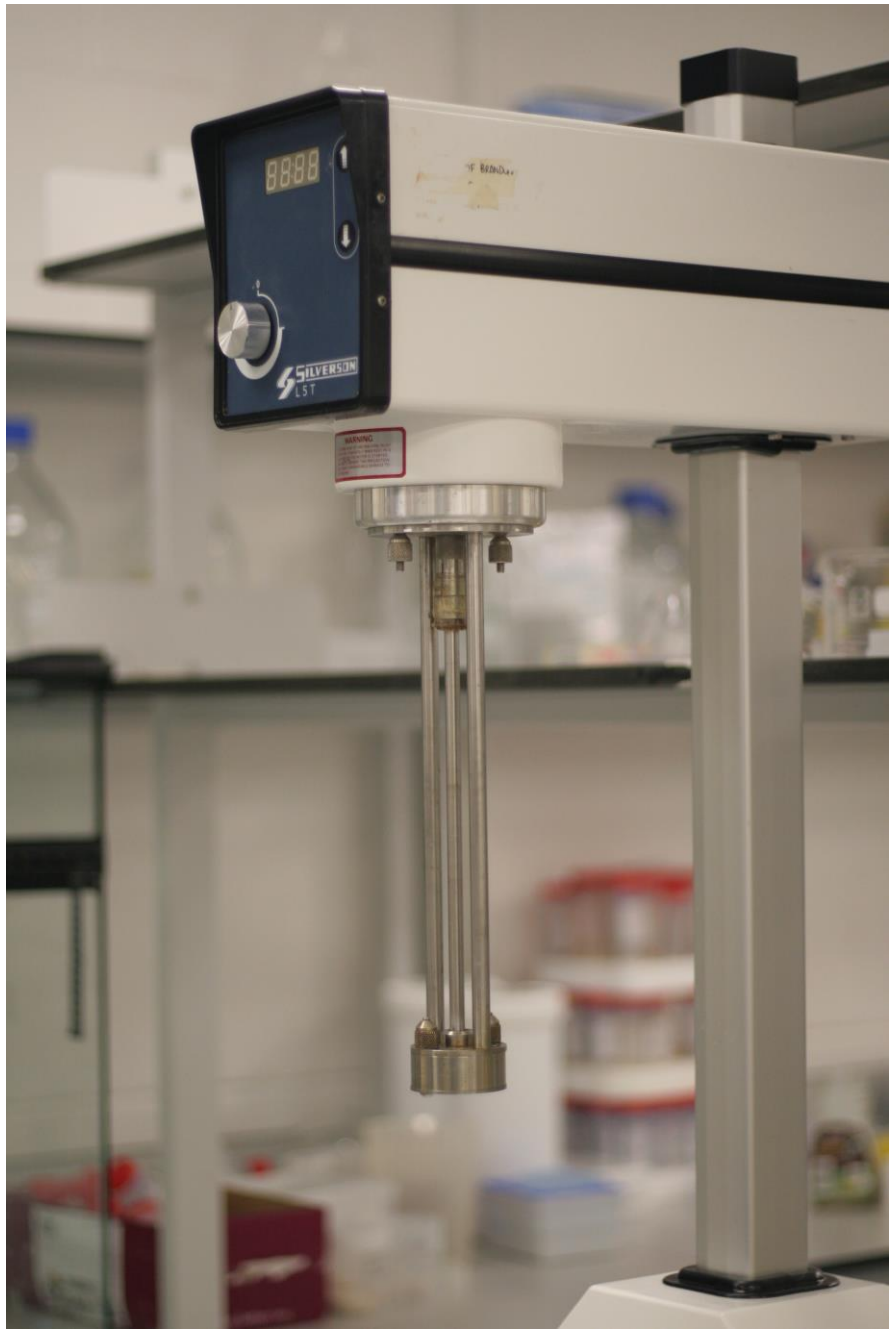


Silverson mixer

Silverson mixer with the addition of solvent blends material into a slurry-like solution of uniform particle size.

Examples of uses:

