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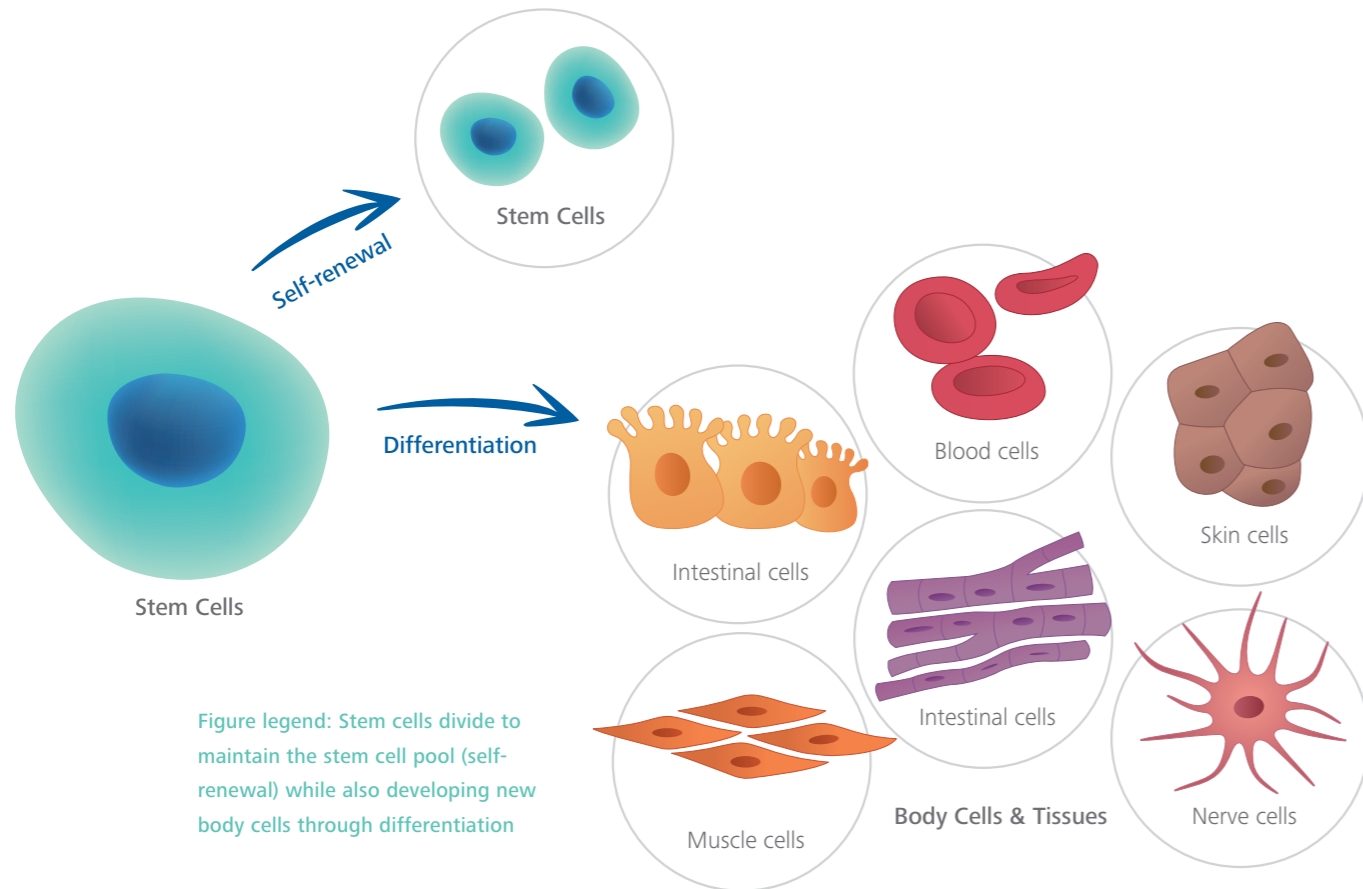
Bio
Processing
Solutions

ESSENTIAL GUIDE TO CULTURING STEM CELLS IN BIOREACTORS

Stem Cells - Building Blocks for Future Medical Treatments

Stem cells have the extraordinary ability to self-renew and transform into various cell types, forming the foundation of the human body. All body cells originate from stem cells and undergo differentiation to achieve their final form and function as they mature. Embryonic stem cells are capable of developing into any tissue type, while adult stem cells show pluripotency with a more limited range.

