Jian Kim

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PROFILE

My intellectual life is organized around one principle: that the microscopic world determines outcomes at the macroscopic scale in ways that are visible and engineerable. Attracted to that principle, I've dived deep into chemistry, experimenting and exploring as I went. In recent days, I've developed an interest in nanocellulose after proposing about it at the internship experience I had at Hansol Paper Co., Ltd. Extending on that interest, I've conducting research regarding both the microscopic and macroscopic properties of CNC (cellulose nanocrystal) through the Pioneer Research Program and an independently organized research with the help of the Condensed Matter Spectroscopy Lab of Ewha Womans University. Outside the lab, I lead a student social enterprise (Jinjigwan) and teach chemistry to gifted children, because I genuinely enjoy both, and enjoyment has **always** been my strongest motivation.

FORMATIVE EXPERIENCES

Private Research Laboratory, Seoul, Korea 2015 - Present

Grade: 1-12, Time: Varies, Ongoing

- First exposure to experimental chemistry at age 6 through a copper sulfate crystal viewed under a microscope – the idea of a microscopic world became the defining lens of my intellectual life
- Sustained access to research environment for 11+ years, participating in laboratory practice across chemistry and physics contexts
- The foundational origin of my academic interest, that small differences in the microscopic world produce measurable and meaningful consequences at the macroscopic scale

ACADEMIC RECORDS

GPA	5.00 / 5.00	10^{th} – 11^{th} grade
SAT	RW 770, M 800, Total 1570	March 2026
	AP Physics 1 – **5**	11^{th} grade
	AP Physics C: Mechanics – **4**	11^{th} grade
	AP Calculus BC – **5**	11^{th} grade
	AP Calculus AB Subscore - **5**	11^{th} grade
	AP Microeconomics – **5**	11^{th} grade
AP	AP Chemistry – **5**	12^{th} grade
	AP Physics C: Electricity and Magnetism – **5**	12^{th} grade
	AP Biology – **5**	12^{th} grade
	AP Statistics – **5**	12^{th} grade
	AP English Language and Composition – **5**	12^{th} grade
	AP Macroeconomics – **5**	12^{th} grade
AMC 12A	132.0 / 150.0	11^{th} grade
AMC 12B	127.5 / 150.0	11^{th} grade

RESEARCH

Limits of Single-Molecule DFT for Cellulose Iβ Vibrational Spectra

Grade: 11-12, Time: 10 hours/week, 15 weeks

- Pioneer Academics – affiliated with Oberlin College, provides individual mentorship sessions with US research professor (Dr. Frank Peiris of Kenyon College, Material Science/Physics)
- Investigated how far a single-molecule quantum chemical model can reproduce the vibrational spectra of a hydrogen-bonded crystalline solid
- Computed IR and Raman spectra of cellobiose at the B3LYP-D3(BJ)/def2-SVP level in ORCA 6.1.1 under gas-phase and CPCM implicit aqueous conditions, obtaining 129 normal modes
- Digitized published experimental IR and Raman spectra, applied Lorentzian broadening and a 0.970 harmonic scaling factor through a custom Python/matplotlib pipeline, and generated normalized comparison and difference spectra
- Identified the precise boundary of the method: single-molecule DFT reproduces the covalent framework of cellulose and fails wherever frequencies are influenced by interactions between chains, motivating periodic DFT and explicit solvent models as the natural extensions

Independent Research, Ewha Womans University Condensed Matter Spectroscopy Lab – CNC Films

Grade: 12, Time: 40 hours/week, 4 weeks

- Planned experimental study of how pH and temperature influence the structural color of self-assembled cellulose nanocrystal films, measuring reflectance spectra across different suspension conditions
- Stems from the Pioneer Academics research project where a hands-on experiment was unrealistic; having established where a single-molecule model breaks down, the aim is to work at a crystalline scale where chiral nematic ordering determines optical behavior
- Builds directly on prior spectroscopy training at the same lab, applying apparatus setup, calibration, and Origin Pro data processing to a self-directed research question
- Manuscript currently being evaluated by JEI (Journal of Emerging Investigators)

