

# LunaX™

## 3D Cell Culture Platform

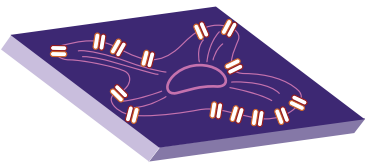
Technical Whitepaper & Product Catalogue  
2026 v1.0

Redefine Discovery.

# Forced Phenotypes

## The Problem with Current Cell Culture Systems

The current cell culture systems used in tens of thousands of academic and pharmaceutical laboratories face a critical challenge: they fail to replicate the native environments in which cells naturally thrive. Most labs rely on flat, rigid surfaces like polystyrene and glass, which cause cells to adopt unnatural shapes, exhibit abnormal polarization, and respond differently to pharmaceutical compounds, leading to a general loss of their natural phenotype. These unphysiologically stiff materials do not mimic the soft, complex tissue environments cells experience in the body. As a result, the behavior of cultured cells is often misleading, limiting the accuracy of biomedical research and drug development. Despite widespread recognition of these limitations, there remains a significant gap in the availability of accessible, reliable systems that can consistently reproduce the cellular microenvironment required for more predictive and effective research outcomes.



Conventional 2D cell culture on plastic or glass surfaces leads to aberrant cellular phenotypes and misleading data<sup>1</sup>

## LunaX Extracellular Matrix Kits

### Growing Tissues rather than just Cells



LunaX is a photocrosslinkable hydrogel cell culture system that recreates the natural extracellular matrix (ECM) surrounding cells in the human body, allowing researchers to grow three-dimensional microscopic tissues, rather than just cells on plastic surfaces. The major components of LunaX include native ECM proteins such as collagen type I, III, IV, and V, as well as connective tissue glycoproteins and proteoglycans. LunaX retains the intrinsic cell-instructive bioactivity of natural ECMs, facilitating cell attachment, proliferation, differentiation, migration, and proteolytic degradation.



**Tunable Extracellular Matrix**  
Vary light exposure duration to easily adjust matrix stiffness



**Easy and Fast**  
Create 3D cell culture models in <15 mins



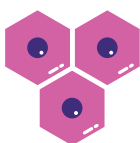
**Consistent Quality**  
Our manufacturing and quality control procedures ensure consistent properties



**Bioactive Motifs**  
LunaX ECM contains cell-instructive motifs and attachment sites



**Proteolytic Degradability**  
Cells can cleave the LunaX ECM and remodel their microenvironment

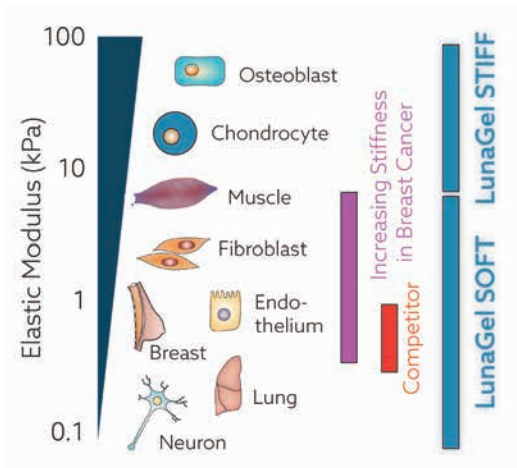


**Biocompatibility**  
LunaX ECM is compatible with a large variety of cell types

Overcoming the Limitations of Traditional Cell Culture Systems

ECM Stiffness Matters

All cells in the human body are exposed to mechanical forces which regulate cell function and tissue development, and each cell type is specifically tuned to the mechanical properties of the tissue it resides in. Neuronal cells, for example, require a very soft matrix similar to brain tissue in order to thrive, while cartilage or bone cells require much stiffer environments<sup>1</sup>. The matrix properties of human tissues can also change with disease and in turn facilitate its progression. For example, normal mammary epithelial cell growth, survival, differentiation and morphogenesis are well-supported by interaction with a soft matrix similar to normal breast tissue stiffness. Following transformation during breast cancer, however, the tissue becomes progressively stiffer<sup>2</sup> and tumor cells become significantly more contractile and hyper-responsive to matrix mechanical cues, ultimately driving epithelial to mesenchymal transition (EMT) and metastasis<sup>3,4,5</sup>. Evidently, the importance of matrix elasticity is increasingly being studied and ECM stiffness has been shown to regulate stem cell differentiation<sup>1,6</sup>, cell migration<sup>7</sup>, epithelial to mesenchymal transition (EMT)<sup>3</sup>, the induction of malignant cancer phenotypes<sup>8</sup>, cell spreading and adhesion<sup>9</sup>, calcium signalling, and many more physiological and pathophysiological cellular events.



Cells are tuned to the material properties of their native matrix.

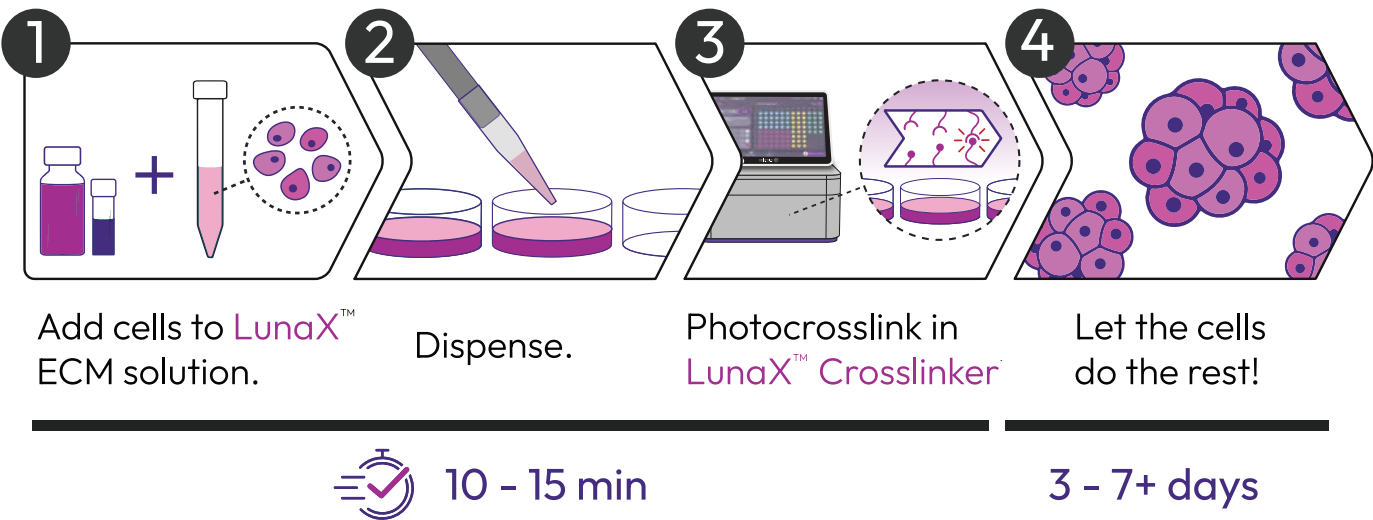


The LunaX Crosslinker enables cell-friendly photocrosslinking

Simplifying 3D Cell Culture with LunaX Tissue Culture System

Easily Replicate Tissue Microenvironments with Adjustable Stiffness and Imaging Compatibility

Creating 3D cell culture models has never been easier! LunaX ECMs can be chemically modified and crosslinked using blue light in the LunaX Crosslinker, forming cell culture models that closely replicate natural microenvironments. Available in low stiffness (0 - 6.5 kPa) and high stiffness (0 - 25 kPa) formulations, LunaX ECMs allow researchers to easily simulate the mechanical properties of a wide range of tissues in both healthy and diseased states. The LunaX hydrogel system is transparent, permeable, and fully compatible with standard imaging systems. By adjusting the duration of light exposure in the LunaX Crosslinker, researchers can fine-tune ECM stiffness to match the physiological conditions of different tissue types.

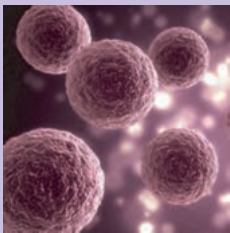




# LunaX™ Photocrosslinkable Extracellular Matrices in Action

## Application Examples of LunaX

The applications of LunaX are vast, spanning 3D cell culture, 3D biofabrication, high-throughput drug screening, and many more. This Whitepaper provides just a few examples of the wide range of potential applications in which LunaX has proven to be an exceptional ECM substrate for biomedical research.



Photocrosslinkable ECM  
3D Cell Culture  
Organoid Culture  
Tissue Engineering  
Advanced Biomanufacturing



Automation Compatible  
Automated Liquid Handling  
High Throughput Screening  
Migration Assays  
Invasion Assays  
Angiogenesis Assays



Animal Studies  
Biocompatibility  
Biodegradability  
Controlled ECM  
For Cell Delivery  
Toxicity screening

## Controlling Matrix Stiffness by Light Exposure Duration

The LunaX ECM offers unprecedented control over matrix stiffness covering a substantial range. LunaX ECMs employ a cell-friendly, rapid photocrosslinking process, allowing researchers to fine-tune the elastic modulus for different applications with just a few minutes of light exposure (Figure 1). Competitor products such as basement membrane extracts or collagen rely on lengthy thermal gelation for curing (30 – 60 min) and produce matrices with elastic modulus limited to < 1 kPa which are unphysiological for most cell types.

