Professor Hanadi Sleiman
Professor of Chemistry and Canada Research Chair (Tier I) in DNA Nanoscience
McGill University
Canada

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January 24, 2024

World Cultural Council
Case Postale 373
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Dear Members of the Selection Committee,

On behalf of McGill University, it gives me great pleasure to nominate Professor Hanadi Sleiman for the Albert Einstein World Award of Science. The recent advances in her lab in DNA nanoscience have all the hallmarks of scientific breakthroughs and make an outstanding case for this nomination. Prof. Sleiman received her PhD in Chemistry from Stanford University in 1999 followed by a postdoctoral fellowship in the lab of the Nobel Prize winner Prof. Jean-Marie Lehn. She joined McGill in 1999, was promoted to Associate Professor in 2005 and Full Professor in 2011. She is a Canada Research Chair (Tier 1) in DNA Nanoscience; these are amongst the most prestigious research chairs in Canada.

Prof. Sleiman's pioneering contributions have been foundational to the development of the field of **DNA nanotechnology** (*Science 2008*, *Nat. Rev. Chem. 2017*). This field, which uses DNA as a building scaffold for the precise engineering of nanostructures, has been revolutionary in our ability to control molecular self-assembly and has had a significant impact on nanoscience and nanotechnology. The Sleiman Lab has generated several 'firsts' in the field. For instance, they were the first to report a modular synthesis of DNA cages and nanotubes with precisely controlled size and shape (*J. Am. Chem. Soc. 2007*, *Nat. Nanotech. 2009*, *Nat. Chem. 2013*, *Nat. Comm. 2015*, *Nat. Chem. 2015*). This work demonstrated, for the first time, that DNA structures can encapsulate nanoparticles and then selectively release them upon encountering a specific complementary DNA (*Nat. Chem. 2010*). The team also reported the first metal-DNA cage for catalysis and *in vivo* imaging (*Nat. Chem. 2009*). To achieve this, they pioneered the incorporation of transition metals into the corners of DNA nanostructures (*Angew. Chem. 2001*, *2008*, *2009*, *2011*, *2019*).

Precision medicine is one area where breakthroughs from the Sleiman Lab are poised to make **the largest societal impact.** Modern drugs save lives and enhance the well-being of countless patients. However, the 'one-size-fits-all' approach to drug development is falling short in meeting many health challenges, such as cancer and antibiotic resistance. **Precision medicine** is a new direction that aims to define the best treatment plan on a patient-by-patient basis, based on the individual's genetics and environment. A thorough medical diagnostic on a patient can identify biomarkers in their diseases. Precision medicine will then require *programmable* materials that target these biomarkers, delivering drugs only to the site of the disease. However, engineering

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such property is a major challenge, and no synthetic nanomaterials that bind to specific biomarkers have made it to the clinic.

Prof. Sleiman's 'Legoland' of DNA-derived nanostructures can address the challenge of targeted delivery of therapeutics with unprecedented elegance. Indeed, DNA occupies a privileged position among biomolecules: it has the highest level of **programmability, predictable assembly, and structural control**. The DNA materials developed in the Sleiman group are precisely controlled in size, shape, and presentation of molecules on their surface. These structures are capable of dynamically responding to complex cues in their environment, acting as *'nanomachines' that translate the presence of a disease biomarker into sensing and drug delivery*. Sleiman's DNA cages can be programmed to **'unzip' on contact with cancer-specific molecules, releasing the drug cargo** (*Chem. Sci. 2014*, *J. Am. Chem. Soc. 2016* & *2017*), including therapeutics that **re-sensitize cancer cells to chemotherapy** (*Chem.Sci. 2017*). Importantly as well, the Sleiman Lab has uncovered the interaction of DNA cages with cells and their ability to **silence gene expression** (*ACS Central Sci. 2019*).

Prof. Sleiman's work has been central in changing our capacity to design complex DNA nanostructures. Before her research, DNA nanostructures were made exclusively from nucleotide sequences. Complex structures required the use of hundreds of different DNA components, making these structures expensive and unstable for use in clinical applications. Sleiman put forward the visionary perspective that although DNA is an impressive scaffold material, the realization of its potential in medicine and materials science requires integration with functional organic, inorganic and polymer molecules. Driven by this outlook, and a clear goal, **Prof. Sleiman introduced a new research area, where synthetic molecules and DNA are intricately combined to build nanostructures**. The result is a game-changing integration of supramolecular and DNA chemistries. Sleiman's work has resulted in precisely controlled DNA nanostructures that are made from a minimum number of DNA strands, rather than the hundreds required by other methods. These DNA nanostructures are very promising for drug delivery and are poised for a timely translation to the clinic because their level of structural control and biologically compatible functions are unique amongst current materials.

In addition, the Sleiman Lab introduced entirely new concepts in supramolecular chemistry with DNA building blocks. They discovered that the **base-pairing of DNA can be re-programmed** by adding a small molecule. This methodology represents a fundamental shift in the field, as it expands the A, T, G, C code of DNA without complex synthesis (*Nat. Chem. 2016*, *Nat. Comm. 2018*, *Nat. Chem. 2021*). This discovery has marked practical value, for example, in its applications to DNA hydrogels for drug delivery and tissue engineering applications. The materials resulting from such applications are biocompatible, non-toxic, stimuli-responsive, and relatively inexpensive to scale up to production quantities (*Adv. Chem. 2023*).

In an unprecedented approach, the Sleiman group also discovered that DNA structures can be used as a temporary **"printing press"**, to transfer their structural information to other materials, such as gold nanoparticles, polymers, small molecules, and proteins (*Nat. Chem. 2016*, *Nat. Chem. 2018*, *Angew. Chem. 2018*, *J. Am. Chem. Soc. 2024*). The latter contribution has defined a new research area: the creation of **new proteins through DNA scaffolding**, bypassing the traditional rules of protein folding – with applications as therapeutics, enzymes, and antibody mimics. This ability to copy the recognition motifs from one material to another addresses the current bottleneck of the field – the synthetic scalability of DNA structures. This approach is now widely

used by many research groups making such DNA-printed materials for diagnostic and plasmonic applications (e.g., Y. Zhang. *Angew. Chem.* 2016; B. Liu, *Small*, 2017; C. Shen, *Adv. Mater.* 2017; N. Xie, *ACS Nano* 2019).

To augment the range of DNA nanostructure applications, the group developed a simple and high-yield synthesis of monodisperse and fully **sequence-controlled polymers attached to DNA**. Sequence-defined polymers are macromolecules where monomer units are arranged in a specific order along the chain. They have been exalted as the 'next holy grail in polymer science' but have been very difficult to access (*Angew. Chem. 2014*, *J. Am. Chem. Soc. 2018*). These polymers assemble into spherical or cylindrical nucleic acids through unprecedented mechanisms (*Chem 2021*, *J. Am. Chem. Soc. 2022*, *Angew. Chem. 2023*). Combining these polymers with DNA nanostructures led to emergent, protein-inspired self-assembly (*J. Am. Chem. Soc. 2014* & *2016*). These contributions have solved a long-standing problem: how to efficiently encapsulate small molecule drugs and selectively release them from DNA nanostructures (*Nat. Chem. 2013*). Remarkably, attaching RNA therapeutics to these polymers resulted in significantly enhancing their stability, gene-silencing capabilities, and improving their *in vivo* biological distribution, making them highly promising as **a new generation of delivery vehicles for RNA therapeutics** (*J. Am. Chem. Soc. 2023*, *Chem Sci 2021*, *Mol. Ther. Nucl. Acids, 2023, Angew. Chem. 2023*, *5 patent appl.*).