창의적 문제해결 – Computational and Experimental Evaluation of Active Ingredients for a Minimal-Step Toner Pad in Stress-Exposed Adolescent Male Skin

Grade: 11-12, Time: 4 hours/week, 30 weeks/year

- Co-authored with Minjoo Kang; Instructor: Gyuhyeon Lee
- Surveyed male HAFS students (n = 214) and found that only 6.1% had any skincare routine, identifying a population whose combination of pubertal sebum overproduction and chronic academic stress was unaddressed by existing multi-step products
- Designed a two-phase study consisting of in silico QSAR screening of four candidate actives and a pilot trial of the top-ranked compound(niacinamide)
- Discovered in pilot experiment that mean facial oil coverage decreased (27.7% → 21.3%)

Think Tank Ultimatum – A Comparative Analysis of Structure and Mechanism in Psychoactive Agents

Grade: 11, Time: 4 hours/week, 30 weeks/year

- Independently built a Structure-Activity Relationship Matrix mapping how incremental molecular changes across psychoactive compound groups produce distinct neurological effects, organizing chemical scaffolds, receptor binding patterns, and mechanisms into a single visual reference
- Integrated color-coding into the SAR Matrix to make cross-system relationships visually interpretable
- Co-developed a neurological action map describing how psychoactive compounds interact with neurotransmitters and brain pathways
- Advanced to finalist, shared findings in a TED-style public presentation, and received first place recognition among competing research teams

PROGRAMS

Stanford University Mathematics Camp (SUMaC)

Grade: 12, Time: 25 hours/week, 3 weeks
Stanford University Pre-Collegiate Studies

- Online Program 1 (Abstract Algebra and Number Theory); Professor: Dr. Sehun Jeong
- Completed an intensive curriculum in abstract algebra and number theory, working through group theory, modular arithmetic, and the structural foundations underlying modern cryptographic systems in daily lectures
- Participated in daily collaborative problem-solving sessions, developing proofs and algebraic arguments in small-group discussion
- Pursued lattice-based cryptography as an independent research interest, studying how the hardness of lattice problems provides a foundation for post-quantum cryptographic security
- Presented findings on lattice-based cryptography to program participants and instructors at the conclusion of the program

WORK EXPERIENCE (INTERNSHIPS)

Hansol Paper Co., Ltd., *Research & Strategy Intern*, On site January 2025

Grade: 10, Time: 40 hours/week, 3 weeks

- Internship opportunity given through first-place finish of Wharton Korea BBB (Business Black Box)
- Conducted strategic research and presented innovative business expansion proposals, recommending specialty paper applications for medical waste containers and commercialization strategies for nanocellulose, a byproduct of the pulping and papermaking process
- Applications of nanocellulose included drug delivery systems and vascular stents (structures that help expand veins) – received feedback that the safety of nanocellulose inside the human body had not been sufficiently tested, suggesting a redirection toward applications where biocompatibility was not a limiting constraint
- Foundational motivation for pursuing independent research on nanocellulose, connecting to a broader interest in materials science and the engineering of material properties for targeted applications

Ewha Womans University, Condensed Matter Spectroscopy Lab, *Lab Intern*, On site July – August 2025, 2026

Grade: 11, Time: 30 hours/week, 4 weeks
Grade: 12, Time: 30 hours/week, 3 weeks

- Participated in daily individual sessions with Professor Seokhyun Yoon, covering theoretical foundations of Raman spectroscopy, Fourier transforms, and field theory – building a conceptual understanding of spectroscopic analysis
- Gained hands-on laboratory experience in spectroscopic techniques, including setting up the apparatus, calibrating and adjusting lasers, and participating in active lab experiments – developed proficiency in experimental data processing and analysis using Origin Pro
- Contributed to the development of a custom Raman spectroscopy microscope, helping with English translation and hardware assembly
- Gained deep interest in interactions between light and matter, specifically on how directing light onto materials can yield significant, quantifiable information about their physical and chemical properties
- Returned in 2026 with a self-directed research question, using the lab's spectroscopic facilities and Professor Yoon's guidance to design an experimental study of pH- and temperature-dependent structural color in CNC films (see RESEARCH)