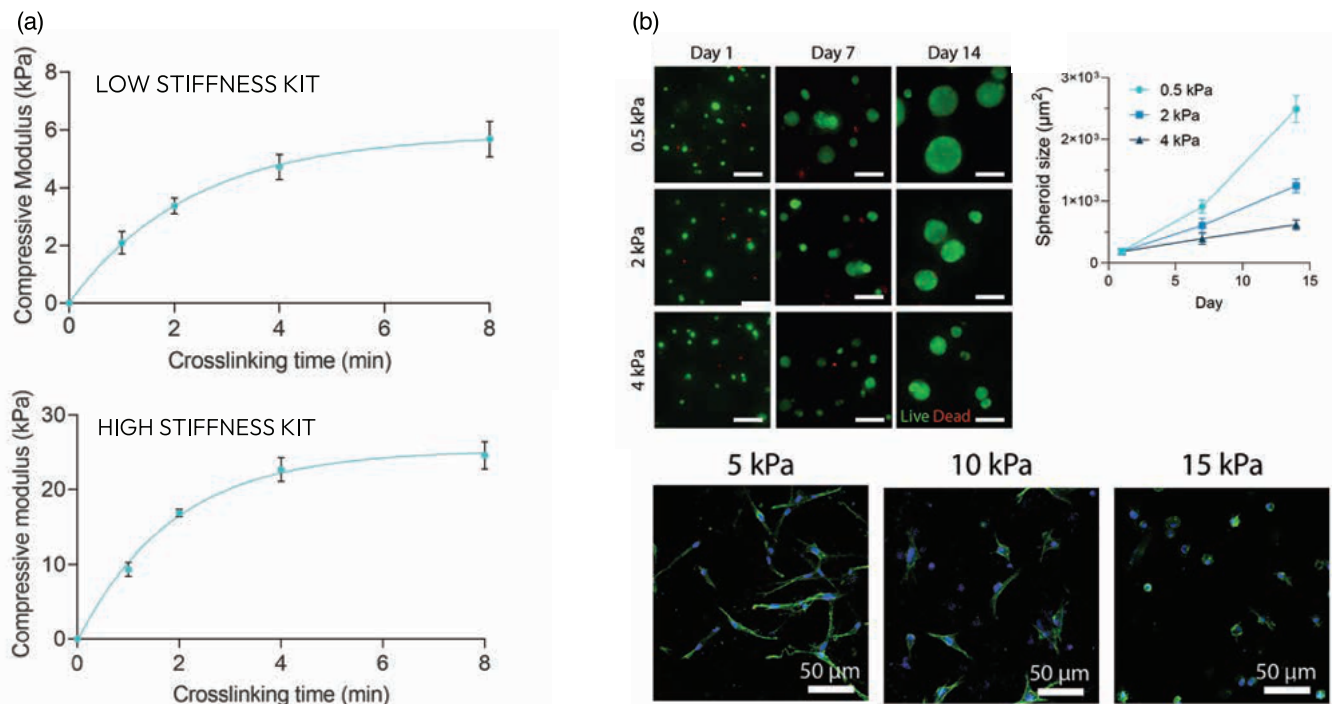


Figure 1: LunaX Extracellular Matrices allow precise control over mechanical properties and cell response. Elastic/compressive modulus of LunaX (a) low and high stiffness samples were crosslinked by exposure to visible light in the Crosslinker. Matrix stiffness regulates (b) MCF-7 Breast Cancer Spheroid growth and human Mesenchymal Stem Cell morphology.

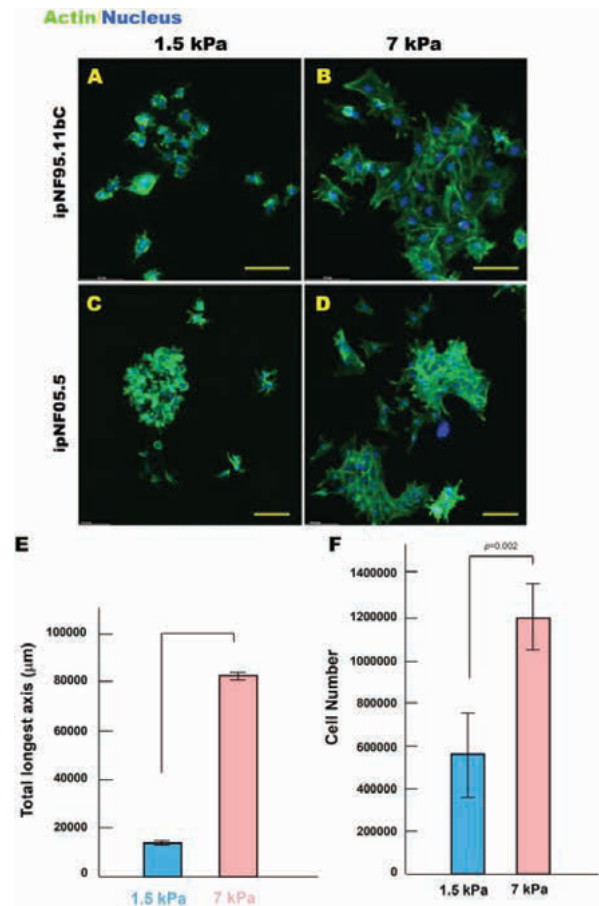


ECM Stiffness Regulates Tumor Growth and Drug Response in 3D Tumor Models

Extracellular matrix (ECM) mechanics play a critical role in regulating tumor behavior in three-dimensional culture environments. In a 3D tumor model of plexiform neurofibroma (pNF1), tumor cells cultured in matrices with defined stiffness values of 1.5 kPa (soft) and 7 kPa (stiff) showed marked stiffness-dependent changes in morphology, proliferation, and drug response. Cells in the stiffer matrix exhibited greater spreading and significantly higher cell numbers after 10 days of culture, indicating that increased ECM stiffness promotes tumor cell expansion.

Stiff ECM conditions increased expression of the drug-efflux transporter P-glycoprotein (Pgp), and greatly reduced sensitivity to the MEK inhibitor selumetinib, underscoring the role of matrix mechanics in regulating cancer progression and drug resistance. Together, these findings show that matrix stiffness is not simply a passive characteristic of the tumor microenvironment, but an active regulator of cancer cell behavior and treatment response. They also highlight the value of tunable hydrogel systems for mechanobiology research, enabling reproducible, precisely controlled 3D culture models that capture how biophysical cues shape tumor growth, therapeutic response, and disease-relevant phenotypes.

Figure 2. Gelomics tunable ECMs reveal how ECM stiffness regulates pNF1 tumor cell morphology and growth (Ji et al., 2026).



Patient-derived plexiform neurofibroma (pNF1) cells were encapsulated in Gelomics LunaX PureMatrix hydrogels and photo-crosslinked with the Crosslinker to generate 3D tumor models with defined stiffnesses of 1.5 kPa (soft) and 7 kPa (stiff). After 10 days in culture, cells in the stiffer 7 kPa matrix showed much greater spreading and larger actin-rich structures than cells in the softer 1.5 kPa matrix (A-D; actin, green; nuclei, blue). In the stiff matrix, cells were both larger (E, total longest axis) and showed greater proliferation (F, cell number), highlighting the value of precision tunable ECMs for investigating how matrix mechanics influence cell response and cancer progression in 3D tumor models. The hydrogels were photocrosslinked using the LunaX Crosslinker to precisely control matrix stiffness (Ji et al., 2026).

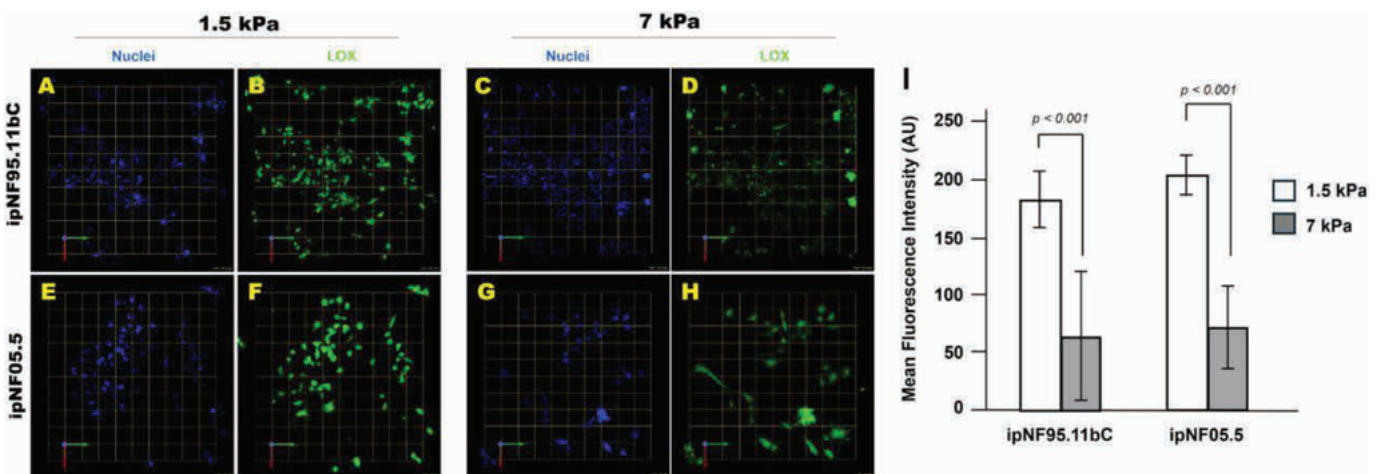


Figure 3. pNF1 tumor cells cultured in tunable LunaX ECMs for 10 days show reduced lysyl oxidase (LOX) expression in stiffer matrices. (A–H) Nuclei are shown in blue and lysyl oxidase (LOX) expression is shown in green. (I) Quantification of mean LOX fluorescence intensity shows that pNF1 cells express significantly lower levels of LOX in the stiff 7 kPa matrix than in the soft 1.5 kPa matrix, indicating that ECM stiffness regulates LOX-mediated matrix remodeling in 3D culture. Adapted from Ji et al, 2026.

