BIOGRAPHICAL SKETCH

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NAME: **Gordana Vunjak-Novakovic**

eRA COMMONS USER NAME (credential, e.g., agency login): gordana

POSITION TITLE: **University Professor**

EDUCATION/TRAINING *(Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable. Add/delete rows as necessary.)*

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	Completion Date MM/YYYY	FIELD OF STUDY
University of Belgrade, Serbia	Ph.D.	06/1980	Chemical Engineering
Massachusetts Institute of Technology (MIT)	Fulbright Fellowship	08/1987	Biomedical Engineering

A. Personal Statement:

My Laboratory for Stem Cells and Tissue Engineering is focused on tissue engineering approaches to improving human health. We investigate innovative technologies for engineering human tissues – including bone, cartilage, heart, and lung – by an integrated use of stem cells, biomaterials, and bioreactors. Our long-term goals are to develop effective treatment modalities for regenerative medicine, tissue models for stem cell research and study of disease, and "organs-on-a-chip" platforms for use in precision medicine. We direct the human cell differentiation and assembly into functional tissues using a "cell-instructive" approach based on tissue-specific scaffolds (providing a template for tissue formation) and advanced bioreactors (providing environmental control, molecular and physical signaling). The biological principles of our designs and the implementation of physical factors are key for unlocking the biological potential of the cells. Our work has been reported in 450 peer-reviewed research articles, in journals including *Nature, Cell, Nature Biotechnology, Nature Medicine, Nature Biomedical Engineering, Nature Communications, Nature Protocols, PNAS, Cell Stem Cell, Science Advances, iScience and Science Translational Medicine*, with an impact factor of h=135. I have mentored over 150 trainees (postdocs, clinical fellows, M.D./Ph.D. and Ph.D. students and junior faculty).

Ongoing projects that I would like to highlight include:

NIH/NCI 5R01 CA249799-03 (PI: Vunjak-Novakovic) 07/15/20 – 06/30/25
Cancer patient on a chip

NIH/NIBIB 5UH3 EB025765-05 (PI: Vunjak-Novakovic) 09/01/17 – 06/30/23
Multi-tissue platform for modeling systemic pathologies

NIH/NHLBI 5R01 HL076485-15 (PI: Vunjak-Novakovic) 07/01/05 – 12/31/22
Engineering vascularized cardiac muscle

NIH/NHLBI 5R01 HL120046-09 (Vunjak-Novakovic and Snoeck MPI) 07/1/19 – 06/30/23
Bioengineering a chimeric human lung

NIH/NIBIB 5P41 EB027062-04 (Director: Vunjak-Novakovic) 09/16/19 – 05/31/24
Tissue Engineering Resource Center

Relevant experience and qualifications:

1. Ronaldson-Bouchard K., and **Vunjak-Novakovic G.** (2018). Organs-on-a-chip: a fast-track for engineered tissues in drug development. *Cell Stem Cell* 22: 310-324. PMCID: PMC5837068.
2. Chramiec, A., Teles, D., Yeager, K., Marturano-Kruik, A., Pak, J., Chen, T., Hao, L., Wang, M., Lock, R., Tavakol, D. N., Lee, M. B., Kim, J., Ronaldson-Bouchard, K and **Vunjak-Novakovic, G.** (2020). Integrated human organ-on-a-chip model for predictive studies of anti-tumor drug efficacy and cardiac safety. *Lab Chip* 20: 4357-4372. PMCID: PMC8092329.
3. **Vunjak-Novakovic, G.,** Ronaldson-Bouchard, K., and Radisic, M. (2021). Organs-on-a-chip models for biological research. *Cell* 184: 4597-4611. PMCID: PMC8417425.
4. Graney, P. L., Tavakol, D. N., Chramiec, A., Ronaldson-Bouchard, K., and **Vunjak-Novakovic, G.** (2021). Engineered models of tumor metastasis with immune cell contributions. *iScience* 24: 102179. PMCID: PMC7921600.
5. Ronaldson-Bouchard, K, Tavakol DN, Yeager K, Chramiec A, Teles D, Halligan SP, Summers M, Stylianos S, Tamargo M, Guo Z, Jack√≥w J, Tagore S, Lee BM, Shih J, Soni RK, Christiano AM, Califano A, Hirschi KK, Chen CS and **Vunjak-Novakovic G**. Inter-organ chips with matured tissue niches linked by vascular flow *Nature Biomedical Engineering* 6:351-371 (2022)

B. Positions, Scientific Appointments, and Honors:

Positions and Employment:

2019 – present	Director, Tissue Engineering Resource Center (NIH)
2019 – present	Director, Center for Dental and Craniofacial Research
2019 – present	Professor, College of Dental Medicine
2017 – present	University Professor, Columbia University
2015 – present	Faculty, Center for Human Development, Columbia University
2014 – present	Faculty, Herbert Irving Cancer Center, Columbia University
2013 – present	Founding Scientific Director, Columbia University Stem Cell Core
2011 – present	The Mikati Foundation Professor of Biomedical Engineering and Medical Sciences
2010 – present	Visiting Professor, Ben Gurion University of the Negev, Israel
2009 – present	Honorary Professor, University of Belgrade
2008– present	Director, Stem Cell Imaging Core, Columbia University
2005 – present	Director, Laboratory for Stem Cells and Tissue Engineering
2005 – present	Professor, Department of Biomedical Engineering, Columbia University

Honors and Awards (selected):

2021	**Lifetime achievement award, Tissue Engineering and Regenerative Medicine Society**
2021	**Life Sciences Power 50**
2021	2021 Vice-Chair, Bioengineering Section, National Academy of Engineering; chair in 2023
2021	International Academy of Medical and Biological Engineering (IAMBE)
2021	**Pierre Galletti Award, American Institute for Medical and Biological Engineering**
2020	National Academy of Engineering, Committee of Membership
2020	Petit Distinguished Lecture, Georgia Institute of Technology and Emory
2020	Edison Lecture, University of Notre Dame
2020	**Order of Karadjordje Star, Serbia's highest honor**
2019 – 2022	Peer Committee, National Academy of Engineering, Section for Bioengineering
2019 – present	**Howard Hughes Medical Institute (HHMI) Scientific Advisory Board**
2019	Winner, NCATS-ASPIRE Design Challenge for Biological Assays for Translational Innovation in Pain, Opioid Use Disorder and Overdose
2019	**American Academy of Arts and Sciences**
2019	Innovation and Commercialization Award, Tissue Engineering and Regenerative Medicine Society
2019	Shu Chien Achievement Award, Biomedical Engineering Society

2019	AIChE Rock Stars of Regenerative Medicine
2019	Birnberg Medal, College of Dental Medicine, Columbia University
2018 – 2021	NIBIB Advisory Council
2015 – 2018	Peer Committee, National Academy of Engineering, Section for Bioengineering
2017	Doctorate in Science *Honoris Causa*, University of Novi Sad
2017	**Robert Pritzker Award for the lifetime achievement, Biomedical Engineering Society**
2016 – 2017	Chair, College of Fellows, American Institute for Medical and Biological Engineering
2015 – present	Council, Tissue Engineering and Regenerative Medicine Society (TERMIS)
2014 – 2017	**National Academy of Engineering, Russ Award Committee**
2014	**National Academy of Medicine**
2014	**National Academy of Inventors**
2014	American Association for the Advancement of Science (AAAS)
2014	Foreign Policy's 100 Leading Global Thinkers for 2014
2013 – 2014	National Academy of Engineering, Executive Committee, Section for Bioengineering
2012 – 2020	Board of Directors, Center for Advancement of Science in Space (CASIS); Scientific Director
2012	**National Academy of Engineering**
2012	**Academia Europaea**
2012	**Serbian Academy of Sciences and Arts**
2012	Serbian Academy of Engineering
2012	Fellow, Biomedical Engineering Society
2011	BioAccelerate Prize of the New York City Investment Fund
2011	Council, Tissue Engineering and Regenerative Medicine International Society (TERMIS)
2010	Clemson award of the Society of Biomaterials
2009	New York Academy of Science
2008	Hall of Fame, Women in Technology International (one of 5 inducted in 2008)
2007	NIH Director's Lecture, the first woman engineer to receive this distinction
2004 – present	Faculty of 1000 Medicine (http://www.f1000medicine.com), Regenerative Medicine
2003 – 2005	Four NASA awards for bioengineering patents

C. Contributions to Science:

1. *Engineering human tissues*: Our laboratory has focus on tissue engineering approaches for improving human health. We pioneered innovative technologies for engineering a range of functional human tissues for use in basic research and clinical applications. Our long-term goals are to develop personalized treatment modalities for regenerative medicine, tissue models for stem cell research, and "organs-on-a-chip" platforms for use in precision medicine. To this end, we are engineering functional human bone and cartilage, and cartilage/bone composites, in anatomical shapes tailored to the patient. We also investigate tissue engineering of synchronously contracting human heart tissue and the perfused and ventilated human lung starting from the patient's iPS cells. In all cases, engineered tissues are used as high-fidelity models to study cell differentiation and tissue development and establish modalities for regenerating the structure and function of human organs.