LABORATORY SKILLS & TECHNICAL PROFICIENCIES

WET LABORATORY SKILLS

- Proficient in standard wet laboratory safety protocols and practices, including appropriate handling, preparation, and disposal of hazardous materials across a range of reaction types: acids and bases, redox reactions, and exothermic reactions
- Experienced in core wet laboratory techniques including solution preparation, concentration adjustment, titration, and experimental setup, gained through participation in laboratory practice across chemistry and physics
- Capable of working independently in a wet laboratory environment, with an understanding of safety precautions also gained through 11+ years of wet laboratory access
- Wet laboratory experience serves as the practical backbone of current and planned experimental research, including preparation of CNC suspensions at varying pH and ionic strength for photonic film characterization (**창의적 문제해결**)

ANALYSIS SKILLS

- Proficient in Origin Pro for spectroscopic data analysis including peak identification, variable selection, graph construction, comparative analysis against reference spectra, and Raman shift calculation (developed through active participation in condensed matter spectroscopy research at Ewha Womans University)
- Experienced in Microsoft Excel for quantitative data organization, statistical analysis, and regression modeling including lines of best fit

TECHNICAL PROFICIENCIES

- Highly proficient in Microsoft PowerPoint as a primary presentation tool
- Experience in creating scientific visual aids for chemistry and biology contexts through leading numerous interdisciplinary forums as President of both the Integrated Chemistry Research Club (Demacia) and Biotechnology Club (Revivi), with cross-school audiences and topics ranging from advanced materials to optogenetics

INSTITUTIONAL HONORS

HAFS Think Tank Ultimatum (Research Competition)	Grand Prize, A Comparative Analysis of Structure and Mechanism in Psychoactive Agents	11th grade
Academic Excellence Award	Debate and Current Affairs, English Prose	10th grade, first semester
	Integrated Natural Sciences, English Prose	10th grade, second semester
	AP English Language and Composition	11th grade
	AP Environmental Science, AP English Literature and Composition	12th grade
HAFS Academic Contest	Gold Prize, Mathematics	12th grade
Booth Competition (School Festival)	Best Booth Award in HAFS 20th Anniversary Night of Passion	11th grade
	Best Booth Award in HAFS 21th Anniversary Night of Passion	12th grade
Award of Excellence for Exemplary Behavior in Dormitory		10th grade

EXTERNAL HONORS

STEM FIELDS

AIME Qualifier + Dual Certificate of Distinction (AMC 12A, AMC 12B)

Grade: 11

- AMC 12A: 132.0 / 150.0, AMC 12B: 127.5 / 150.0
- Certificate of Distinction: Top 5% internationally

Second Place (South Korea), Honorable Mention (International), Purple Comet! Math Meet 2025

Grade: 10, Time: 2 hours/week, 8 weeks

- Scored 26 / 30
- Second place of high school mixed teams (out of 5 teams)
  Third place of all Korean high school teams (out of 34 teams)
  Fourth place of all teams (honorable mention)

Third Place, Humans In Space (HIS) Youth 2025

Grade: 11, Time: 5 hours/week, 16 weeks

- Achieved third place among 11 finalists selected from 700+ competing teams in national aerospace research competition
- Led literature review and biomimetic analysis of radiation-resistant organisms (including Deinococcus radiodurans and Halobacterium salinarum), identifying carotenoid pigments as a common survival mechanism and characterizing their antioxidant action against radiation-induced reactive oxygen species (ROS)

- Proposed three biomimetic strategies for astronaut radiation protection: embedding carotenoids into spacesuit materials as a protective layer, incorporating them into astronauts' daily diets as supplements, and delivering them directly to vulnerable organs through microencapsulated carriers
- Research directly embodies a core scientific interest in how microscopic biological mechanisms can be extracted and engineered into macroscopic protective technologies for human use