### Cancer Spheroid and Organoid Culture

Recent high-impact papers have demonstrated that primary tumor growth, epithelial-to-mesenchymal transition (EMT), and metastasis are regulated by ECM stiffness. The ability to tightly control the ECM stiffness makes LunaX the ideal product to study this crucial biological pathway. LunaX has been successfully used to culture a large variety of commonly used cancer cell lines derived from breast cancer (MCF-7, MDA-MB-231), prostate cancer (LNCaP, PC3), ovarian cancer (OV-MZ-6), liver cancer (HUH-7, C3A) and melanoma (SK-MEL-28, WM35). Below are some examples of micro tumors formed by commonly used prostate and breast cancer cell lines (Figure 4).

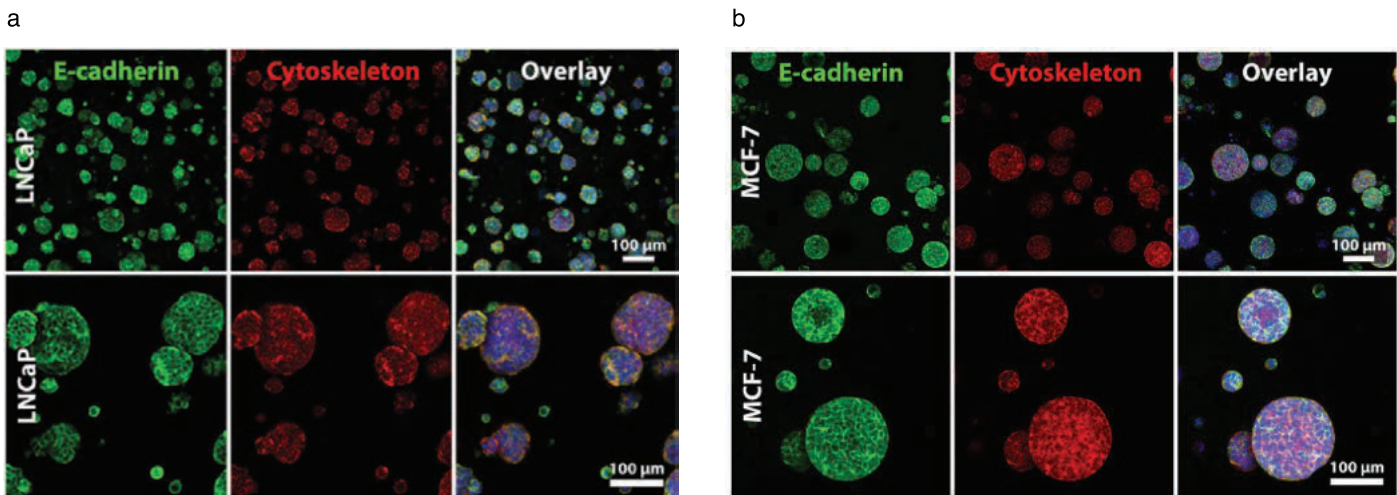


Figure 4: Representative images of cancer spheroids generated in LunaX SOFT (Meinert et al, Prostate Cancer, 2018).

(a) LNCaP prostate cancer cells and (b) MCF-7 breast cancer cells were encapsulated in LunaX (3 kPa) and cultured under standard conditions for 14 days, followed by fixation with 4% PFA and immunofluorescence staining for E-Cadherin (green) and actin (red).

LunaX ECMs are the ideal substrate to study EMT processes in vitro. The images below demonstrate that MDA-MB-231 breast cancer cell phenotypes are highly regulated by ECM stiffness. After 7 days of culture on LunaX substrates replicating breast tissue in different states of pathology (ranging from healthy tissue to late-stage cancer), cell invasiveness increased as a function of ECM stiffness, corroborating clinical data suggesting preferential occurrence of metastasis in breast cancer with higher tissue stiffness. A shift towards more migratory cell morphologies associated with metastasis (magnified inserts) was observed with increasing LunaX ECM stiffness. Critically, this key biological process, so consequential for cancer metastasis and patient survival, cannot be effectively studied using traditional BME products. These products lack the ability to replicate the pathological stiffness necessary to model advanced cancer environments, limiting their effectiveness in capturing the complex mechanical properties crucial for understanding metastasis.

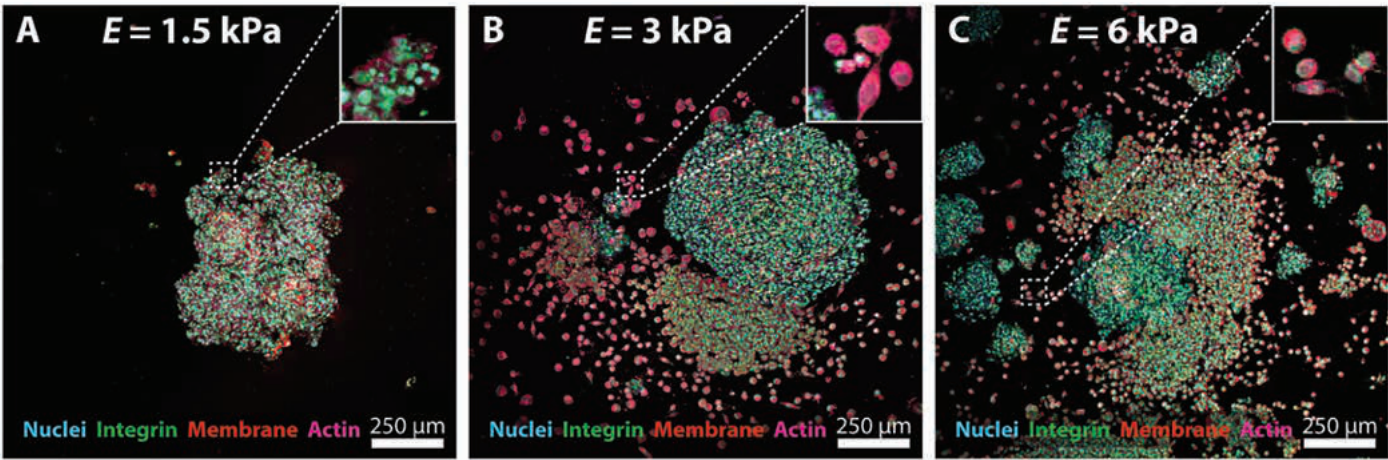


Figure 5: MDA-MB-231 breast cancer cell invasiveness increases with ECM stiffness. MDA-MB-231 spheroids were cultured on LunaX Bovine Gelatin - Low Stiffness ECM with compressive moduli of (A) 1.5 kPa, (B) 3 kPa, and (C) 6 kPa to mimic the mechanical properties of healthy breast tissue, as well as breast tissue with early stage and late stage cancer, respectively, for 7 days.



Inducing physiological gene expression patterns in human hepatoma-derived (C3A) cells

Liver cells express a variety of iron regulators including transferrin receptors (TFRs) and metallothioneins (MTs) in vivo. However, the expression of these genes is largely lost during in vitro 2D monolayer culture, limiting the value of current laboratory models. Figure 6 demonstrates that the expression of key marker genes including TFR1, TFR2, and MT2 is significantly higher in LunaX ECM compared to monolayer and Matrigel culture, showing that in LunaX, the liver cells are showing stronger retention of their characteristic liver cell phenotype. Furthermore, the expression of these genes is regulated by ECM stiffness suggesting that disrupted iron homeostasis which is often observed in hepatocellular carcinoma patients, may be induced by changes in the ECM properties during cancer progression.