Stem cells offer groundbreaking possibilities for advancing medical treatments. By leveraging the unique properties of these cells, researchers aim to develop novel therapies for a wide range of health conditions. Regenerative medicine, where stem cells could be used to replace or regenerate damaged tissues, represents a promising frontier. Additionally, stem cells can be utilized for drug testing and disease modeling, providing more accurate representations than animal models. While largely experimental, stem cell therapies offer remarkable possibilities for personalized and regenerative medicine, potentially improving the well-being of countless individuals.



What is a Bioreactor?

A bioreactor is an advanced equipment crucial for modern biotechnological innovation. These systems offer precise regulation of critical factors such as temperature, pH, oxygen levels, and nutrient delivery, which is crucial for optimizing cell performance and product yield.

Systems like the IKA HABITAT bioreactor are pivotal in transitioning stem cell cultivation from

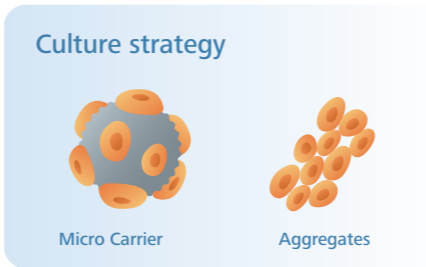
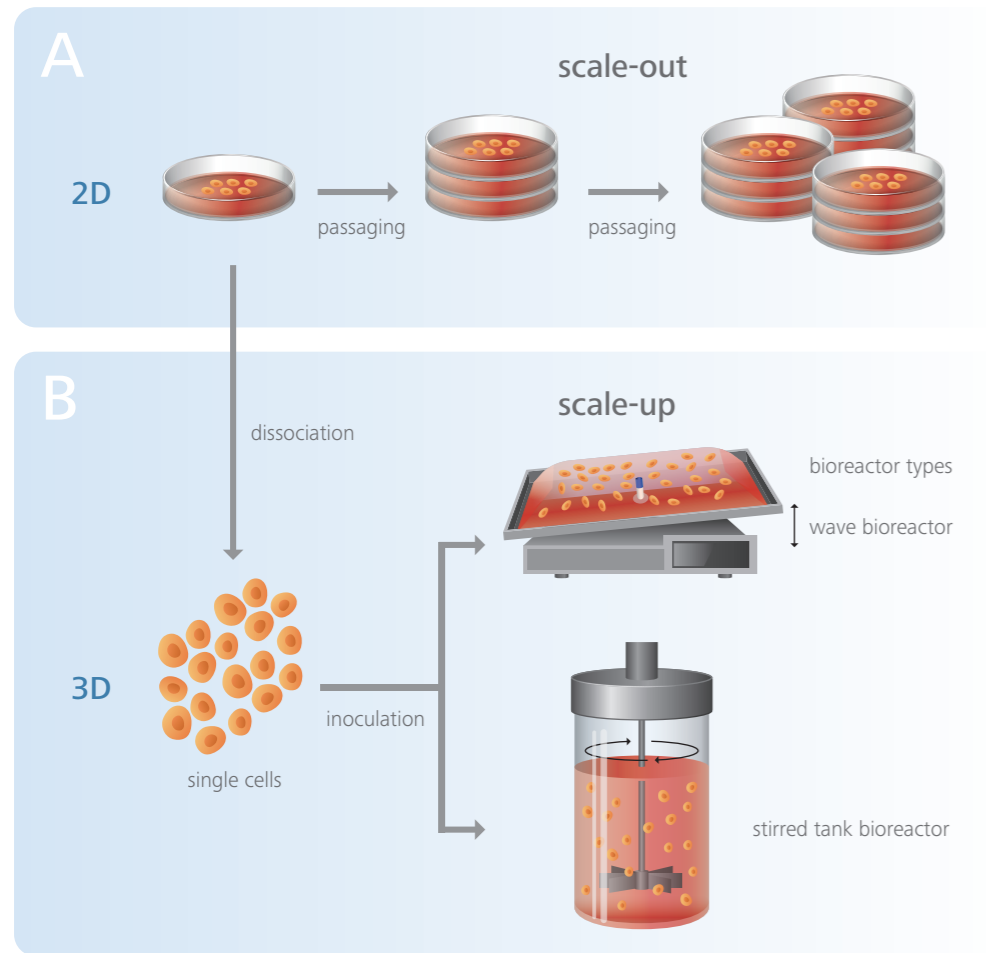
small-scale laboratory settings to large-scale industrial production. They offer enhanced features that improve the quality of stem cell cultures and make large-scale production feasible. In critical biotechnological applications, these sophisticated bioreactors are not just beneficial—they are fundamental, enabling advancements that outperform conventional methods.