The Sleiman group has thus created an unprecedented class of DNA nanostructures as materials for precision medicine: they have a single size, their shape and molecule presentation are finely controlled, and they are biologically compatible and biodegradable. They provide a unique opportunity for systematic studies, resulting in design guidelines for researchers to optimize the effectiveness of drug delivery. This research has developed materials that address important problems in precision medicine and cancer therapy: delivering cancer-killing drugs to tumour cells and not to healthy cells and overcoming drug resistance in cancer. Many other important applications continue to emerge from Sleiman's work on DNA nanomaterials. These include catalytic cascades, materials for tissue engineering, 'shape-shifting' structures for robotics, and plasmonic structures for diagnostics (*Nat. Rev. Chem. 2017*). These are only a few examples of the remarkable breadth, depth and creativity that is uniquely characteristic of the research work of Prof. Sleiman.

Prof. Sleiman is one of the most celebrated Canadian scientists of her generation. Her research breakthroughs have been highlighted in prestigious journals, *Nature* (which called their DNA cages "Gene Boxes"), *Science*, *Nature Materials*, and *Materials Today.* She has been interviewed and featured in scientific and popular media worldwide (*The Scientist*, *Wired*, *Chemistry World, Canadian Chemical News, Nano Today, Quebec Science, TeleQuebec, Découverte, Asharq El Awsat)*. As an indication of the esteem with which she is held, in 2015, she was invited by the Nobel Committee to draft a review on DNA Nanotechnology and assess whether the field is worthy of a Nobel Prize, producing a 10-page document on her findings.

Prof. Sleiman is a Fellow of the Royal Society, UK (2023) and the Royal Society of Canada (2016). Her work has been recognized through a broad spectrum of national and international awards: E. W. R. Steacie Award from the Canadian Society of Chemistry (2024) - granted to only the most distinguished Chemists in Canada; John C. Polanyi Award from the Natural Sciences and Engineering Council (2021) - one of the two highest awards given by NSERC for Science and Engi-

neering in Canada, $250K; Killam Research Fellowship (2018) - awarded to scholars of exceptional ability to pursue research projects of broad significance and widespread interest, $140K; R. U. Lemieux Award, Canadian Society of Chemistry (2018) - granted to the top Organic Chemists in Canada; Netherlands Scholar Award in Supramolecular Chemistry (2018) - for outstanding contributions to Supramolecular Chemistry; and the Izatt-Christensen Award (2016) - the highest international award in Supramolecular Chemistry. Prof. Sleiman is highest funded researcher in the National Science and Engineering Council of Canada (NSERC), in all disciplines. In 2013, she was selected by the Faculty of 1000 Biology. Her contributions are consistently in the highest (98th) percentile for online attention (e.g., in *Nature Chem.).*

Prof. Sleiman is a much sought-after speaker. In the last six years alone, she has presented >50 invited talks at major universities and international conferences, including many plenary and named lectures. The recognition of the quality and impact of the research undertaken in her laboratory extends to the vast number (>140) of graduate and undergraduate students and postdoctoral fellows she has mentored over her years at McGill. Their research efforts have resulted in several major national and international awards, including NSERC, IUPAC, MSED and FRQNT Doctoral Prizes, the Governor General's Gold Medal, and countless best papers / best conference presentation awards. Sleiman graduates are welcomed as postdoctoral fellows in prestigious labs at Harvard, MIT, Northwestern, Stanford, ETH, and Caltech and many have themselves become professors in top-tier universities including U. Toronto, U. British Columbia, University College London, U Hong Kong, McMaster U., Texas A&M.

Prof. Sleiman currently serves as the Associate Editor of the *Journal of the American Chemical Society* - the world's most influential chemistry journal, and a member of the Editorial Boards of other high-impact journals, including *Chem*., *J. Org. Chem*., *ChemBioChem* and *Nanoscale Horizons*. She was a Fellow of the Canadian Institute for Advanced Research (2004-12) and President of the International DNA Nanotechnology Society (ISNSCE, 2019-2021).

Prof. Sleiman's research has nucleated collaborations with universities, clinicians, and companies in many countries and across multiple disciplines. These efforts have resulted in the development of new antitumor therapeutics, cancer diagnostic microfluidic devices, and drug delivery vectors. Sleiman currently leads a $1.65M NSERC CREATE program (2019-2025) with six universities across Canada, providing "soft-skills" training for Canadian graduate students to make them work-ready – training that is normally not offered in graduate schools. She is co-PI in a Horizon 2020 Consortium grant involving scientists based in France, Spain, Italy, Cuba, and the United States. The translational opportunities derived from Sleiman's research have attracted the interest of major international companies such as L'Oreal (collaboration to use DNA structures to deliver active ingredients to the skin), Grifols (to develop albumin-binding DNA nanostructures), Quantum Si (DNA nanostructures to increase sensitivity in DNA sequencing), and Alnylam (to increase the potency of their RNA therapies).

In summary, Professor Hanadi Sleiman's recent research advances have profoundly impacted the fields of biological and materials chemistry. The DNA nanostructures developed in her laboratory are poised to transform the field of precision medicine in the coming decade. It is therefore my pleasure to nominate Professor Sleiman for the Albert Einstein World Award of Science.

Sincerely,

Martha Crago, PHD, C.M.

c.c.: Professor R. Bruce Lennox, Dean, Faculty of Science
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October 29, 2023

World Cultural Council
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Dear Colleagues:

I am truly delighted to support the nomination of Prof Hanadi Sleiman for the *"Albert Einstein" World Award of Science*. Simply put, Prof. Sleiman is an international treasure. This level of renown begins with her science. But, it also goes beyond the science itself, as Prof. Sleiman is genuinely inspirational. I believe she is one of the most important scientists in the world. She is trailblazing in setting the agenda and working out its details, expanding the boundaries of our discipline, nucleating a next-generation school of open-minded colleagues, and in defining the highest standards of excellence all the while. Details on these points follow, but when I was approached to write a in support of her nomination for this Award, my reaction was positive in the extreme. In a field blessed with so many outstanding colleagues, Prof. Sleiman still stands out. She absolutely has it all. Recognition of Prof. Sleiman in this way will absolutely accomplish what I believe awards are for – it will inspire all to ever higher heights, such as those reached by Prof. Sleiman day in and day out, as she advances our field.

Prof. Sleiman is unquestionably viewed as one of the world's best supramolecular scientists. Although she is exactly that, she is also much more. Prof. Sleiman entered the field at a moment when polymer science and nucleic acid science were certainly beginning to cross, but they were not yet cross-fertilizing. Synthesis was limiting the precision and complexity of polymers that could be made, and nucleic acid science might be said fairly to have been still in its descriptive phase. Yet, the fields were absolutely ripe for mixing, as "supramolecular chemistry," and "synthesis beyond the covalent bond," gained momentum. Prof. Sleiman was absolutely pioneering in bridging the fields, defining a horizon which many now call "DNA Nanotechnology." An essential ingredient was merging the precision of DNA-based self-assembly with the chemist's limitless ability to conceive (and synthesize) nucleic acid-like monomers that are limited only by imagination. Accordingly, Prof. Sleiman creatively and forcefully forged a path forward that delivered a stunningly broad set of high precision nanostructures armed with functional molecular appendages. Her manifesto, "Assembling Materials with DNA as a Guide" (*Science* **2008**, *321*, 1795-1799; cited >700 times as of this writing), signaled the arrival of a new field, capturing many of Prof. Sleiman's early and independent themes. Moreover, this paper remains a beacon for the field of DNA nanotechnology that inspires many to go beyond structure to function, illustrating how scientists can take the field beyond description, to invention.