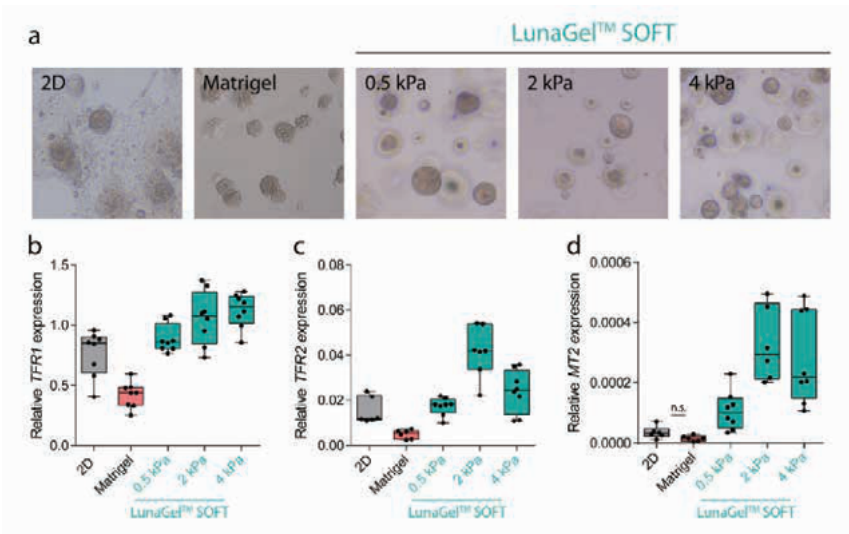


Figure 6: C3A liver cells cultured in LunaX show varying levels of iron regulator gene expression depending on matrix stiffness.

(a) Representative brightfield images of C3A cells after 6 days of culture in 2D monolayer, Matrigel, and LunaX at varying ECM stiffness. Spheroids formed in LunaX appear more regular and spherical compared to Matrigel. The expression of (b) TFR1, (c) TFR2, and (d) MT2 - markers of healthy, functional liver cells - was highest in LunaX cultures at day 6 and was further regulated by ECM stiffness.

Investigating the effects of IGF-I:IGFBP-3:VN trimeric complexes on melanoma spheroid growth

Two 3D cell culture systems, Matrigel® and LunaX, were used to test how melanoma cells responded to a treatment called the TRI complex (IGF-1:IGFBP-3:VN), a combination of small molecules known to influence cell signaling. They found that spheroid size increased significantly with TRI dosage in LunaX, in contrast to the inconsistent response seen in Matrigel®.

This shows that LunaX offers a more sensitive and controlled environment for studying drug responses, due to its tunable mechanical properties and defined composition.

These findings highlight how LunaX 3D models can better capture subtle changes in tumor cell behavior, making them highly valuable for cancer research and drug screening.

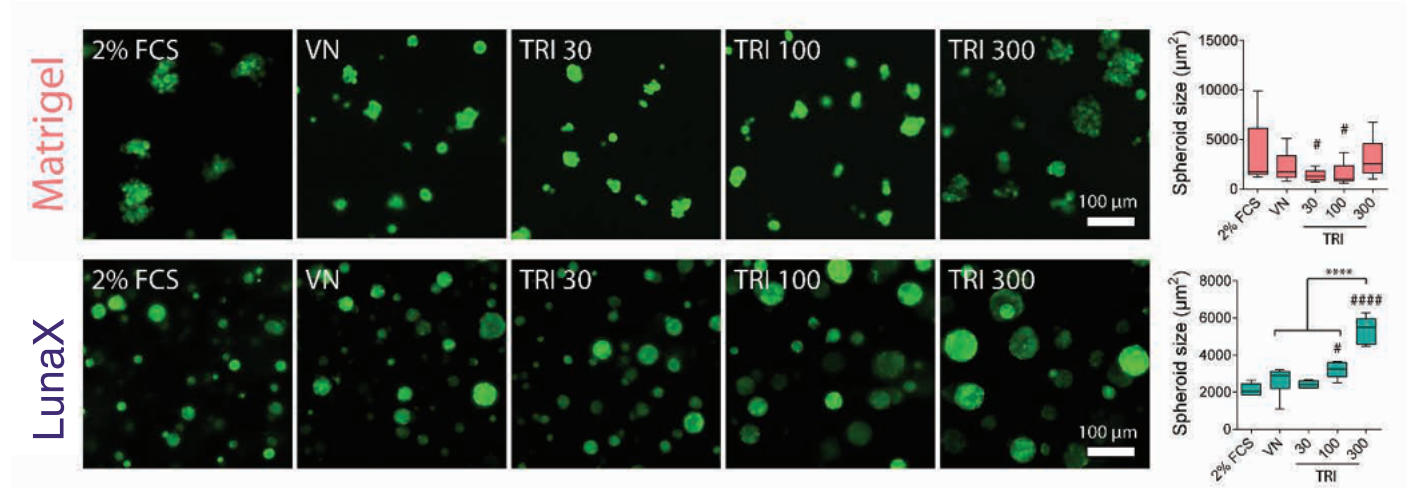


Figure 7: IGF-1:IGFBP-3:VN (TRI) complex stimulates the growth of melanoma spheroids in LunaX ECM (Murekatete et al, Scientific Reports, 2018).



SK-MEL-28 cells were seeded onto Matrigel® or encapsulated in LunaX (5 kPa). On day 14, cells were stained with FDA for visualisation and spheroid size assessment. TRI 30 = 1 ng/mL VN + 30 ng/mL IGF-I + 90 ng/mL IGFBP-3; TRI 100 = 1 ug/mL VN + 100 ng/mL IGF-I + 300 ng/mL IGFBP-3; TRI 300 = 1 g/mL VN + 300 ng/mL IGF-I + 900 ng/mL IGFBP-3. n = 6 (2 technical repeats, 3 experimental repeats); # p < 0.05 compared to 2% FCS, #### p < 0.0001 compared to 2% FCS; \*\*\*\* p < 0.0001.

### Drug Screening and Development – 2D vs 3D cell culture in LunaX

LunaX ECM facilitates drug-response studies that are highly predictive of in vivo conditions. Below is an example of MCF-7 breast cancer spheroids subjected to a chemotherapeutic agent (Abraxane/human serum albumin-conjugated paclitaxel). While Abraxane treatment led to almost complete loss of viability in monolayer cultures, the metabolic response and viability of MCF-7 cells, a cell line derived from non-metastatic breast tumors, was more similar to in vivo responses when cultured in LunaX 11,12 (Figure 8). By comparison, Abraxane treatment of metastatic MDA-MB-231 breast cancer cells led to a substantially larger decrease in metabolic activity and viability, as well as a loss of metastatic cellular morphologies.

The difference in cell response between non-metastatic MCF-7 and metastatic MDA-MB-231 cells may be related to the variances in growth and migration patterns. MCF-7 cells form tumor-like spheroids which may hinder the penetration of the drug in the cells to the spheroid core. MDA-MB-231, on the other hand, are metastatic and highly migratory, and hence often exist as single cells rather than cell clusters, in turn leading to higher drug efficiencies. Indeed, this finding is supported by clinical studies which clearly demonstrate more effective treatment of metastatic cancers with Abraxane compared to primary tumors, ultimately leading to the use of Abraxane for metastatic breast cancer treatment. Using a non-physiological 2D model would have incorrectly led to the conclusion that Abraxane is an effective treatment for both non-metastatic and metastatic breast cancer tumors. Using LunaX, the data clearly show that Abraxane is an effective therapeutic for metastatic tumors, but ineffective for non-metastatic tumors. This example highlights the importance of using predictive, accurate models to assess the efficacy of cancer therapeutics.

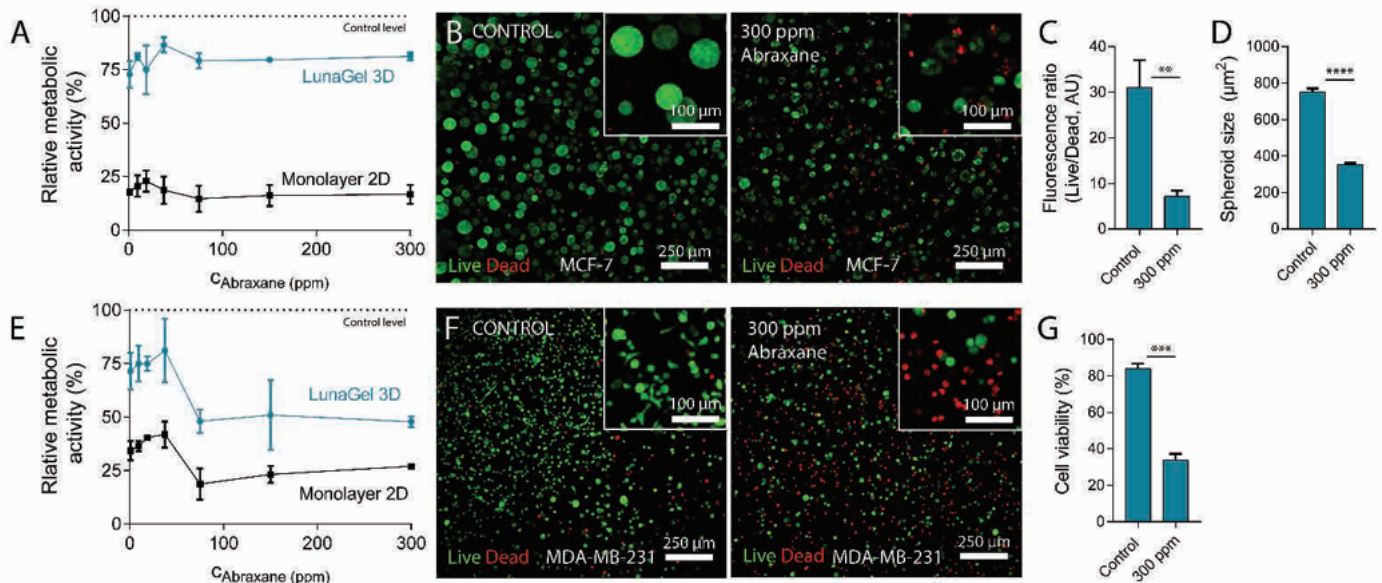


Figure 8: Response of MCF-7 and MDA-MB-231 breast cancer cells to Abraxane treatment. Relative metabolic activity of (A) MCF-7 and (E) MDA-MB-231 breast cancer cells encapsulated in LunaX and monolayer cultures following 3 days of treatment with varying concentrations of Abraxane (metabolic response of treated groups was normalised to untreated controls). Viability and spheroid/cell morphology of (B) MCF-7 and (F) MDA-MB-231 cells in untreated cultures (control) and following treatment with 300 ppm Abraxane. Quantification of (C) relative integrated fluorescence intensities (live/dead) and (D) spheroid size revealed cytotoxic effects of Abraxane treatment in embedded MCF-7 cultures. (G) Treatment of MDA-MB-231 cells reduced cell viability by > 50% compared to controls.