Godier-Furnemont, A. F., Martens, T. P., Koeckert, M. S., Wan, L., Parks, J., Arai, K., Zhang, G., Hudson, B., and **Vunjak-Novakovic, G.** (2011). Composite scaffold provides a cell delivery platform for cardiovascular repair. *Proc. Natl. Acad. Sci. USA* 108: 7974-7979. PMCID: PMC3093484.

Bhumiratana, S., Eton, R. E., Oungoulian, S. R., Wan, L. Q., Ateshian, G. A., and **Vunjak-Novakovic, G.** (2014). Large, stratified and mechanically functional human cartilage grown in vitro by mesenchymal condensation. *Proc. Natl. Acad. Sci. USA* 111: 6940-6945. PMCID: PMC4024923.

Bhumiratana, S., Bernhard, J. C., Alfi, D. M., Yeager, K., Eton, R. E., Bova, J., Shah, F., Gimble, J. M., Lopez, M. J., Eisig, S. B., and **Vunjak-Novakovic, G.** (2016). Tissue-engineered autologous grafts for facial bone reconstruction. *Sci. Transl. Med.* 8: 343ra83. PMCID: PMC4944852.

Ronaldson-Bouchard, K., Yeager, K., Teles, D, Chen, T., Ma, S., Song, LJ, Morikawa, K., Wobma, H. M., Vasciaveo, A., Ruiz, E. C., Yazawa, M., and **Vunjak-Novakovic, G.** (2019). Engineering of human cardiac muscle electromechanically matured to an adult-like phenotype. *Nat. Protoc.* 14: 2781-2817. PMCID: PMC7195192.

2. *Microtechnologies for modeling tissue morphogenesis*: Our lab has great interest in fundamental studies of cellular function at various levels of scale (molecular, cellular, tissue, organ) and in various contexts (development, regeneration, disease) using microtechnologies. Cell micropatterning has led to new insights into the initiation of left-right asymmetry in response to boundaries, a process underlying normal and pathological tissue morphogenesis. A simple method for generating micro-sized hydrogels with shape-coded biological properties, and docking these blocks into hydrogel templates, is used to study the migratory patterns in three-dimensional multicellular communities and the formation of complex tissues. Combinations of inducible gene expression with microfluidic technologies are used to pattern gene expression in stem cells, and establish *in vitro* the pluripotency-differentiation boundaries similar to those in early development. We are now developing an integrated microphysiological platform with functionally connected vascular, liver, cardiac, skin and tumor microtissues derived from a single line of human pluripotent stem cells and matured in culture. This platform enables functional representation of human physiology and real-time biological readouts for studies of the toxicity, efficacy and mechanisms of action of drugs.

Ronaldson-Bouchard K., and **Vunjak-Novakovic G.** (2018). Organs-on-a-chip: a fast-track for engineered tissues in drug development. *Cell Stem Cell* 22: 310-324. PMCID: PMC5837068.

Ronaldson-Bouchard, K., Ma, S., Chen, T., Yeager, K., Sirabella, D., Song, L. J., Yazawa, M., and **Vunjak-Novakovic, G.** (2018). Advanced maturation of human cardiac tissue grown from pluripotent stem cells. *Nature* 556: 239-243. PMCID: PMC5895513.

Tavakol, D. N, Fleischer, S., and **Vunjak-Novakovic, G.** (2021). Harnessing organs-on-a-chip to model tissue regeneration. *Cell Stem Cell* 28: 993-1015. PMCID: PMC8186820.

Vunjak-Novakovic, G., Ronaldson-Bouchard, K., and Radisic, M. (20210. Organs-on-a-chip models for biological research. *Cell* 184: 4597-4611. PMCID: PMC8417425.

3. *Tissue models of disease and injury*: Three-dimensional models of human tumors engineered *in vitro* are just starting to show potential for predictive studies of therapeutic targets and screening of anticancer drugs. We recently established human bone tumors with cancer cells residing within an engineered tissue resembling the native tissue context. The engineered tumor models emulate some of the key features of the *in vivo* tumor environment, and allow physiologically relevant studies of tumor initiation, progression and metastasis. These models can also incorporate the capillary plexus to generate vascularized tumors, and the components of the human immune system. Such implementation of tissue engineering tools enables controlled quantitative studies of tumor biology and testing of drugs in settings that more closely mimic the clinical situation.