Specific and signature triumphs accumulate in the Sleiman Laboratory, as a striking range of rationally designed structural types with pre-assigned targeted functions emerges continuously. As an early example, Prof. Sleiman showed that miniaturized DNA-based templates could be interfaced with gold nanoparticles to achieve shape-defined assemblies that could undergo structural changes in response to external stimuli, delivering signals that could be adapted to write/erase processes (*J. Am. Chem. Soc.* **2007**, *129*, 4130-4131). DNA-based supramolecular structures were designed and achieved that could capture and release cargos of tremendous diversity, with extremely high levels of control. For example, Sleiman-type DNA based systems can usher in and out, on the one hand, electronically and optically interesting nanoparticles (*Nature Chem.* **2010**, *4*, 319-328), and small interfering RNAs on the other (*J. Am. Chem. Soc.* **2016**, *138*, 14030-14038). Capabilities like these set the stage for a stunning array of impactful applications, ranging from medical diagnostics and even interventions involving drug delivery, to entirely new concepts for functional materials and the emerging field of systems chemistry.

One specific example at the interface of chemistry and biology can be seen in studies that involve targeting and elimination of cancer cells (*J. Am. Chem. Soc.* **2012**, *134*, 2888-2891). In studies like these, Prof. Sleiman's bedrock scientific soul also emerges in her extensive fundamental characterization of the phenomena. Puzzling charge transport behavior is eventually made clear in work that then serves as a platform for others to follow. So too, her applications of DNA-based nanostructures to *in vivo* imaging is at once pioneering, but also grounded in extensive characterization of issues related to biostability and subcellular localization (*Chem. Sci.* **2017**, *8*, 6218-6229).

On the functional materials and systems chemistry side, an amazingly exciting new direction in the Sleiman Lab involves an analyte-based re-assignment of the rules of DNA base pairing, which amounts to a type of re-programming of the genetic code (*Nature Chem.* **2016**, *8*, 368-376). At the same time, the Sleiman Laboratory is pioneering another entirely new approach to the transfer of chemical information from DNA-based nanostructures to other target molecules, which may imply a new type of "printing press," setting the stage for new chemical network designs as well as signal processing (*Angew. Chem. Int. Ed.* **2019**, *58*, 3042-3047).

All of Prof. Sleiman's brilliant and forward-looking projects interface with her simultaneously refreshing perspective of realism. The Sleiman Lab always projects an eye to scalability, which translates to synthetic innovations as well. Indeed, her portfolio is replete with detailed procedures and concepts for synthesis on scale, with an emphasis on DNA-based materials that are polymeric in their dimensions, and monodisperse in their precision. This is indeed an approach that brings the "Holy Grail" vision of sequence-defined, function-specified, nanomaterials ever closer to reality, in the minds and hands of Prof. Sleiman and her students.

Prof. Sleiman's science provides the perfect backdrop for a summary of her numerous other characteristics that define her as a perfect choice for this recognition. Her story is one of incredible inspiration. Perhaps readers of this letter will already know that her early education at the American University of Beirut in Lebanon coincided with a period in history of tremendous tragedy and turmoil there. In the midst of it all, the young Hanadi Sleiman became enamored of science nonetheless. Following her Ph.D. at Stanford, she returned to Lebanon, and did incredible work at the American University of Beirut, where her intensive focus on excellence in

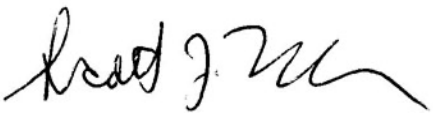
education was entirely evident despite significant obstacles in terms of resources, and indeed of traditionalism. Yet, in characteristic fashion, Prof. Sleiman succeeded in every way possible, reaching and inspiring numerous students nonetheless. But, her research opportunities were limited. Courageously, and in response to her own expanding hopes and dreams, after great success in her roles at the American University of Beirut, she transitioned back to postdoctoral research, now with Prof. Jean-Marie Lehn at the Université Louis Pasteur in Strasbourg. There is simply no doubt that Prof. Hanadi Sleiman began her Professorship at McGill University as a prototype of the highest quality individual who always made the best of every opportunity available to her.

At this stage, one could sum up and say, "the rest is history." If so, it would be important to emphasize that this history is still unfolding in dramatic fashion. Prof. Sleiman is just as successful in every other phase of her professional life as she is in her science. Her teaching at McGill, where she is consistently involved in heavy lifting undergraduate classes, is legendary and award winning. Her research students – at all levels, undergraduate, graduate and postdoctoral – are incredibly successful. Her research presence has made her group a coveted nexus for collaboration, with numerous and impactful interactions all over both academia and industry.

Fittingly, Professor Sleiman's CV and web page (http://sleimangroup.com/prof-sleiman/) recount a trove of honors and recognitions that speak to her stature. Less visible, Prof. Sleiman is also engaged in a number of other roles that underscore the intersection of her great generosity and deep wisdom. Numerous agencies seek her opinions, ranging from academic institutions and companies, to governments and prize committees. Likewise, numerous scientific journals seek her counsel. Among all of these roles, her ongoing service as an Associate Editor for the *Journal of the American Chemical Society* may be the one I wish to call out most specifically. Once again, this is a heavy lifting, many-hours-per-week role. But, being asked to serve as an Associate Editor for *JACS* is something I have always viewed as akin to being nominated for the United States Supreme Court. It is a role reserved for our colleagues with not only the highest standards, but also for the most brilliant, the most thoughtful, the most fair, and perhaps above all, ideally for the most humane. Prof. Hanadi Sleiman possesses all of these qualities, at the theoretical maximum of the scale in each case.

Prof. Hanadi Sleiman is the paragon of an outstanding teacher-scholar. She is the professor so many of us strive to be. Prof. Sleiman accordingly would be the quintessentially fantastic choice for the *"Albert Einstein" World Award of Science*.

Sincerely,



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November 30, 2023

"Albert Einstein" World Award of Science
World Cultural Council
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Dear Selection Committee,

I am delighted to write in support of Professor Hanadi Sleiman's application for the "Albert Einstein" World Award of Science. The executive summary of this letter: Prof. Sleiman is a brilliant and creative scholar who has a well-earned international reputation for breakthrough discoveries at the intersection of supramolecular chemistry and DNA nanoscience. Not only has Prof. Sleiman has created a new field of research with multiple important fundamental discoveries, she and her coworkers are on the cusp of translating some of their finding into important applications in biomedicine. Some support for these strong statements is provided below along with more detail of some of Prof. Sleiman's important work.

The programmed assembly of DNA strands into three dimensional objects was already an established field, largely pioneered by Ned Seeman at NYU. What Prof. Sleiman did was to show that the DNA fragments can be connected by metal coordination complexes or organic linkers. The previous approaches utilized DNA solely as a connector, and that seriously limited many aspects of the process and particularly the applications possible. To give one specific example, Prof. Sleiman and her coworkers were able to create a self-assembled nanoscale, cubic assembly in very high yield and with an extremely simple strategy whereas the previous published approach by a competitor was multi-step and gave a yield of only 1%. In an impressive series of papers, Prof. Sleiman showed the generality of their approach, converting self-assembled DNA triangles, squares, pentagons, and hexagons into triangular, cubic, pentameric, and hexameric prisms, respectively. By manipulating the linking and rigidifying DNA it was further shown that these geometric objects could have their sizes dynamically adjusted. Overall, this was just a beautiful demonstration of the power of her approach to self-assembling 3D objects, which has revolutionized nanoscale assembly. The applications of this breakthrough chemistry are limited to one's imagination. Information storage systems, nano-electronic systems, and organized enzyme nano-manufacturing centers are just three possibilities easily imagined.

I would like to discuss two recent papers in more detail that further illustrate the impact of Prof. Sleiman's accomplishments. The first (*J. Am. Chem. Soc.* **2017**, *139*, 7355), focuses on the delivery of therapeutic oligonucleotides (e.g., antisense or siRNA) and reports a brilliant strategy wherein the DNA/nucleotide-based agents are protected inside the self-assembled nano-cubes.

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The assemblies give long blood circulation times and yet allow cellular uptake and gene silencing. The approach involving imbuing the cube with lipid structures that sequester human serum albumin and protect the therapeutic DNA (or RNA) from degradation. In related work, Prof. Sleiman reported that the DNA nanostructures can be unzipped by cancer cells thereby providing another critical element needed from selective drug delivery.