LunaX ECMs Enable High-Throughput 3D Metabolic Profiling of Stem Cell Spheroids

Sleep and colleagues developed a high-throughput 3D metabolic assay using human dental pulp stem cells (hDPSCs) encapsulated in tunable LunaX hydrogels and analyzed with a Seahorse XFe96 Analyzer under hypoxic, human-serum culture conditions. By leveraging the precision tunability of Gelomics ECMs, the authors were able to tailor ECM stiffness to 2, 3.5 and 5 kPa. The oxygen consumption rate varied with ECM stiffness, with 3.5 kPa found to be the optimal condition, underscoring the importance of hydrogel mechanics for cell metabolic activity. In the optimized 3.5 kPa system, photobiomodulation (PBM) produced clear dose-dependent bioenergetic responses: 5 J/cm<sup>2</sup> increased basal respiration at 24 hours and enhanced maximal respiration, whereas 15 J/cm<sup>2</sup> reduced maximal respiration after treatment. Together, these findings highlight the value of LunaX as a tunable 3D platform for physiologically relevant, high-throughput metabolic analysis of stem cells in regenerative medicine and dental tissue engineering.

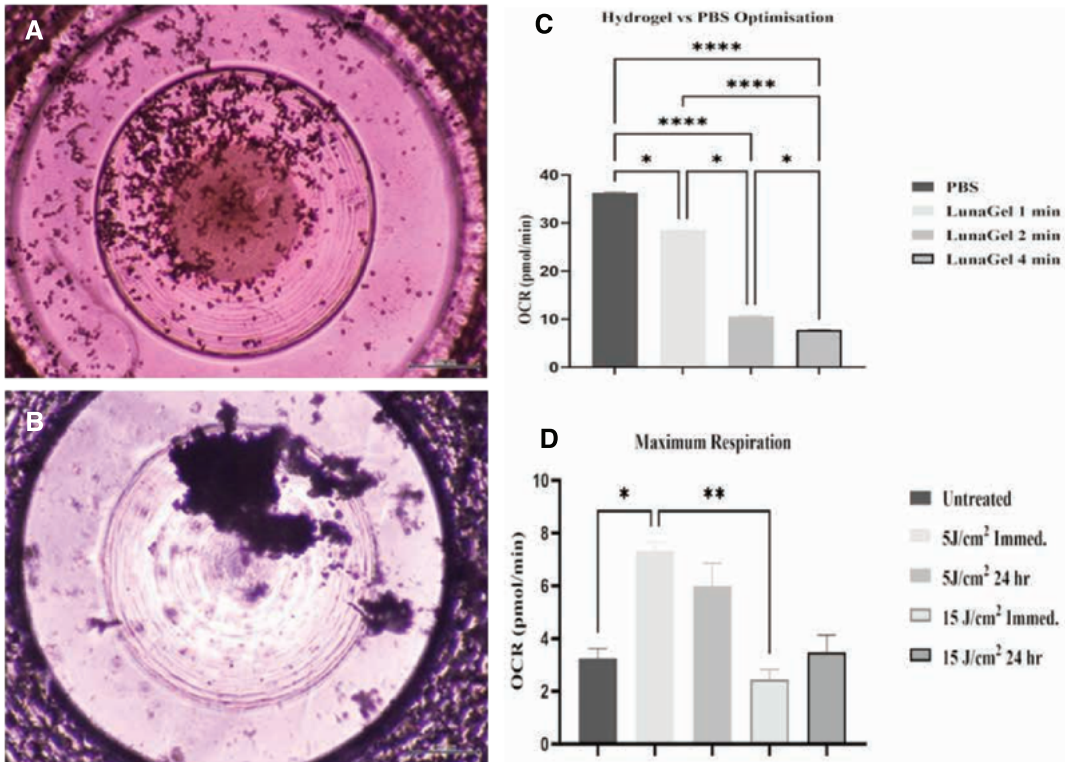


Figure 9. Precision-tunable LunaX enables reproducible hDPSC spheroid culture and dose-dependent metabolic profiling.

Human dental pulp stem cells (hDPSCs) encapsulated in LunaX were (A) well distributed after seeding, and (B) formed compact spheroids over 7 days in hypoxic culture. (C) A stiffness of 3.5 kPa was identified as the best balance between efficient oligomycin diffusion and a stable microenvironment for Seahorse XFe96 analysis. (D) In the optimized 3D system, photobiomodulation produced clear dose-dependent effects on mitochondrial function: 5 J/cm<sup>2</sup> increased maximal respiration, whereas 15 J/cm<sup>2</sup> reduced maximal respiration immediately after treatment. Together, these results demonstrate how tunable LunaX hydrogels enable reproducible 3D spheroid culture and high-throughput metabolic profiling in a physiologically relevant stem cell model. Sleep et al. 2025.

Patient-Derived Osteosarcoma Tumoroid Models

Patient-derived three-dimensional (3D) tumoroid models provide physiologically relevant platforms for studying tumor heterogeneity and therapeutic response.

In osteosarcoma models, patient-derived tumor cells cultured in LunaX ECM self-assembled into multicellular tumoroids with diameters of approximately 100–500  $\mu\text{m}$ . These tumoroids displayed variability in morphology, growth behavior, and drug sensitivity across patient samples, reflecting the intrinsic phenotypic diversity of osteosarcoma tumors.

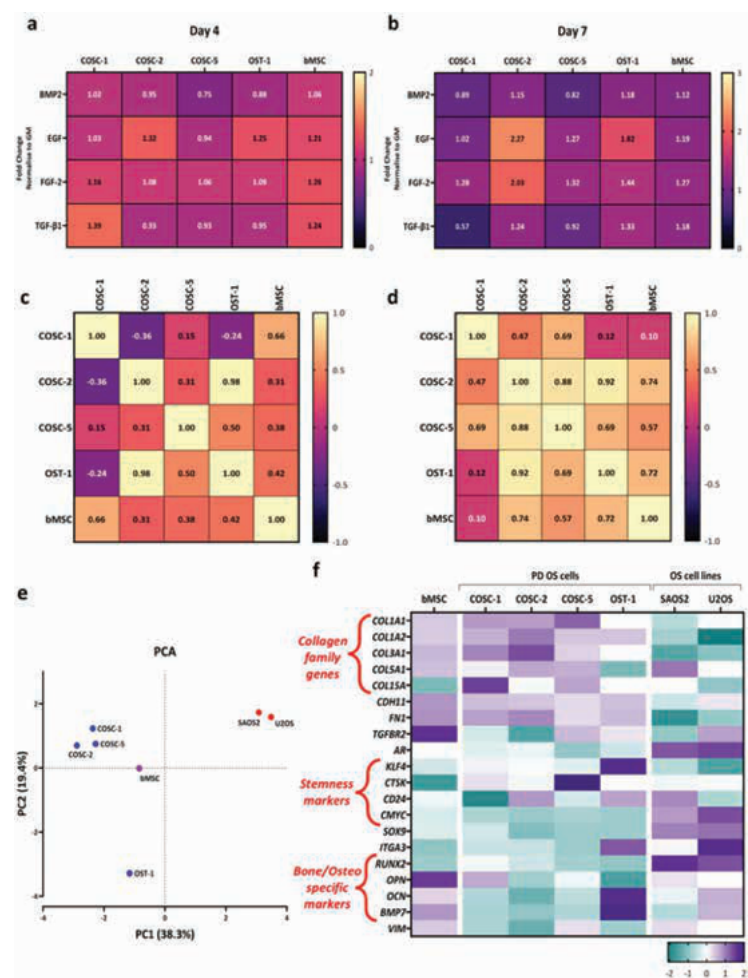


Figure 10. Tumor cells isolated from osteosarcoma patient samples self-assemble into multicellular tumoroid structures ( $\approx 100\text{--}500\ \mu\text{m}$  diameter) in LunaX ECM. Differences in tumoroid morphology, growth behavior, and drug response across samples illustrate the phenotypic heterogeneity of osteosarcoma tumors (Bhatia et al., 2026).