Honorable Mention, KYPT (Korea Young Physicists' Tournament) 2026

Grade: 11, Time: 20 hours/week, 12 weeks

- Investigated Problem #4 (Oil Flow) as a reporter, analyzing the outward flow of cooking oil on a heated metal surface through the lens of thermocapillary flow and the Marangoni effect, hypothesizing that surface tension gradients driven by temperature differences create shear stress that propels oil outward and forms a dry spot at the heat source
- Conducted qualitative analysis of three parameters (heat intensity, oil viscosity, and oil volume), derived theoretical predictions for each, and designed and executed 54 controlled experiments using an infrared thermal camera, gas burner, and frying pan
- Processed and analyzed thermal imaging data to quantify dry spot formation time and size across all conditions, confirming all three theoretical predictions
- Developed an interest in Problem #11 (Sweet Monochromator) through teammate's investigation, recognizing that chirality (the structural property that enables sugar solutions to rotate polarized light) is also what gives cellulose nanocrystals their photonic properties, directly inspiring the Pioneer Research project on CNC photonic films

BUSINESS / ECONOMICS

Second Place, SAGE Korea 2026

Grade: 12, Time: 8 hours/week, 12 weeks

- Presented Jinjigwan's self-sustaining social enterprise model: funding disability inclusion through campus dessert sales
- Pitched a business prospectus covering revenue structure, donation pipeline, and partnerships with disability employment bakeries; placed 2nd nationally
- Competed nationally with a student enterprise generating ₩4M+ in revenue and a ₩500,000 monthly donation commitment to Save the Children under a formal MOU

First Place, Wharton Korea Business Black Box 2024

Grade: 10, Time: 8 hours/week, 5 weeks

- Achieved first place in a business strategy competition organized by Wharton School, forming a comprehensive ESG-focused proposal for Starbucks Korea addressing greenwashing accusations
- Proposed a personalized tumbler customization service allowing consumers to design and print custom tumblers in-store via heat press, doubling as a Starbucks membership card to create a daily-use incentive and reduce disposal rates
- Designed the "Eco Tree" loyalty system, an addition to the original star system that tracks and displays each consumer's cumulative environmental contribution, replacing passive eco-stamps with tiered membership rewards to drive sustained engagement

- Recommended adoption of biodegradable, recyclable cups developed using multi-ceramic catalyst liquefaction technology, achieving a Carbon Reduction Efficiency of 43.5%: an 11-percentage point improvement over Starbucks Korea's previous reusable cup initiative in Jeju
- Supported all proposals with quantitative cost-benefit analysis
- Awarded Starbucks Discovery Program and internship opportunity at Hansol Paper Co., Ltd.

Bronze Award, Korea Economic Daily National Youth Economics Competition 2024

Grade: 10, Time: 10 hours/week, 8 weeks

- Proposed "Agrit," a sharing economy platform connecting farmers with local agricultural cooperatives to provide cost-effective access to advanced farming equipment and machinery

Finalist, Social Hackathon 2025 (Changemakers Korea)

Grade: 11, Time: 10 hours/week, 8 weeks

- Conceptualized and developed MediBuddi, an AI-powered medication management app addressing elderly polypharmacy and improper drug disposal through AI pill identification, visual scheduling, gamified disposal education, and a caregiver Family Sync feature
- Designed a three-stream business model (targeted medical advertisements, point margin revenue, and premium family subscriptions) with a projected SOM of $25.64M

SCHOOL CLUBS (LEADERSHIP)

President, Integrated Chemistry Research Club (Demacia)

Grade: 10-12, Time: 4 hours/week,20 weeks/year

- Coordinated and led interdisciplinary forum series connecting chemistry with other scientific fields, organizing collaborative presentations with diverse clubs including medical and astrophysics clubs
- Facilitated cross-disciplinary research discussions on topics including regenerative medicine, epigenetics, and advanced materials applications in aerospace technology
- Managed internal research initiatives, mentoring club members through experimental design, literature review, and discussions regarding member-selected chemistry research areas