The second paper appeared in *ACS Central Science* (**2019**, *5*, 911) and looks at the wide ranging results from multiple research groups around the world, each describing DNA nanostructure uptake by cells. In short, this literature was an absolute mess, with contradictory results regularly published. Prof. Sleiman's extraordinarily scholarly and insightful examination demonstrated that many of these publications are likely the result of false positives. Through a series of incisive and cleverly designed experiments Prof. Sleiman demonostrated that the DNA nanostructures are being degraded outside of the cell and it is the fluorescent labels that are being taken up. The ACS Central Science paper takes a broad section of confusing and contradictory literature and offers a level of clarity that has overnight changed the field. Such reports almost invariably become landmark papers and predict this will be one.

I have selected these two papers to discuss in large part because they very much appealed to me. It would have been easy to selected multiple other of Prof. Sleiman's remarkably impactful papers. Hopefully this detailed analysis offers strong support for the highly positive summary at the start of this letter.

In conclusion, Prof. Sleiman has received a large number of awards to dates, which are listed on her c.v. Notably, she is an Associate Editor for our top-tier general chemistry journal, Journal of the American Chemical Society, an honor given only to the broadest scholars who are widely respected by the community. I could write much more, but I think the picture is clear. Prof. Hanadi Sleiman is a highly productive, brilliant researcher, whose creative breakthrough discoveries have led to the creation of an important new area of chemistry, supramolecular DNA nanoscience. It gives me great pleasure to support her nomination for the "Albert Einstein" World Award of Science with my highest level of enthusiasm.

Sincerely yours,

Research. Hanadi Sleiman's contributions have profoundly impacted DNA nanotechnology, supramolecular chemistry, and biological chemistry. Her group's research focuses on using the molecule DNA as a scaffold to build nanostructures for biological and materials applications. Sleiman developed a new research discipline that merges DNA nanotechnology with supramolecular chemistry, streamlining the construction of DNA nanostructures and enabling important applications in cancer therapy. Structures which once required hundreds of DNA strands can now be efficiently assembled from a minimum number of components, thanks to Sleiman's integration of DNA with synthetic molecules. *(Science 2008, Nat. Rev. Mater. 2017)*

The Sleiman team created a unique class of DNA nanostructures for precision drug delivery. These structures are capable of detecting tumour cells and enabling targeted drug delivery—without affecting normal cells—before biodegrading harmlessly. Her breakthroughs can help bypass drug resistance, eliminate the toxic side effects of chemotherapy, and generate greater success rates for cancer treatments.

Sleiman introduced fundamentally new concepts in supramolecular chemistry, such as using DNA structures as a 'printing press' rather than permanent scaffolds and transforming DNA base-pairing by adding a small molecule. Her work has produced DNA nanostructures whose structural control is unmatched by current materials: they are very promising for drug and nucleic acid therapeutic delivery and are poised for timely translation to the clinic. DNA cages that release their cargo specifically in cancer environments, polymers with controlled sequences for RNA therapy, artificial proteins scaffolded by DNA as therapeutics and enzymes, and metal-DNA structures for *in vivo* imaging are applications enabled by Sleiman's research.

1. Supramolecular Construction with DNA. Three-dimensional DNA nanostructures, such as cages and nanotubes, offer transformative applications in nanomaterials organization, drug delivery and catalysis. They are particularly important for delivering nucleic acid (RNA and DNA) therapeutics. As exemplified by the recent COVID-19 mRNA vaccine, nucleic acids are a new class of selective therapeutics: they address diseases that are difficult or impossible to treat with small-molecule drugs. Despite their promise, challenges in stability, body distribution, and cellular uptake hinder their clinical use. Nucleic acid therapy stands to revolutionize disease treatment if these barriers are overcome. Sleiman has developed DNA nanostructures that overcome the challenges of nucleic acid therapies, precisely delivering them to cancer cells, and significantly advancing the field of precision cancer treatment. When Sleiman started her research program, the field of DNA nanotechnology was in its nascent stages, and three-dimensional DNA structures were challenging to construct. The group reported the first modular synthesis of DNA cages *(J. Am. Chem. Soc. (JACS) 2007)* and nanotubes *(Nat. Nanotech. 2009, Nat. Chem. 2015)* with precisely controlled geometry *(Nat. Commun. 2015, ACS Nano 2013, 2015, 2018)* and designed the first structurally switchable cages from a minimum number of DNA strands *(Nat. Chem. 2010, Nat. Chem. 2013)*. They reported the first metal-DNA cage for catalysis, diagnostics, and imaging *(Nat. Chem. 2009)*, by pioneering the incorporation of transition metals into the corners of DNA nanostructures (*Angew. Chem. 2008, 2009, 2010, 2019)*. They showed the first example of gold nanoparticle discrete and switchable assemblies using DNA (*Angew. Chem. 2006, JACS 2007, Nat. Chem. 2010*).

The group set out to explore the applications of these structures as drug delivery vehicles. (*Chem 2018*) Unlike most nanomaterials, these cages are precisely controlled in size, shape, and surface presentation *(JACS 2019)*. Intriguingly, despite their negative charge, they penetrate biological cells and silence gene expression more effectively than DNA strands themselves *(JACS 2012, ACS Nano 2021, Chem. Sci 2021)*. They are stable in bodily fluids *(JACS 2023)* and bind to specific serum proteins to improve in vivo distribution *(JACS 2017, J. Cont. Release 2020, Mol. Ther. Nucl. Acids, 2023, 5 patent appl.).* The group uncovered the interaction of DNA cages with cells: in a "cautionary tale", they showed that studies of cellular uptake of DNA structures require a battery of control experiments to be valid *(ACS Central Sci. 2019)*. Importantly, DNA cages can dynamically respond to complex cues in their environment. The group created a DNA cage that stays closed until it encounters a molecule only present in cancer cells; this cancer-specific molecule unzips the DNA cage and releases the drug cargo *(Chem. Sci. 2014, JACS 2016, ACS Appl. Mat. Interfaces, 2019)*. On a fundamental level, they examined the interaction of DNA cages with bilayer membranes. This showed that altering patterns of cholesterol units on a DNA cube dramatically changes its interaction with lipid membranes, mimicking membrane protein functions: peripheral anchoring, nanopore behaviour and conformational switching *(JACS 2017, JACS 2019)* These cages and nanotubes have been adopted by many research groups for drug delivery and biophysical studies. This work was highlighted in e.g., Nature, Nat. Mat., Mat. Today, C&E News, scientific and popular media. It was selected by the Faculty of 1000 Biology and led to review invitations e.g., Science (1117 citations), Nat. Rev. Mat. (with the founder of DNA Nanotechnology, N. Seeman, 1323 cit.).