- homogenization
- extracts preparation

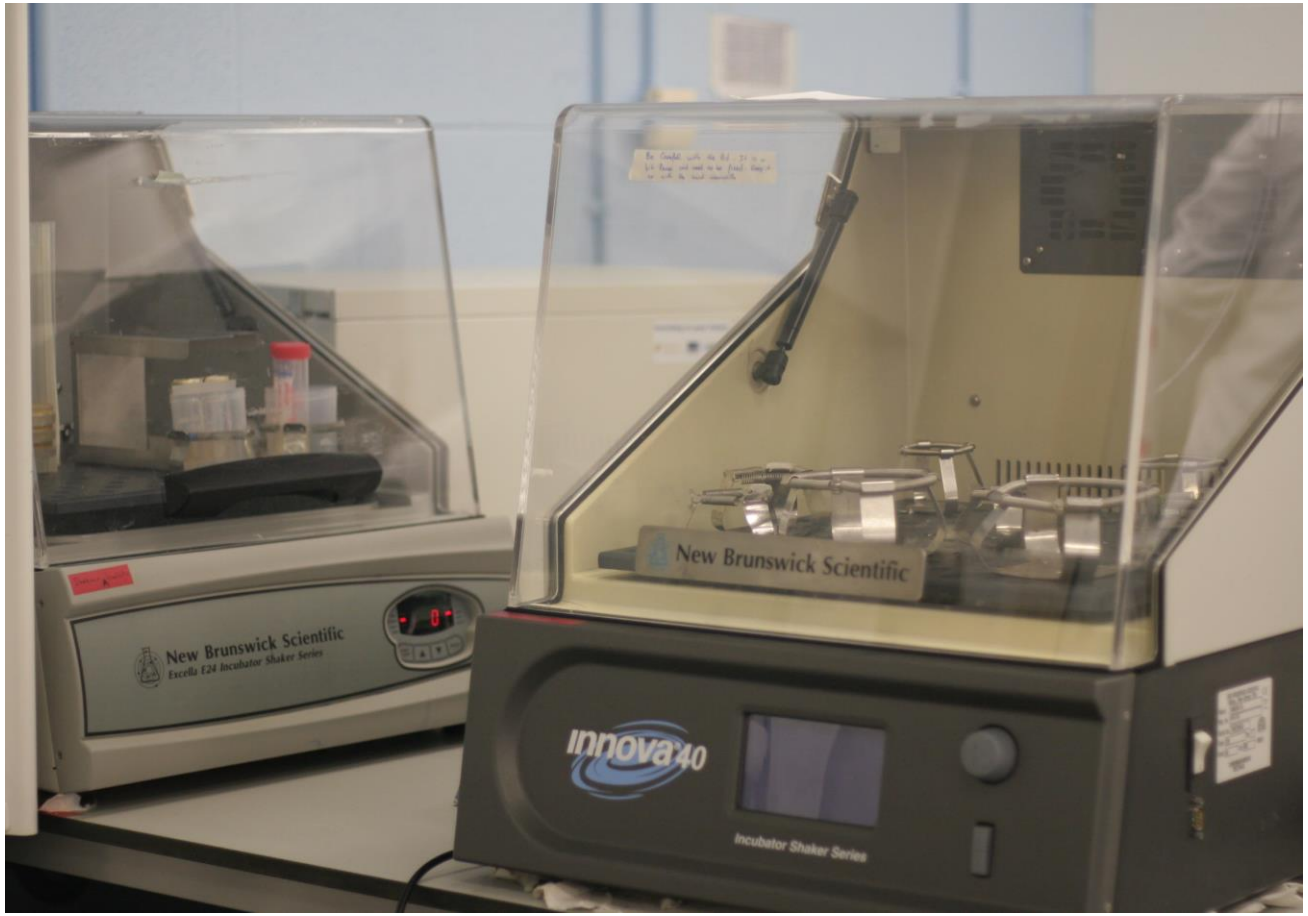


Shaking incubator

A piece of laboratory equipment designed to mix components by horizontal plane rotary motion at different set temperatures.

<u>Examples of uses:</u>

- culturing of bacterial cells
- cells aeration
- studies of solubility



Cryo-freezer

Cryo-freezer is used for the controlled freezing of biological material. It provides cryopreservation of many cells types, including bone marrow, stem cells, skin, cord blood and other important high volume samples in ampoule, sample bag and straw format. Temperature range from –180°C to +40°C allows for a variety of applications and offers user-defined cooling rates of –0.01°C/min to -50°C/min with multiple protocols.

Examples of uses:

- cells cryopreservation

Centrifuge

A piece of laboratory equipment driven by a motor, which spins liquid samples at high speed.

<u>Examples of uses:</u>

- separation of fluids, gas or liquid, based on density

Spectrophotometer

The spectrophotometer is an optical instrument for measuring the intensity of light relative to wavelength in cuvette-based format. It contains a monochromator, a device which produces a light beam containing wavelengths in a narrow band around a selected wavelength, and a means of measuring the ratio of that beam's intensity as it enters and leaves a cuvette.

<u>Examples of uses:</u>

- quantitative measurement of the reflection or transmission properties of a material
- qualitative and quantitative analysis of DNA, RNA, and proteins

Fume hood

A fume hoods is a type of local ventilation device that is designed to limit exposure to hazardous or toxic fumes, vapours or dusts. They protect workers by containing vapours, dusts, gases, and fumes generated within the hood, and removing them as air flows into the hood and then out via the laboratory exhaust system

<u>Examples of uses:</u>

- handling with flammable or toxic chemical

Autoclave

Autoclaves provide a physical method for disinfection and sterilization. They work with a combination of steam, pressure and time. Autoclaves operate at high temperature and pressure in order to kill microorganisms and spores.

Examples of uses:

- decontamination of certain biological waste
- sterilization of culture media, instruments and lab ware.