LunaX ECMs Support Stem Cell Viability and *In Vivo* Tissue Integration

Pham and colleagues used LunaX ECMs as a photocrosslinkable scaffold for stem cell delivery in a subcutaneous tissue engineering study. Human umbilical cord-derived mesenchymal stem cells (hUC-MSCs) were encapsulated in LunaX ECMs and retained their characteristic MSC phenotype after 14 days. The cell-laden constructs were well-tolerated, with mice showing normal activity, weight gain and fur regrowth. Histological analysis showed a collagen-rich scaffold-tissue interface, *de novo* connective tissue formation, and human CD44-positive cells within and surrounding the implant – evidence of cell survival, migration and integration with surrounding tissues. These findings highlight the utility of LunaX ECMs as a tunable 3D scaffold for supporting stem cell function, promoting early tissue integration, and enabling regenerative applications across both *in vitro* and *in vivo* settings.

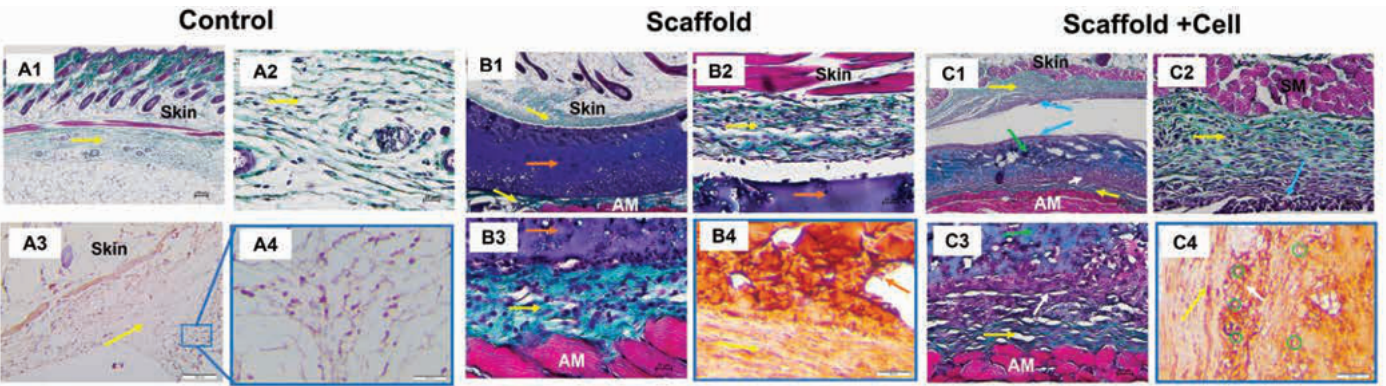


Figure 11. LunaX ECM supports *in vivo* survival and integration of implanted hUC-MSCs. (A1–A4) Control tissue, (B1–B4) cell-free scaffold, and (C1–C4) hUC-MSC-laden scaffold 14 days after subcutaneous implantation in mice. Histological staining shows collagen-rich tissue surrounding the implants, with the cell-laden scaffold showing a connective tissue interface and concentrated cellular regions not observed in the cell-free control. Human CD44-positive cells were detected both within and around the implanted construct, indicating that encapsulated MSCs survived implantation and migrated into adjacent tissue. (Pham et al., 2023)

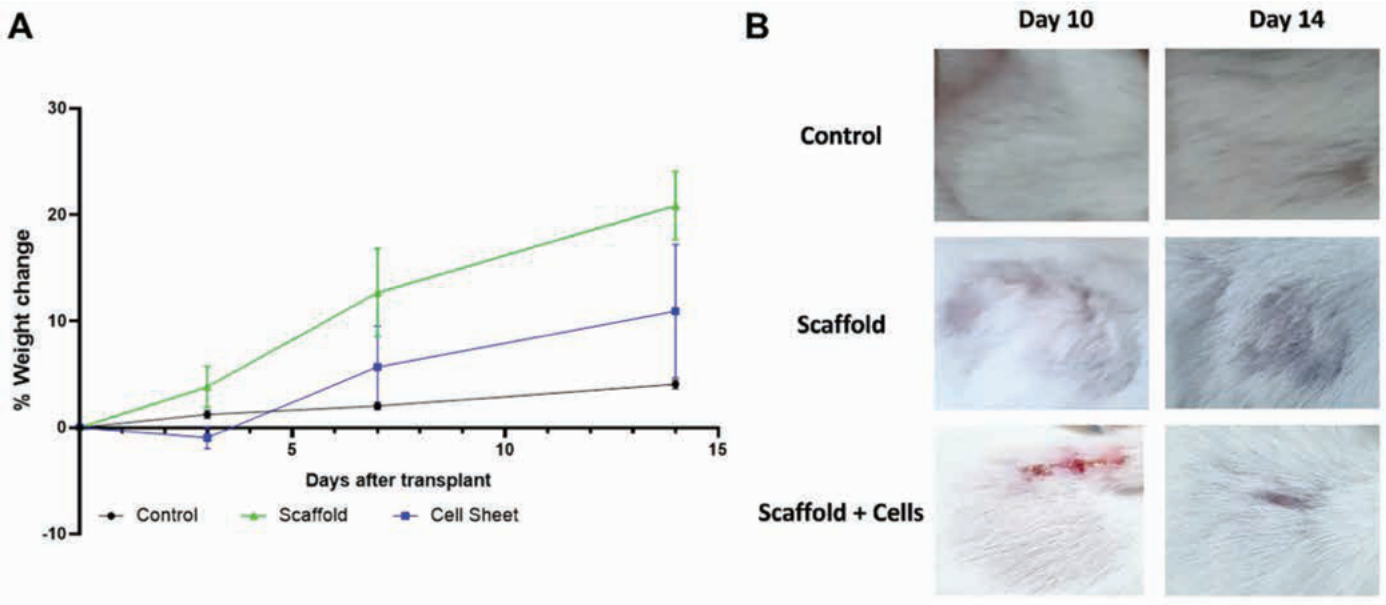


Figure 12. Tissue healing and condition monitoring following implantation of cell-free and MSC-laden LunaX scaffolds. Mice implanted subcutaneously with cell-free or hUC-MSC-laden scaffolds showed normal weight gain over 14 days, good healing and complete fur regeneration at the implantation site, indicating good short-term tolerability *in vivo*.

Drug Screening and Development - Automated Determination of IC50 Values of Anticancer Drugs

The IC50 is a quantitative measure that indicates how much of a particular inhibitory substance (e.g. drug) is needed to inhibit a given biological process or biochemical function by 50%. In this study, our collaborators have used automated liquid handling to produce LunaX 3D cell culture samples with MDA-MB-231 breast cancer cells. The effect of paclitaxel, a chemotherapeutic agent, was studied using high-throughput screening approaches used in the pharmaceutical industry. The ability to use LunaX with high-throughput techniques is a clear advantage over other 3D cell culture platforms.

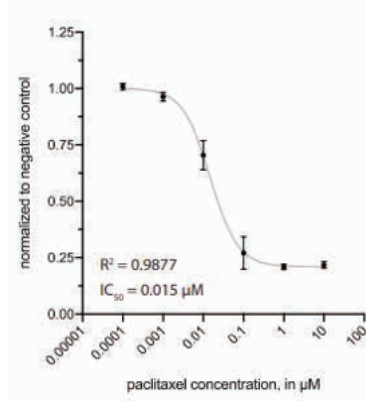


Figure 13. Determination of the IC50 of paclitaxel using LunaX (Eggert et al, unpublished data, 2020).

MDA-MB-231 breast cancer cells were cultured in LunaX (5 kPa) for 7 days, and incubated with different concentrations of paclitaxel for 120 h. Metabolic activity was assessed using automated oxygen consumption measurements.

Cell Delivery and Animal Experiments

LunaX offers an effective alternative to animal models, particularly for studying processes like ECM stiffness, EMT, and cancer metastasis. However, given the extensive reliance on animal models in preclinical drug development, it is widely recognized in the industry that transitioning to alternative approaches will take time. Importantly, LunaX is also compatible with in vivo models, providing a platform for direct comparison studies. This allows for the evaluation of in vivo models using LunaX ECM substrates alongside in vitro models, offering an important step towards the eventual acceptance and adoption of non-animal models as a viable alternative to traditional animal testing. For example, as shown in Figure 14, LunaX-embedded luciferase-labeled OV-MZ-6 ovarian cancer cells successfully led to primary tumor formation and metastases in mice. Treatment with Paclitaxel resulted in reduced tumor burden and metastasis, in line with the findings from the in vitro studies.