2. Reprogramming DNA Assembly with a Small Molecule. The group has introduced transformative concepts in DNA supramolecular chemistry. They discovered that DNA base-pairing can be re-programmed, simply by adding a small molecule. The DNA 'alphabet' (A, T, G, C) is the underlying code that gives rise to the double helix. Scientists would like to develop a larger, designer alphabet of DNA bases to create more varied DNA structures, but this goal requires costly and complex synthetic procedures. Sleiman discovered that when cyanuric acid, an inexpensive small molecule with three thymine-like faces, is added to poly(adenine) DNA strands, it coaxes them to assemble into a completely new structure: a triple helix that

grows into long fibres, with the bases organized in a continuous hydrogen-bonded structure. (*Nat. Chem. 2016, topped the journal's most-read list, Nat. Commun. 2018, Sci. Adv. 2020*). This is a fundamental shift in the field, broadening the structures and functions of DNA materials without complex synthesis, merely by adding a small, inexpensive, and non-toxic molecule. The group used this new material to generate DNA hydrogels for drug delivery and tissue engineering; remarkably, they showed the highest stiffness of any known DNA hydrogel. *(Adv. Sci. 2023, US patent appl.)* They are self-healing, stimuli-responsive, and inexpensive for scale-up and they significantly enhance the stability and efficacy of nucleic acid therapies *(JACS, 2023)*. Hundreds of nucleoside-mimicking molecules are known and can be added to DNA strands to create unique motifs. Sleiman showed that this is a general approach to reprogram DNA assembly *(JACS, 2021, Nat. Mat. 2020).*

In a second exciting direction, Sleiman showed that steering this DNA assembly away from equilibrium leads to unique morphologies *(Nat. Chem. 2020, Editor's Choice).* Natural systems like collagen fibres consume energy to modify their structure and function. In contrast, synthetic fibres do not exhibit this dynamic behaviour. Sleiman's fibres initially created tangled networks. By introducing light and a photoacid, the group developed a dissipative system that slowly releases monomers, changing these disorganized structures into thick nano-cables with healed defects, improved mechanical properties and thermal stability. This represents an important step in the development of out-of-equilibrium systems for bioinspired materials organization.

3. The DNA Structure as a Molecular "Printing Press". Despite some recent advances in cost and scalability, DNA nanostructures are far from becoming readily available, commodity materials. Materials made entirely of DNA also present problems of stability and difficult cellular entry, and they may not be ideal for all biological applications. In an unprecedented approach, the Sleiman group discovered that DNA structures can be used as *transient templates*, as opposed to permanent scaffolds. The DNA patterns contained in these structures can be transferred onto gold nanoparticles that then become just as programmable as the original structure. The DNA "printing press" can then be re-used, significantly reducing fabrication costs. This introduces the fundamental notion that supramolecular information can be transmitted from one material to another through a chemical process *(Nat. Chem. 2016)*. This paper generated press in numerous science news outlets, including Can. Chem. News, and was in the top 2% for online attention. The group then applied the concept of "DNA printing" to synthetic polymers *(Nat. Chem. 2018)*, small molecules *(Angew. Chem. 2018)*, metal nanoparticle growth (*Chem. Sci. 2020, Nat. Commun. 2023, revisions requested)* and peptide assembly into artificial proteins *(JACS 2024)* to encode DNA's structural programmability in biomolecule and materials self-assembly.

4. Sequence-Defined Polymers. Sequence-defined polymers are macromolecules with specifically ordered monomer units. While sequence control is essential in biopolymers like DNA and proteins, their non-biological synthesis poses significant challenges. To address this, the Sleiman group generated a new class of monodisperse and sequence-controlled polymers by adapting the tools of automated DNA synthesis to artificial monomers. *(Angew. Chem. 2014, JACS 2018, J. Org. Chem. 2018, Polym. Chem. 2023, US Patent US-2021-0163422)*. They found that sequence-defined polymers attached to DNA assemble into spherical, cylindrical, or lamellar nucleic acid nanostructures through unprecedented mechanisms, and with applications in drug and nucleic acid delivery *(Chem 2021, JACS 2022, Angew. Chem. 2023)*. For example, they assembled monodisperse spherical structures, with a hydrophobic core and a dense nucleic acid corona (spherical nucleic acids, SNAs). These SNAs encapsulate small molecule drugs that re-sensitize patient leukemia cells to chemotherapy, and significantly enhance the gene silencing ability of nucleic acid therapies (*Chem. Sci. 2021, Angew. Chem. 2023)* Remarkably, SNAs show full body biodistribution *in vivo* and long circulation times *(Chem. Sci. 2017)*, in contrast to most nucleic acid drugs which are confined to the liver and kidneys. Combining polymers with DNA led to emergent, protein-inspired self-assembly modes (*JACS 2014, 2016)*. Using this strategy, they developed aptamers with the highest level of chemical diversity for diagnostics and therapeutics *(Nat. Chem. 2023, in revision, US-2023-0220381)* This research resulted in collaborations/contracts with the companies L'Oreal, IntelGenX, Grifols, n-plex Biosciences, Galenvs and Alnylam.

H. Sleiman was elected Fellow of the Royal Society (London, 2023) and of the Royal Society of Canada (2016), and received numerous awards, including the E. W. R. Steacie Award from the Canadian Society for Chemistry (2024), NSERC John C. Polanyi award (2021), Killam Research Fellowship (2018), CSC Lemieux Award (2018), Netherlands Scholar Award (2018), Izatt-Christensen Award (highest international award in supramolecular chemistry, 2016). Sleiman has mentored 147 trainees. Her graduate students received numerous awards, were postdoctoral fellows in prestigious labs and are now professors in excellent universities, e.g., U. Toronto, UBC, U. College London, McMaster U., U. Leiden, Texas A&M, Max Planck, or scientists in major companies (Xerox, Grifols, Moderna, L'Oreal). As a particular demonstration of her outstanding impact and expertise on the international level, Sleiman was invited by the Nobel Committee to write a review on DNA nanotechnology and assess whether the field is worthy of a Nobel Prize (10-page document). Sleiman received ~150 invitations to give talks at major universities, and plenary, named and invited lectures. She has been Associate Editor of the *Journal of the American Chemical Society* since 2018.

Curriculum Vitae

Hanadi Sleiman Professor of Chemistry and Canada Research Chair (Tier I) in DNA Nanoscience

1. Education/training

Université Louis Pasteur, France	*CNRS Postdoctoral fellow* (with Jean-Marie Lehn)	1994-96	Supramolecular Chemistry
Stanford University, CA, USA	*Ph. D.* (with L. McElwee-White)	1985-90	Organic Chemistry
American University of Beirut, Lebanon	*B.Sc.* (with High Distinction)	1982-85	Chemistry

2. Tenure Track Positions

McGill University	*Professor*	2011-present
McGill University	*Associate Professor*	2005-2011
McGill University	*Assistant Professor*	1998-2003

3. Awards, Honours and Distinctions (selected)

2024 ***E. W. R. Steacie Award***, Canadian Society for Chemistry, "presented to a scientist who has made a distinguished contribution to chemistry while working in Canada"

2023 ***Fellow of the Royal Society*** **(UK)**; granted to individuals who have made a "substantial contribution to the improvement of natural knowledge, including mathematics, engineering science, and medical science".

2021 ***NSERC John C. Polanyi Award****;* One of two highest awards given by NSERC for Science and Engineering in Canada; $250,000 in research funding. NSERC is the Natural Science and Engineering Research Council.

2020 ***Cottrell STAR Award***, Research Corporation, USA; "designed to recognize the outstanding research and educational accomplishments of members of the community of Cottrell Scholars."

2018 ***Killam Research Fellowship*****,** Canada Council for the Arts; "provides support ($140K) to scholars of exceptional ability by granting them time to pursue research projects of broad significance and widespread interest within the humanities, social sciences, natural sciences, health sciences, engineering."

2018 ***R. U. Lemieux Award***, Canadian Society for Chemistry, "presented to an organic chemist who has made a distinguished contribution to any area of organic chemistry"

2017 ***Netherlands Scholar Award*** in Supramolecular Chemistry; to "recognize and reward outstanding scientists working in supramolecular chemistry and encourage excellence in the field".

2016 ***Fellow of the Royal Society of Canada*** "They are 2000 Canadian scholars, artists, and scientists, peer-elected as the best in their field. The fellowship of the RSC comprises distinguished men and women from all branches of learning who have made remarkable contributions in the arts, the humanities and the sciences, as well as in Canadian public life."

2016 ***Izatt-Christensen Award*** (Highest International award in Supramolecular Chemistry)

2012 ***Canada Research Chair in DNA Nanoscience, Tier I.*** (renewed in 2019) "The Canada Research Chairs Program invests up to $311 million per year to attract and retain some of the world's most accomplished and promising minds. Chairholders aim to achieve research excellence in engineering and the natural sciences, health sciences, humanities, and social sciences."