/// Importance of Using a Bioreactor for Culturing Stem Cells

Traditional cell culture flasks are widely utilized in stem cell research and production due to their affordability and ease-of-use. However, scaling up with these methods means multiplying the number of containers. This inherently raises costs, labor, space requirements, and the risk of contamination. Furthermore, these methods face challenges in maintaining consistent culture conditions and scaling up efficiently.

Alternatively, 3D cultivation within automated bioreactors creates conditions that more closely resemble the cell's normal physiology, leading to potentially higher yields. In bioreactors, stem cells can either be cultivated either attached to microcarriers or as self-assembling aggregates.



Bioreactors offer numerous advantages including:

- › Automated operations and advanced controls allow researchers to closely monitor and adjust critical culture parameters like pH, temperature, and nutrient levels. This precise regulation promotes consistent and enhanced quality of the cell culture.
- › Bioreactors simplify scale-up processes by expanding the culture environment to larger volumes without the need for multiple separate culture systems. This reduces labor, saves space, and improves batch-to-batch uniformity, addressing key challenges in large-scale cell cultivation.
- › The tightly-controlled bioreactor environment is essential for maintaining stem cell properties or guiding differentiation. By carefully regulating conditions, bioreactors provide reliable outcomes and consistent product quality.
- › Closed bioreactor systems limit contamination risk compared to open flask cultures. The contained environment, combined with automation, creates a more robust and reproducible process.



Figure legend: Stem cell expansion strategies



/// Why IKA HABITAT Bioreactors are Optimal for Culturing Stem Cells

Precise environmental control

Mass flow controllers precisely regulate the input of air, nitrogen, and oxygen, optimizing cell growth. Dissolved oxygen (DO) levels are a critical parameter in this process. A dedicated carbon dioxide supply system maintains optimal pH levels, while headspace gassing options facilitate efficient oxygen transfer with minimal cellular perturbation. This precise control over the cell culture environment promotes consistent and reproducible experimental results.

Advanced monitoring with next generation sensors

Advanced sensors for comprehensive bioprocess monitoring, including new-generation sensors for biomass, cell viability, and off-gas analysis, offer high selectivity, sensitivity, and long-term stability. These sensors enable contamination-free bioprocessing and improved operator efficiency by monitoring dissolved carbon dioxide, conductivity, turbidity, Redox, cell viability, off-gas, temperatures, and non-intrusive foam.

Soft-sensors can be used to calculate and display specific batch data, such as parameter setpoints, organism-specific rates (μ , q_s , RQ , etc.), and extended batch values (culture broth weight, biomass).

Reducing shear stress

IKA HABITAT Bioreactors have a reactor geometry with a pitched blade and impeller design that ensures a gentle yet efficient mixing without the risk of damage from excessive shear forces. This approach optimizes the growth and maintenance of suspension and sensitive adherent cells. A new chaotic mixing mode that follows mathematical principles of chaotic-dynamic systems also provides for a more homogeneous mixture.



/// How IKA HABITAT Bioreactors Enhance Lab Operations

IKA HABITAT Bioreactors are more than mere cultivation tools; they are integrated solutions designed to enhance operations with smoother, more efficient workflows tailored to the dynamic needs of our customers.

Award-Winning Design

Recognized with the iF DESIGN AWARD 2023, the IKA HABITAT Bioreactor integrates the capabilities of a bioreactor, photobioreactor, and fermenter, reducing the need for multiple setups and switching. Its ergonomic handling, intuitive operation, and user-friendly features, such as an open skid, unique lid stand, and lightweight components, reduce operator fatigue and improve portability. The compact design maximizes bench space. The bioreactor's intelligent support systems and controls make it accessible to both beginners and experts.

Consistent Quality

The IKA HABITAT Bioreactor sets the benchmark for consistent quality in bioprocessing by ensuring that each production cycle meets the high standards expected in the industry. Its sophisticated control systems and precision engineering provide a dependable foundation for operations, guaranteeing uniform outputs that streamline the entire downstream process. Variable-speed, bi-directional peristaltic pumps and an optional fifth pump provide for diverse fluid management. This fidelity in performance facilitates the scalability of production and significantly reduces the occurrence of batch failures, mitigating downtime and waste.