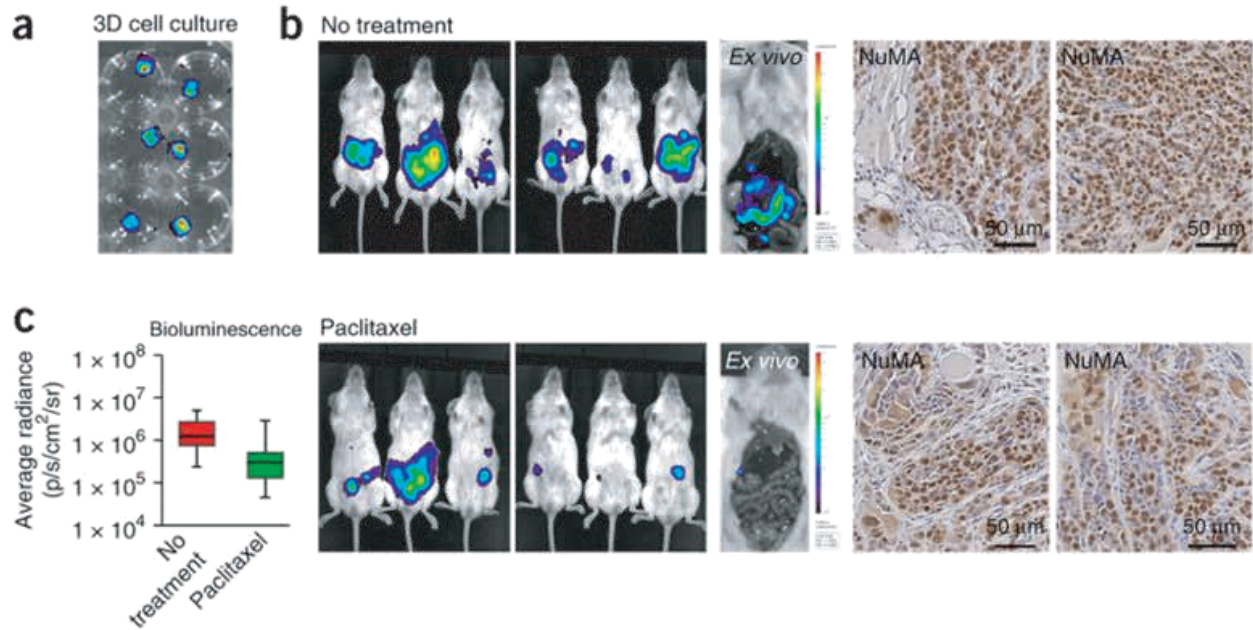


Figure 14: Application of LunaX as cell delivery vehicle in an intraperitoneal animal model (Loessner et al, Nature Protocols, 2018).

(a) Luciferase-transduced ovarian cancer cells (OV-MZ-6) were encapsulated in LunaX and bioluminescence indicative of spheroid formation was confirmed at day 14 of in vitro pre-culture. (b) Bioluminescence imaging confirmed substantial tumor formation 8 weeks following implantation and ex vivo imaging of the peritoneal organs indicated the presence of metastases. Human-derived tumor load was confirmed by positive staining for human-specific nuclear mitotic apparatus protein 1 (NuMA). (c) 4 weeks following implantation, mice were treated with intraperitoneal paclitaxel injections (10 mg/kg administered twice per week) over 4 weeks, leading to decreased tumor load and metastases.



## Tube formation and angiogenesis assays

LunaX ECM has successfully been applied for the in vitro generation of capillary-like networks formed by primary endothelial cells (human umbilical vein endothelial cells, HUVECs) and pericytes (primary human mesenchymal stem cells, MSCs) (Figure 15). In contrast to existing tube formation assays in Matrigel, capillary-like structures can be generated by embedded cells (true 3D environment), as opposed to seeding cells on top of the hydrogel. In addition, models are stable for much longer - up to 20 days, compared to 1-2 days in Matrigel. When cultured in specialized microfluidic chips, LunaX embedded HUVECs/MSCs form perfusable capillaries capable of replicating physiological blood flow conditions (Figure 15).

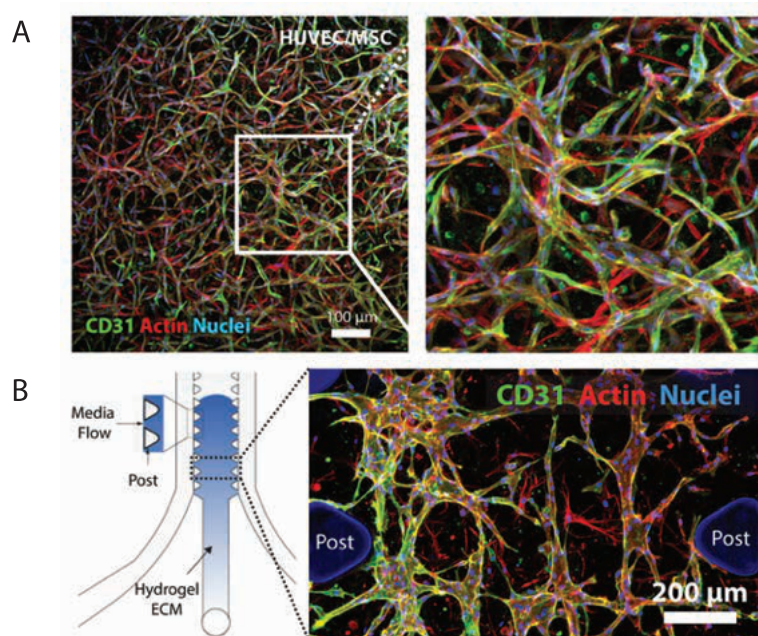


Figure 15: Capillary-like network formation of HUVECs and MSCs in LunaX low stiffness. (A) HUVECs and MSCs were cultured in LunaX low stiffness (0.8 kPa) in the presence of VEGF, SDF-1, and FGF-2, fixed with 4% PFA and stained for endothelial cell marker CD31 (green) and actin (red). (B) HUVECs/MSCs cultured in LunaX low stiffness form perfusable capillary networks in microfluidic chips.

## Engineering anisotropic muscle tissue

Myoblasts (C2C12) encapsulated in LunaX form functional myotubes – microscopic muscle fibres that spontaneously start twitching as they mature. In this study, myoblasts suspended in LunaX precursor solutions were first patterned to form lines using standing ultrasound waves, followed by photocrosslinking of the LunaX matrix. This process “locks” the cells in place, allowing them to form into highly aligned muscle fibres that express key markers of skeletal muscle tissue (Figure 16) and twitch, just like real muscles.

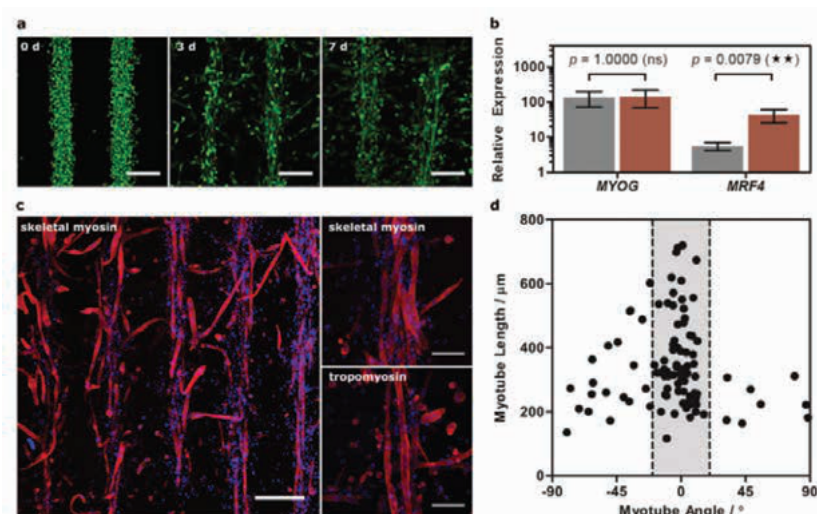


Figure 16: Engineered ultrasound patterned muscle tissue in LunaX (Armstrong et al, Advanced Materials, 2018).

(a) Confocal images of patterned myoblasts stained with Calcein over 7 days of culture. (b) Relative gene expression of skeletal muscle markers MYOG and MRF4 in unpatterned (grey) and patterned (red) tissues. (c) Immunostaining for skeletal muscle markers (red) and cell nuclei (blue) at day 7. (d) Myotube length as a function of orientation angle.



3D Bioprinting and Advanced Biomanufacturing

Bioprinting entails the spatially controlled deposition of cells in so-called bioinks (hydrogels) using specialized 3D printing systems. Bioprinting holds promise for the engineering of functional tissues and advanced 3D cell culture models. Below are some examples of LunaX used as an advanced bioink for 3D printing.

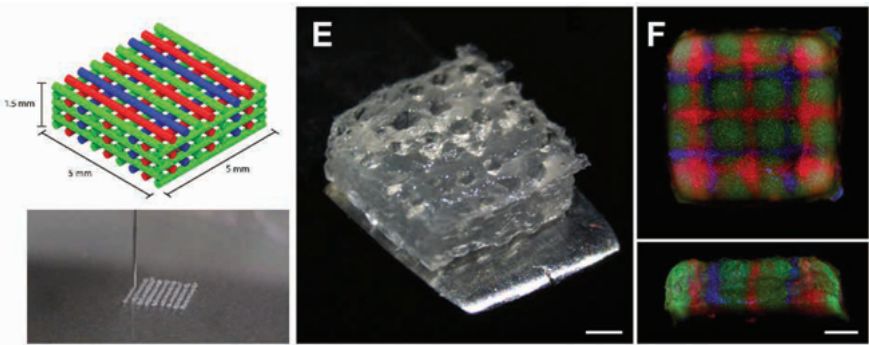


Figure 17: Bioprinting of LunaX ECM. LunaX ECM was allowed to gelate at room temperature and extruded through a G20 needle using a Gesim BioScaffolder printing system. To demonstrate the capability of precise deposition of multiple cell types in one print, fluorescent beads of different colours were embedded in the LunaX matrix.