2009 ***Strem Award for Inorganic Chemistry****,* Canadian Society for Chemistry; "presented to a Canadian who has made an outstanding contribution to inorganic chemistry, demonstrating exceptional promise."

2009 ***Fellow***, Canadian Institute of Advanced Research, Nanoelectronics Program.

2008 ***NSERC Discovery Accelerator Supplement*****;** "provides substantial and timely additional resources to accelerate progress and maximize the impact of established, superior research programs." $120K

2005 **Leo Yaffe Award** for Excellence in teaching, McGill University, Faculty of Science.

2004 **William Dawson Award** for Excellence in Research and Teaching McGill University (2004-2014).

2003 **Principal's Prize for Excellence in Teaching,** McGill University, (Assistant Professor Category).

2002 **Cottrell Scholar Award**, Research Corporation, USA; "honors and helps to develop outstanding teacher-scholars who are recognized by their scientific communities for the quality and innovation of their research programs and their potential for academic leadership in Chemistry, Physics and Astronomy".

4. Lectureships (selected)

2023 *Cambridge Energy Transition Lectureship*, U. Cambridge, UK
2023 *Hirschman Lectureship*, U. Wisconsin-Madison
2023 *Ayer Lectureship*, University of Alberta
2022 *Bristol-Myers Squibb Lectureship*, Columbia U.
2016 *Bristol-Myers-Squibb Lectureship*, Massachusetts Institute of Technology
2013 *Swiss Chemical Society Lectureship, U. Genève, EPFL, U. Neuchâtel, U. Fribourg, U. Basel*

5. Selected National and International Leadership Roles.

- *Associate Editor*, Journal of the American Chemical Society (JACS), 2018-pres.
- *Member, Editorial Advisory Board*, *JACS, Chem, Nanoscale Hor., Bioconj. Chem., J. Org. Chem., ChemBioChem*
- *President of the DNA Nanotechnology Society* (Int. Soc. Nanoscale Sci., Comp. & Eng., ISNSCE, 2019-21)
- *Associate Co-Director, DNA to RNA (CFREF Nucleic Acids Therapy, McGill), 2023-pres.*
- *Lead PI* on two large grant applications for a National Center of Excellence in RNA Therapeutics (Lead co-PI, Canada First Excellence Research Fund, $165 million, approved) and Research Infrastructure (Lead PI, Canada Foundation for Innovation, ca. $10 million, approved) -2023
- *Director, NSERC CREATE* (2019-2025). I led an initiative to establish a comprehensive NSERC CREATE graduate training initiative in nucleic acid chemistry across 6 Canadian universities and 52 collaborators, focusing on communication, leadership, management and entrepreneurship skills, and workplace readiness for 85 trainees.

6. Reviews and Media Coverage of our Work (selected)

2021 Article in JACS, ***highlighted by Nat. Rev. Chem***. ("Fabricating Functionalized Fibres")
2021 Article in ***Nat. Chem.***, featured in ***Nat. Chem.*** "News and Views" (Dissipative DNA Fibres), and other media
2020 Article in ***Nat. Mat.*** 2020, featured in ***Chem&Eng News***
2019 Article in ***ACS Central Sci.***, 2019, generated press and 95% in altmetric score.
2019 ***Interview*** for the magazine BioLab Business
2018 ***Interview*** for Mike FM; Montreal Times; and CJAD Radio
2018 Article in *Nat. Commun.* 2018, ***Editor's Choice***.
2017 Article in *Nat. Chem.* 2017 generated press in multiple news outlets, see McGill coverage
2016 Article in *Nat. Chem.* 2016, 98% altmetric; see media coverage
2016 Article in *Nat. Chem*., 98% altmetric; see McGill coverage
2016 Article in *Nat. Commun*., 2015, media coverage
2015 Article in *Nature Chemistry* 2015, Journal Cover, and generated media coverage
2014 Article in *J. Am. Chem. Soc.* 2014, selected as a ***JACS Research Spotlight***.
2014 Article in *Angew. Chem., 2014*, selected as '***Very Important Paper' and Journal Cover Page***
2014 Highlight of our research in Chemistry World (Royal Society for Chemistry)
2013 Article in Nature Chemistry, 2013, top 10 Altmetric Score, generated press multiple new outlets (McGill, Wired, Guardian, Canadian Chemical News, Revue Decouverte)
2013 Article in *J. Am. Chem. Soc.* 2013, nominated for the ***Faculty of 1000 Biology***
2012 Highlight of our research in Chemistry World (Royal Society for Chemistry), 'DNA Motors On', Jan. 2012
2012 TV Documentary about our DNA research on TeleQuebec (Code Chastenay, Ep. #100, Feb 7, 2012)
2011 Article on our research for Canadian Chemical News (ACCN) for the International Year of Chemistry 2011
2010 Article in Nature Chemistry, 2010, selected for ***Faculty of 1000 Biology***, and research highlights in Chemistry World, Nano Today, Quebec Science, and popular media (Rutherford radio show, Asharq Awsat newspaper).
2010 Articles (1, 2) on our research in Asharq El Awsat
2010 Editor's Choice in Science Magazine, "Stringing DNA Along", 2010, 327
2009 Manuscript in Angew. Chem. 2009, ***Journal Front Cover***
2009 "News and Views" article on our work in Nature Chemistry, "Coordinating Corners", 2009, 1, 339.
2009 Editor's Choice in the journal "Nature Chemistry", "Conjugated Polymers: Template Trickery"
2009 Manuscript in Nat. Nanotech., 2009, press coverage in multiple scientific and popular media (McGill, Biofutur, NextBio, NextBigFuture, Foresight Institute, etc.)
2008 Research Highlight in "Materials Today", "Molecular Architectures Using DNA" (Nov. 2008)
2008 Research Highlight in the journal "Nature Materials", "Unnatural Life" (Feb. 2008)
2007 ***Editor's Choice in the journal Nature,*** "Gene Boxes" (Dec. 2007)
2007 Research Highlight in the journal "ACS NANO", "Inspiration and Perspiration from Biology" (Dec. 2007)
2007 Editor's Choice in "Nature Nanotechnology": "Gold Nanoparticles: DNA Builds Bridges" (Nov. 2007)

7. Invited, Keynote and Plenary Lectures (selected from ~150):

I. Universities: - ***Cambridge U***., 2023 (***Named*** *lecture*); – ***U. Alberta***, 2023 (***Named*** *lecture*); - ***U. Wisconsin-Madison***, 2023 (***Named*** *lecture*); - ***NYU***, 2022; – ***Columbia U.,*** 2022 *(**Named** lecture*); - ***U. British Columbia***, 2020; - King Abdullah U. (***KAUST***) , 2020 (*Keynote*); - ***U. Victoria***, 2019; - ***U. Chicago***, 2018; -***Eindhoven U.,*** 2018; -***Leiden U***., 2018; - ***Nijmegen U***., 2018; - ***Groningen U.,*** 2018; - ***Twente U***., 2018; -***Georgia Tech***, 2017; -**Arizona State U.**, 2017; –***Purdue U***. 2017; –***U. Vermont*** (*Keynote*) 2016; – ***MIT***, 2016 (***Named*** *lecture*); –***UC Berkeley***, 2016; - ***Northwestern*** U., IIN, 2015 (***Plenary***); - ***U. Montreal***, 2014; - Swiss Chemical Society Lecture Tour: ***U. Genève, EPFL (Lausanne), U. Neuchâtel, U. Fribourg, U. Basel***, 2013; ***U. Pennsylvania***, 2011, ***UC San Diego***, 2011; - ***Northwestern U***., 2010; - ***ETH Zurich***, 2010; - ***UC Santa Barbara***, 2010; - ***McMaster U.,*** 2010; - ***UCLA,*** 2010; - ***Yale U.,*** 2010; ***U. Colorado,*** Boulder, 2009; - ***Queens U.*** 2008; - ***Indiana U.*** 2008; - ***Cal Tech*** 2008; - ***U. Tokyo,*** 2008; - ***U. Texas,*** Austin, 2007.