Villasante, A., Marturano-Kruik, A., and **Vunjak-Novakovic, G.** (2014). Bioengineered human tumor within a bone niche. *Biomaterials* 35: 5785-5794. PMCID: PMC4048837.

Marturano-Kruik, A., Nava, M. M., Yaeger, K., Chramiec, A., Hao, L., Robinson, S., Guo, E., Raimondi, M. T., and **Vunjak-Novakovic, G.** (2018). Human bone perivascular niche-on-a-chip for studying metastatic colonization. *Proc. Natl. Acad. Sci. USA* 115: 1256-1261. PMCID: PMC5819403.

Chramiec, A., Teles, D., Yeager, K., Marturano-Kruik, A., Pak, J., Chen, T., Hao, L., Wang, M., Lock, R., Tavakol, D. N., Lee, M. B., Kim, J., Ronaldson-Bouchard, K and **Vunjak-Novakovic, G.** (2020). Integrated human organ-on-chip models for predictive screening of anti-tumor drug efficacy and cardiac safety. *Lab Chip* 20: 4357-4372. PMCID: PMC8092329.

Graney, P. L., Tavakol, D. N., Chramiec, A., Ronaldson-Bouchard, K., and **Vunjak-Novakovic, G.** (2021). Engineered models of tumor metastasis with immune cell contributions. *iScience* 24: 102179. PMCID: PMC7921600.

4. *Bioreactors*: Over the last twenty years, our lab has pioneered bioreactor systems that are designed based on biological principles governing tissue development, regeneration and disease. This “biomimetic” approach subjects the cultured cells to environmental signals similar to those experienced *in vivo* and thereby helps unlock their full biological potential. To engineer heart tissue, bioreactors provide interstitial flow and electrical signals inducing mechanical stretch, towards establishing mature cardiac ultrastructure and orderly electromechanical coupling. To engineer skeletal tissues, bioreactors provide perfusion (to enhance mass transport and hydrodynamic shear), dynamic mechanical compression (to stimulate the cells), and anatomically correct shape of the graft (to fit the defect being repaired). To engineer lung, the bioreactor provides blood perfusion and ventilation, to maintain lung viability and function while it is being repaired with stem cells. As a home of the NIH Tissue Engineering Resource Center, our lab continues to develop technologies for regenerative medicine, stem cell research, and study of disease.

Vunjak-Novakovic, G., and Scadden, D. T. (2011). Biomimetic platforms for human stem cell research. *Cell Stem Cell* 8: 252-261. PMCID: PMC3048803.

Dorrello, N. V., Guenthart, B. A., O’Neill, J. D., Kim, J., Cunningham, K., Chen, Y.-W., Biscotti, M., Swayne, T., Wobma, H. M., Huang, S. X. L., Snoeck, H.-W., Bacchetta, M., and **Vunjak-Novakovic, G.** (2017). Functional vascularized lung grafts for lung bioengineering. *Sci. Adv.* 3: e1700521. PMCID: PMC5576878.

Guenthart, B. A., O’Neill, J. D., Kim, J., Queen, D., Chocotka, S., Fung, K., Simpson, M., Donocoff, R., Salna, M., Marboe, C., Cunningham, K., Halligan, S. P., Wobma, H. M., Hozain, A. E., Romanov, A., **Vunjak-Novakovic, G.,** and Bacchetta, M. (2019). Regeneration of severely damaged lungs using an interventional cross-circulation platform. *Nat. Commun.* 10: 1985. PMCID: PMC6504972.

Hozain, A. E., O'Neill, J. D., Pinezich, M. R., Tipograf, Y., Donocoff, R., Cunningham, K. M., Tumen, A., Fung, K., Ukita, R., Simpson, M. T., Reimer, J. A., Ruiz, E. C., Queen, D., Stokes, J. W., Cardwell, N. L., Talackine, J., Kim, J., Snoeck, H.-W., Chen, Y.-W., Romanov, A., Marboe, C. C., Griesmer, A. D., Guenthart, B. A., Bacchetta, M., and **Vunjak-Novakovic, G.** (2020). Xenogeneic cross-circulation for extracorporeal recovery of injured human lungs. *Nat. Med.* 26: 1102-1113.

Complete List of Published Work:

http://www.ncbi.nlm.nih.gov/sites/myncbi/gordana.vunjak-novakovic.1/bibliography/40562218/public/?sort=date&direction=ascending