Bioprinting of cells embedded in LunaX. In this example, human periodontal ligament fibroblasts retain cell viability and facilitates the spreading, migration, and proliferation of embedded cells (Figure 18).

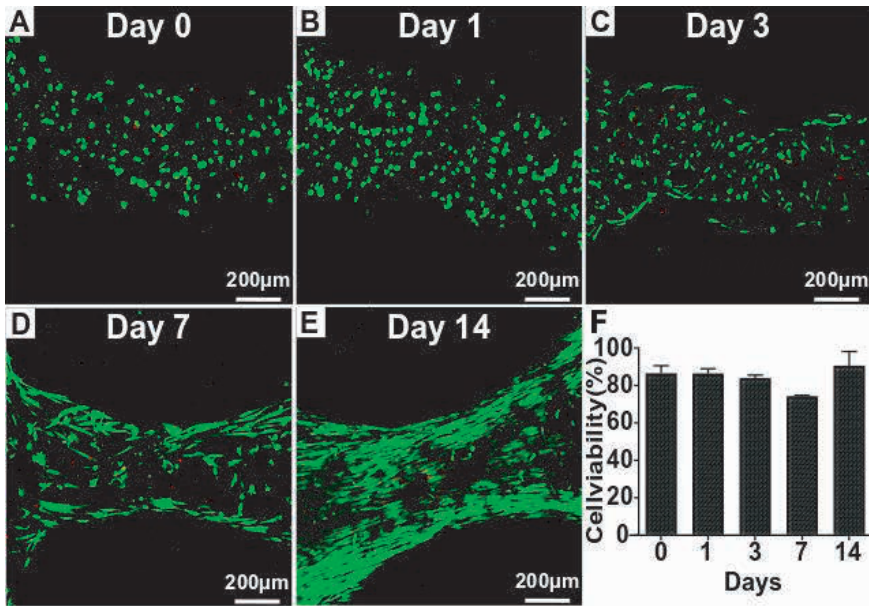


Figure 18: Bioprinting of human fibroblasts; cells retain high viability and exhibit physiological cellular behavior(Raveendran et al, Dental Materials, 2019)

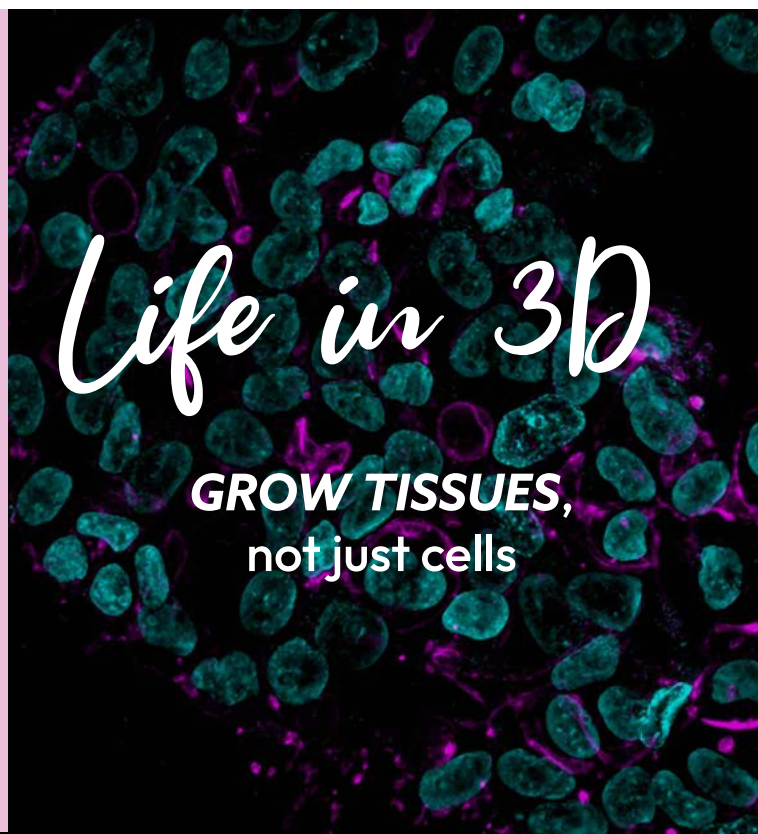
Human periodontal fibroblasts were resuspended in LunaX ECM and printed using Gesim BioScaffolder. Living cells appear green, dead cells appear red.

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- Compatible with high throughput liquid handling
- Cell-instructive motifs for optimal cell growth and differentiation
- Optically transparent: Forms hydrogels compatible with standard imaging systems and bioassays
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SKU: 0007 - Low stiffness (0 - 6.5 kPa)

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- Perfect for mesoderm-derived cells

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- Optically transparent: Forms hydrogels compatible with standard imaging systems and bioassays
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- Hydrogel digestion in under 1 hour at 37°C
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- Designed for LunaX™ matrices

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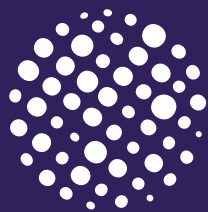
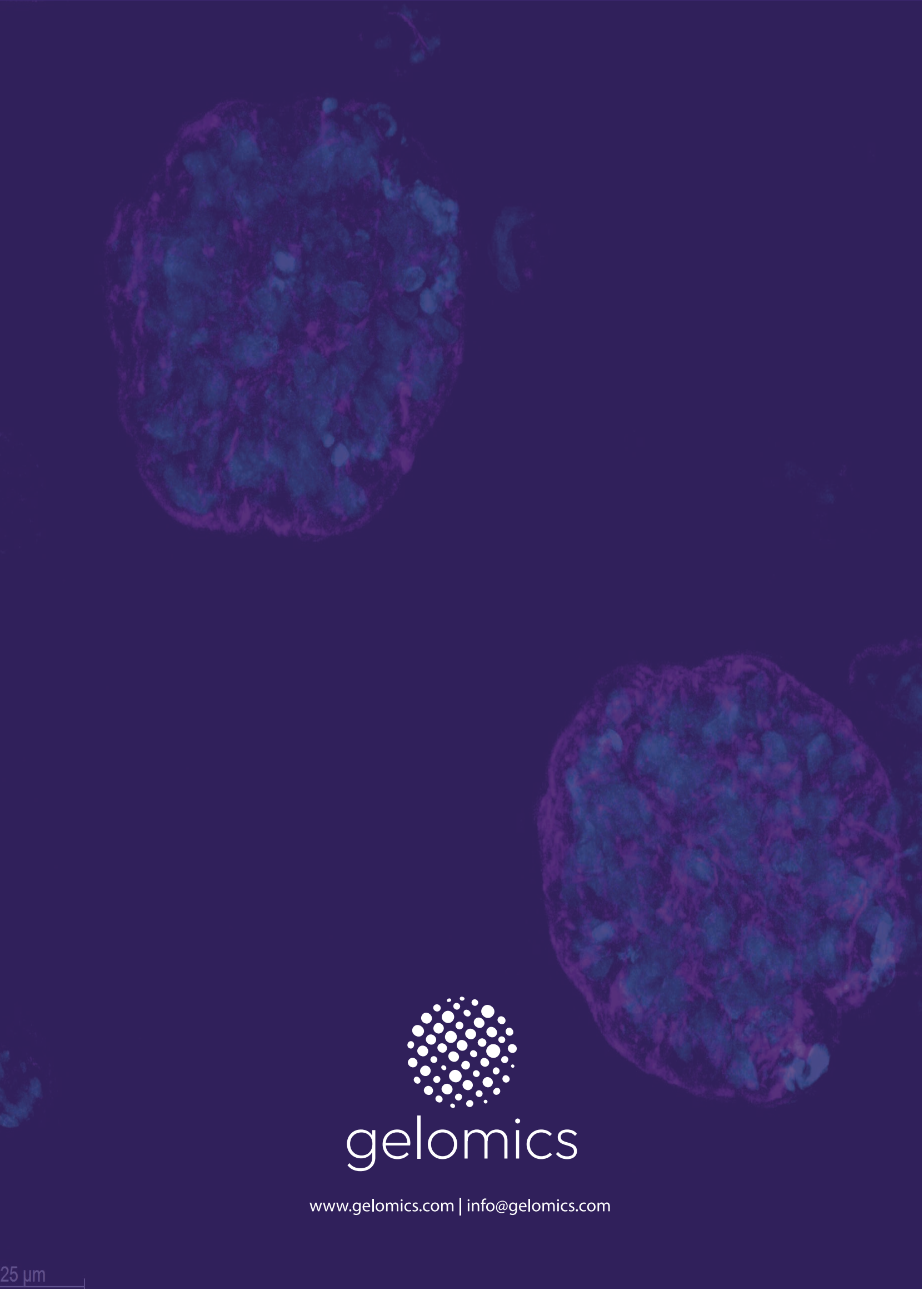


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