II. Conferences: - Int. Symp. on Supramolecular and Macrocyclic Chem. (ISMSC), Hangzhou, China, 2024 (***Plenary***); - Supr@Paris 2024, 3rd French Supramolecular Congress, 2024 (***Plenary***); - Suprachem 2024, U. Ulm, Germany, 2024 (***Keynote***) – ISMSC, Iceland, 2023; EuChemS, Lisbon (***Plenary***), 2022; - 2nd Int. Conf. on Noncovalent Interactions (***Plenary***), 2022; - American Chemical Society Conference, Doha, Qatar, 2021 (***Keynote***); - Swiss Chemical Society Meeting (***Plenary***), 2022, Geneva; - Pacifichem, 2021 (virtual); - Sigma-Aldrich Symposium (***Keynote***, virtual), 2021; - Nature Conference: Bioinspired Materials (***Keynote***, virtual), 2021;- ISMSC, Italy, 2019; - Gordon Research Conf. in RNA Nanotechnology, USA, 2019; - Bordeaux Symposium on Foldamers (***Plenary***), 2018; - Functional DNA Nanotechnology Workshop, Italy, 2018; - Canadian Society for Chemistry Meeting, 2018; - 7th Cambridge Symp. on Nucleic Acids Chemistry and Biology (UK), 2017, - Gordon Conference on "Self-Assembly & Supramolecular Chemistry", Switzerland, 2017; -Int. Symposium on Visionary Trends in Molecular Science, (***Keynote***), Tianjin, 2017; - XXII Int. Roundtable on Nucleosides, Nucleotides and Nucleic Acids ***(Plenary)***, Paris, 2016; -Int. Symp. in Supramol. Macrocyclic Chem., Seoul, 2016 (***Izatt-Christensen Award Lecture***); - Pacifichem. 2015, Hawaii; - 12th Int. Conf. on Materials Chemistry, 2015, York, UK (***Plenary***); - Oligonucleotide Therapeutics Society Conference, San Diego, USA, 2014; 7th Int. Conf. Molecular Electronics, Strasbourg, France, 2014 (***Plenary***); - Gordon Res. Conf. Bioinspired Materials, 2014, Maine, USA; - 16th Symp. on Chem. of Nucleic Acid Components, Czech Rep., 2014; - 19th Int. Conf. on DNA Computing and Molecular Programming, 2013; -National Organic Symposium, Seattle, 2013 (***Keynote***); - 1st Herrenhauser Conference, 2012, Hanover, Germany (***Keynote***); - ISMSC, New Zealand, 2012 (***Keynote***) - 46th EUCHEM Burgenstock Conference, 2011, Switzerland (***Plenary***); - Tetrahedron Symp., 2008 (***Keynote***)

8. Current Research Support.

2023-2029: *Canada Excellence Research Fund*, "DNA to RNA (D2R)", $165 Million, H. Sleiman and 9 lead co-PIs, McGill U., 70 researchers.
2021-2023: *NSERC John Polanyi Award*, $250,000. (100%)
2018- 2023: *NSERC Discovery Grant*, $138,000/year, (100%) PI: H. Sleiman; Supramolecular DNA Structures.
2020- 2027: *Canada Research Chair, Tier I* (Renewal) $50,000/year PI: H. Sleiman; DNA Nanoscience (100%)
2021-2023: *NFRF New Frontiers in Research Fund – Exploration*, $100,000/year; (50%) Toward automated synthesis of DNA nanomaterials, with G. Cosa (50%)
2020-2023: Research Corp., *Cottrell SEED award*, $66,950; DNA Hydrogels Promoted by Small Molecules (100%)
2020-2023: *I+P Partnership*, $100,000; with Nplex Bio, Mono-functionalized DNA-Antibody Conjugates (100%)
2020-2023: *FRQNT Team Grant*, $60,000/year, (33%), PI: D. Perepichka; co-PIs: H. Sleiman, G. Cosa;
2019- 2025 *NSERC CREATE,* $1,650,000 *PI and Director:* H. Sleiman (9%), Programmed Molecules for Therapeutics, Sensing and Diagnostics (PROMOTE)
2017- 2023, *FRQNT Materials Centre*, $412,500/year, PI: L. Reven, co-PI: H. Sleiman (3%)
2019- 2023, *FRQS Structural Biology Centre*, $600,000/year, PI: M. Schmeing, co-PI: H. Sleiman (3.5%)
2017-2023: *Horizon 2020*: Marie Skłodowska-Curie Actions (MSCA) PI: L. De Cola (U. Strasbourg); co-PIs: H. Sleiman; U. Strasbourg, McGill U., U. Rome, U. Parma, UCLA, U. Havana.
2023: *CFI JELF Nucleic Acids Infrastructure,* Sleiman, $595,483, 100% (equipment grant)
2023: CFI Innovation Fund, Sleiman (PI), $ 9,824,380, 10% (equipment grant)
2022: *NSERC Research Tools and Instrument Grant,* 2022, Sleiman, $112,000, 100% (equipment grant)

9. Supervision of Research Students and Postdoctoral Fellows.

Our graduate students and post-doctoral fellows have been recognized for the quality and impact of their research by major national and international awards, including NSERC, Banting, Vanier, IUPAC, MSED and FRQNT Prizes, Governor General Gold Medal, Swiss Chemical Society, and numerous best papers / best conference presentation awards. Our graduates are welcomed as postdoctoral fellows in many prestigious labs (Harvard, Northwestern, Stanford, MIT, ETH, Caltech), many have themselves become professors in excellent universities, e.g., U. Toronto, McMaster U., UBC, U. College London, U. Hong Kong, Texas A&M, Max Planck, UNSW or work at excellent companies, e.g., Moderna, Xerox, IntelGenX, Grifols, Atalanta, Pharmascience, SixFold, GE, Goodyear, L'Oreal, Cascades, Nova.

1. F. Zhao, M. Frandsen, S. Capodaglio, H. Sleiman, DNA-Mediated Peptide Assembly into Mini-Proteins, ***J. Am. Chem. Soc.*** 2024, in press; DOI: 10.1021/jacs.3c08984
2. F. Rizzuto, C. Platnich, X. Luo, M. Dore, C. Lachance-Brais, G. Cosa, H. Sleiman, A dissipative pathway for the structural evolution of DNA fibers, ***Nature Chem.***, 2021, 13, 843–849. ("News and Views" highlight in Nature Chemistry, Dissipative DNA Fibres, and other science media, Lighting the way to improved materials).
3. N. Seeman, H. Sleiman, "DNA Nanotechnology", ***Nature Rev. Mat.*** 2017, 17068.
4. K. E. Bujold, J. C. C. Hsu and H. F. Sleiman; Optimized DNA "Nanosuitcases" for Encapsulation and Conditional Release of siRNA***, J. Am. Chem. Soc.*** 2016, 138, 14030–14038.
5. N. Avakyan, A. A. Greschner, F. Aldaye, C. J. Serpell, A. Petitjean, H. F. Sleiman, 'Reprogramming the assembly of unmodified DNA with a small molecule', ***Nature Chem.***, 2016, 8, 368-376; Highlighted in several science media (Chemical in the pool coaxes DNA to form triple helix)
6. T. Edwardson, H. F. Sleiman, 'Transfer of molecular recognition information from DNA nanostructures to gold nanoparticles', ***Nature Chem.*** 2016, 8, 162-170. Top 2% in altmetric score. Highlighted in several science media (A 'printing press' for nanoparticles).
7. T. Edwardson, C. McLaughlin, K. Carneiro, C. Serpell, H. F. Sleiman, "Site-specific positioning of dendritic alkyl chains on DNA cages enables their geometry-dependent self-assembly" ***Nature Chem.*** 2013*, 5, 868 – 875;* highlighted in McGill, Wired, Guardian, Canadian Chemical News ACCN, and several other media; Nature Chem—top 10 papers in 2013 in altmetric score. Currently top 2% in altmetric score. (Nanostructures made of DNA strands can encapsulate, release small-molecule drugs).
8. P. K. Lo, P. Karam, F. Aldaye, G. Hamblin, G. Cosa, H. F. Sleiman, "Loading and Selective Release of Cargo in DNA Nanotubes with Longitudinal Variation", ***Nature Chem.*** 2010*, 2,* 319-328. (Faculty of 1000 Biology, highlights in Chemistry World (All aboard the DNA Nanotube), Nano Today, Quebec Science, and popular media (Rutherford radio show, Asharq Awsat newspaper and various web science media).
9. H. Yang, C. McLaughlin, G. Hamblin, F. Aldaye, A. Rys, I. Rouiller, H. F. Sleiman; "Metal-Nucleic Acid Cages", ***Nature Chem.*** 2009, 1, 390 ("News and Views" highlight in Nature Chemistry); (Coordinating Corners).
10. F. A. Aldaye, A. Palmer, H. F. Sleiman; Assembling Materials with DNA as the Guide, ***Science,*** 2008, *321*, 1795-1799.

