

# Thermo

SCIENTIFIC

## Thermo Scientific products enable cutting-edge stem cell application

The Thermo Scientific Stem Cell Excellence portfolio includes many of the products essential for successful stem cell research. Used by researchers to support cutting-edge applications in laboratories around the world, the products in the Stem Cell Excellence portfolio provide the accuracy and dependability required to support this groundbreaking research area. Here we describe an application of several of these products in the study of stem cells for bioengineering.

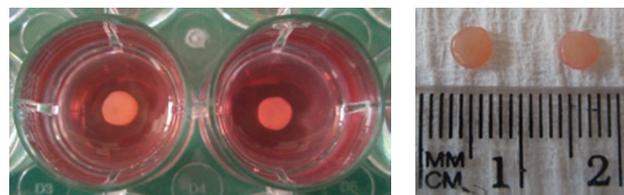
All Thermo Scientific products in the Stem Cell Excellence portfolio are designed to provide the best conditions for the samples and the researchers. Here we detail the use of an array of laboratory equipment products—including the Thermo Scientific Cytoperm 2 CO<sub>2</sub> incubator, Thermo Scientific Herasafe KS12 Type 2 Class 2 biological safety cabinet, Thermo Scientific Sorvall Legend RT-Plus centrifuge, Thermo Scientific Multiskan microplate photometer, Thermo Scientific Finnpiptette single- and multichannel pipettes and Thermo Scientific Revco freezer—for research involving the use of stem cells for bioengineered grafts. This is being carried out by Anthony Hollander and his group at the University of Bristol, who work extensively with human stem cells to develop consistent protocols for the generation of autologous cartilage grafts.

### Stem cells show therapeutic potential

Stem cells have shown the promise to revolutionize the treatment of many diseases, including Alzheimer's disease, Parkinson's disease and diabetes, as well as regenerative medicine applications such as organ and tissue replacement. A. Hollander's work focuses on the latter area, with a goal of repairing cartilage damage in patients suffering from degenerative joint diseases such as osteoarthritis. His research team uses adult (somatic) stem cells, which are found in a number of locations, such as the bone marrow, and can therefore be retrieved directly from patients and used for their treatment. This autologous approach removes the need for immunosuppressive therapies to prevent rejection, thereby greatly increasing the chance of grafting success.

### Thermo Scientific products in stem cell research

For autologous cartilage grafts (**Fig. 1**) bone marrow mesenchymal stem cells (BMSCs) are collected from heads of the femora, which provide an ideal source for stem cells. The BMSCs are multipotent and can form



**Figure 1** | Tissue-engineered cartilage produced from bone marrow stem cells (macroscopic appearance). Engineered cartilage elements in culture medium in a multiwell plate (left) and the scale of the engineered cartilage elements (right). (Images courtesy of Sally Dickinson, University of Bristol.)

the major cell types required for rheumatology applications, especially those of the osteogenic pathway (**Fig. 2**). The collected cells are suspended in a specialized stem cell culture medium formulated to promote the growth and differentiation of BMSCs. The Thermo Scientific Sorvall Legend RT-Plus general purpose centrifuge is used at this stage to ensure that any bone remnants and fat are removed. The Sorvall Legend RT-Plus—a highly flexible benchtop centrifuge that delivers unprecedented speed and capacity—enables the gentle sedimentation of the cells at 1,500 r.p.m. (equivalent to 500g) for 5 minutes. Once the cells are free from bone and fat remnants, they are incubated in a Thermo Scientific Cytoperm 2 CO<sub>2</sub> incubator. This model offers the safety and reliability required for consistent cell culture, and features an external water reservoir with a pyrolytic filter to ensure that there are no open water sources or contaminants in the incubation chamber.

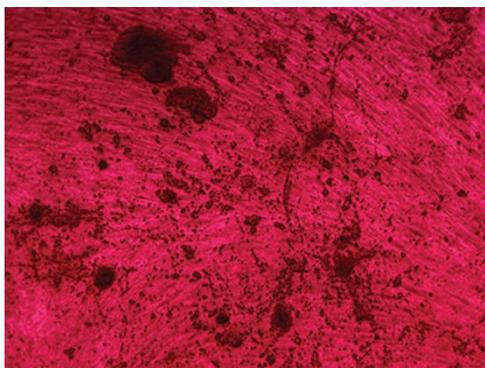
At every manipulation stage, it is essential to handle cells in a biological safety cabinet that provides protection for the sample, the researcher and the environment. The Thermo Scientific Herasafe KS12 Type 2 Class 2 biological safety cabinet provides the right level of protection and has a highly ergonomic design that enables operators to use it for extended periods of time without fatigue.

Several analytical techniques are used to assess BMSC cultures and their differentiation, including histological staining, real-time PCR and enzyme-linked immunosorbent assays (ELISAs). Owing

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## APPLICATION NOTES



**Figure 2** | Bone marrow stem cells that have undergone osteogenic differentiation. (Image courtesy of Sally Dickinson, University of Bristol.)

to their great flexibility, ELISAs are the most commonly used technique. The Thermo Scientific Multiskan microplate photometer family provides the sensitivity, wavelength range and speed to develop new ELISAs and consistently perform existing assays. The Multiskan photometer range also offers onboard shaking and incubation as well as the capability to handle cuvettes, 96-well plates and 384-well plates.

All research involving cell culture requires a large amount of manual pipetting, which, if not done properly, can lead to inconsistencies and possibly repetitive strain injuries for the user. The Thermo Scientific Finnpiptette line includes single- and multichannel pipettes for a broad range of applications. Each pipette incorporates features such as soft-touch tip ejection and adjustable finger rests for maximum user comfort.

Stem cell research protocols generally involve the storage of samples and reagents in various states. Long-term storage is most commonly done in ultra-low-temperature (ULT) freezers, which reduce degradation by stopping biological activity. The Thermo Scientific Revco ULT freezer range provides highly dependable ULT storage at  $-86^{\circ}\text{C}$ .

In 2008, A. Hollander and his team were involved in the first bioengineered tracheal graft. For this procedure, they adapted their existing osteoarthritis-based protocols using their Thermo Fisher Scientific equipment to ensure that a large population of chondrocytes derived from the patient's BMSCs could be grown quickly and precisely by another research team elsewhere. The overall operation was a great success<sup>1</sup>.

### Summary

Stem cell-based therapies have promised huge changes in the treatments of many diseases and disorders, but much research is still required to ensure safety and consistency before they can be applied more extensively. Such essential work relies on the dependability and functionality of a broad range of equipment from the Thermo Scientific Stem Cell Excellence portfolio. All of the Thermo Scientific products in the portfolio offer the best conditions for the various stages of research, ensuring that the results obtained are highly precise and repeatable.

1. Macchiarini, P. *et al.* Clinical transplantation of a tissue-engineered airway. *Lancet* **372**, 2023–2030 (2008).

This article was submitted to *Nature Methods* by a commercial organization and has not been peer reviewed. *Nature Methods* takes no responsibility for the accuracy or otherwise of the information provided.