Solutions that Scale

IKA HABITAT Bioreactors excel from micro-scale research to industrial production. They feature a chaotic mixing option for faster mixing, an advantage especially beneficial at the beginning of an experiment. The bioreactor's design includes a range of vessel volumes from 0.5L to 10L, available in both single and double-wall configurations. Properly-sized motors for each volume—small for up to 2L, and larger for 5L to 10L—ensure efficient operation and customization in contrast to the standard one-size-fits-all motor approach. Advanced, integrated control systems guarantee consistent scale-up processes, enabling seamless capacity growth.

Cross-Platform Integration

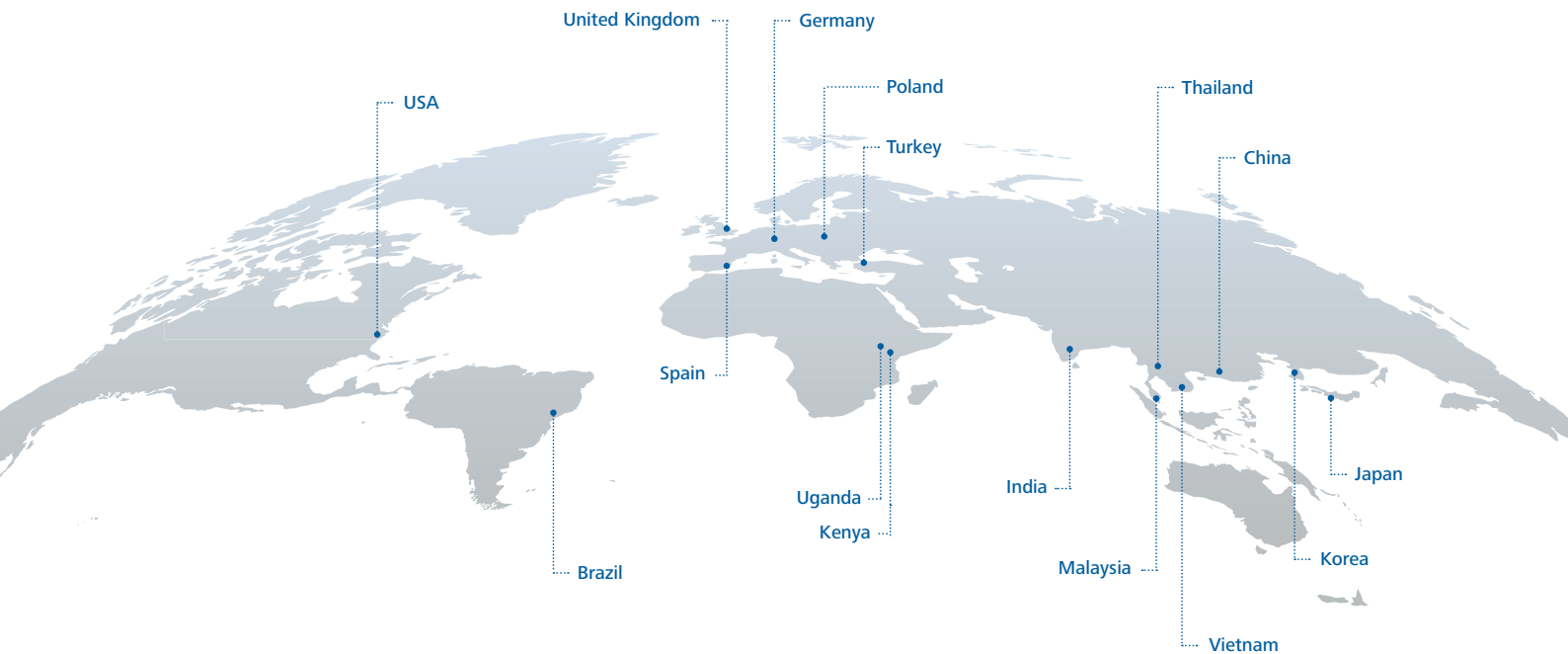
OPC UA integration and extensive interface options including USB, Ethernet, and RS-232 to provide comprehensive data connectivity. The lid's additional ports enable customized modifications to accommodate a range of bioprocessing applications.

Global Presence, Local Support

IKA's global presence provides comprehensive support, including technical service, spare parts, calibration, qualification, and commissioning, empowering customers to achieve their bioprocessing goals.



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