RESEARCH PUBLICATIONS

Journal Publications.

1. F. Zhao, M. Frandsen, S. Capodaglio, H. Sleiman, “DNA-Mediated Peptide Assembly into Mini-Proteins”, ***J. Am. Chem. Soc.*** 2024, in press. (Impact Factor IF=16.4)
2. C. Lachance-Brais, C. Yao, A. Reyes-Valenzuela, J. Asohan, E. Guettler, H. Sleiman, Exceptional Nuclease Resistance Induced in DNA and RNA Through the Addition of Small Molecule Nucleobase Mimics, ***J. Am. Chem. Soc***. 2024, in press. (IF=16.4)
3. H. H. Fakih, Q. Tang, D. Echeverria, D. A. Cooper, A. Lacroix, A. Khvorova and H. F. Sleiman, Dendritic Amphiphilic siRNA: Selective Albumin Binding, *In Vivo* Efficacy and Low Toxicity, ***Mol. Ther. – Nucl. Acids***, 2024, in press. (IF= 10.2)
4. J. Asohan, H. H. Fakih, J. G. Mungia-Lopez, J. M. Kinsella, H. F. Sleiman, Control of the Assembly and Disassembly of Spherical Nucleic Acids is Critical for Enhanced Gene Silencing, ***ACS Nano***, 2024, in press. (IF=17.1)
5. X. Luo, D. Saliba, T. Yang, S. Gentile, K. Mori, P. Isla Garcia, T. Das, N. Bagheri, A. Porchetta, A. Guarne, G. Cosa, H. Sleiman, Minimalist Design of Wireframe DNA Nanotubes: Tunable Geometry, Size, Chirality, and Dynamics, ***Angew. Chem.***, 2023, 62, e202309869. (IF=16.8)
6. M. G. Rafique, J. M. Remington, F. Clark, V. Toader, D. F. Perepichka, J. Li, H. F. Sleiman, Two-Dimensional Supramolecular Polymerization of DNA Amphiphiles is Driven by Sequence-Dependent DNA-Chromophore Interactions, ***Angew. Chem***. 2023, 62, e202217814. (IF=16.8)
7. C. Lachance-Brais, M. Rammal, J. Asohan, A. Katolik, X. Luo, D. Saliba, A. Jonderian, M.J. Damha, M. Harrington, H.F. Sleiman, Small Molecule-Templated DNA Hydrogel with Record Stiffness Integrates and Releases DNA Nanostructures and Gene Silencing Nucleic Acids. ***Adv. Sci.*** 2023, 2205713. (IF=17.5)
8. T. M. Brown, H. H. Fakih, D. Saliba, J. Asohan, H. F. Sleiman, Stabilization of Functional DNA Structures with Mild Photochemical Methods, ***J. Am. Chem. Soc***., 2023, 145, 2142–2151 (IF=16.4)
9. P. Pichetti, S. Volpi, M. Rossetti, M. D. Dore, T. Trinh, F. Biedermann, M. Neri, A. Bertucci, A. Porchetta, R. Corradini, H. Sleiman, L. De Cola, Responsive Nucleic Acid-Based Organosilica Nanoparticles, ***J. Am. Chem. Soc****.,* 2023, 145, 22896-22902. (Impact Factor, IF=16.4); selected for Journal Cover.
10. P. Pichetti, S. Volpi, M. Sancho-Albero, M. Rossetti, M. D. Dore, T. Trinh, F. Biedermann, M. Neri, A. Bertucci, A. Porchetta, R. Corradini, H. Sleiman, L. De Cola, Supramolecular Nucleic Acid-Based Organosilica Nanoparticles Responsive to Physical and Biological Inputs, ***J. Am. Chem. Soc***., 2023, 145, 22903-22912. (IF=16.4)
11. S. Faiad, Q. Laurent, A. Prinzen, J. Asohan, D. Saliba, V. Toader, H. F. Sleiman. (2023). Impact of the Core Chemistry of Self-Assembled Spherical Nucleic Acids on their In Vitro Fate. ***Angew. Chem. Int. Ed.***, 2023, 62, e202315768. (IF=16.8)
12. D. de Rochambeau, M. Barlog, F. Rizzuto, Q. Laurent, X. Luo, K. Lau, H. Bazzi, H. Sleiman, A single monomer difference can impact the nanostructure output of precision oligo(phosphodiesters), ***Polym. Chem***. 2023, *14*, 3971 - 3977. (IF=4.6)
13. S. Kaviani, H. H. Fakih, A. Katolik, J. Asohan, M.J. Damha, H. F. Sleiman, Sequence-Controlled Spherical Nucleic Acids: Effect of Hydrophobic Monomer Structure and Sequence on Gene Silencing, Encapsulation and Cellular Uptake, **Nucl. Acids Ther,** 2023, *33*, 265-276. (IF=4.24)
14. D. Saliba, X. Luo, F. Rizzuto, H. F. Sleiman, “Programming rigidity into size-defined wireframe DNA nanotubes”, ***Nanoscale*** (invited), 2023, *15*, 5403-5413 (IF=8.3)

15. F. Rizzuto, M. Dore, M. G. Rafique, X. Luo, H. Sleiman. DNA Sequence and Length Dictate the Assembly of Nucleic Acid Block Copolymers, ***J. Am. Chem. Soc***., 2022, 144, 12272–12279. (IF=16.38)
16. D. Saliba, T. Trinh, C. Lachance-Brais, A. L. Prinzen, F. J. Rizzuto, D. de Rochambeau, H. F. Sleiman, Asymmetric patterning drives the folding of a tripodal DNA nanotweezer, ***Chem. Sci.*** 2022, 13, 74-80. (IF=9.97) (Featured in the 2021 Chemical Science HOT Article Collection)
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Patents and Translational Work.

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2. International (PCT) Patent Application No. PCT/CA2021/050899: DNA-ENCODED FUNCTIONALIZED APTAMERS; licensed to Galenvs, Montreal, Canada; granted US20230220381A1.
3. US Provisional Patent Application, Dendritic conjugates for the brain delivery of therapeutic oligonucleotides, in collaboration with UMass Medical School, filed by UMass, with Hassan Fakih and Hanadi Sleiman as co-inventors from McGill.
4. US Provisional Patent Application, Dendritic conjugates for the skin delivery of therapeutic oligonucleotides, in collaboration with UMass Medical School, filed by UMass, with Hassan Fakih and Hanadi Sleiman as co-inventors from McGill).
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