President, Biotechnology Club (Revivi)

Grade: 10-12, Time: 4 hours/week, 20 weeks/year

- Organized biotechnology forums bringing together student clubs from 5+ schools to explore interdisciplinary topics, including optogenetics, biomedical applications, and speculative biology
- Facilitated collaborative research presentations examining biological feasibility of mythological creatures and emerging biotechnology fields across partner schools

Head Chef (President), Cooking Club (Jinjigwan)

Grade: 11-12, Time: 8 hours/week, 20 weeks/year

- Founded and led Jinjigwan as a student social enterprise, overseeing all of culinary production, business operations, team management, and charitable partnerships across the club's activity
- Generated $1,000+ in revenue within 3 hours at the school festival (Night of Passion) through production and sale of 300+ baked goods and beverages, getting awarded best booth of the year

- Organized and executed a Christmas fundraiser featuring 400+ specialty holiday cookies, raising $1,500+ in 2 hours; followed by an International Tiramisu Day event selling 500+ tiramisu cups and raising $2,000+
- Negotiated and signed a formal MOU with Save the Children Korea, establishing a monthly donation commitment of $400 for one year to fund the right-to-play program for children with disabilities, inspired by the story of French Papa, a chef from Netflix's Culinary Class Wars who has a disabled son, and the belief that food can be a vehicle for meaningful social impact
- Selected as a finalist by SAGE Korea to represent the country at the International SAGE Competition in Hanoi, Vietnam (August 2025), recognizing Jinjigwan's model as a replicable student social enterprise

VOLUNTEER & COMMUNITY

Chemistry Education Volunteer, HUFS (Hankuk University of Foreign Studies) Gifted Education Center

Grade: 11-12, Time: 2 hours/week, 8 weeks/year

- Independently designed and delivered a self-developed science curriculum for gifted children aged 10–12, teaching once every two weeks in two-hour sessions on an ongoing basis
- Created a space-themed chemistry unit exploring what chemical compounds extraterrestrial life would need to survive, using the alien theme to introduce Le Chatelier's Principle and Boyle's and Charles' Laws, exploring the behavior of gas in the extreme conditions of space
- Focused on making microscopic and molecular phenomena tangible and genuinely exciting for young learners, reflecting my conviction that chemistry education should connect the invisible world of molecules to phenomena students can actually see and wonder about

Mathematics Education Volunteer, HUFS (Hankuk University of Foreign Studies) Gifted Education Center Summer Camp

Grade: 12, Time: 60 hours/week, 1 week

- Designed and taught a four-session cryptography course for gifted 4th to 6th graders, building from classical ciphers to lattice-based cryptography, a foundation of post-quantum encryption
- Reworked lattice-based cryptography into intuitive, visual explanations that elementary students could follow without university-level math
- Adjusted lesson density to the class's pace after finding students grasped concepts quickly, replacing physical demonstrations with more substantive content
- Created 2-hour long cipher-decoding race including rules such as purchasable hint cards and team versus team matches

Science Education Volunteer, Pureun School

Grade: 10-11, Time: 4 hours/week, 2 weeks/year

- Led interactive STEM workshops for elementary students, teaching physics and engineering concepts through hands-on experiments, model building, and educational games
- Experiments included elephant toothpaste, assembling a gyroscope, and crafting a simple electric motor

English Tutor, Mohyeon Library (LAMP)

Grade: 10-12, Time: 3 hours/week, 8 weeks/year

- Led pro bono English instruction sessions for Korean elementary students, designing a film-based curriculum using popular animated movies (Moana, Hotel Transylvania, Aladdin, etc.) as the basis for vocabulary learning, sentence practice, and interactive games

Youth Volunteer Program, Yangjae Stream Environmental Conservation

Grade: 9, Time: 4 hours/week, 4 weeks

- Participated in invasive species removal project, extracting Japanese hops from riverbanks to protect native ecosystems and restore environmental balance along Yangjae Stream