

Markuss Gustavs Kenins

Curriculum Vitae (Version May 7, 2024)

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EDUCATION

- University of Groningen** Groningen, The Netherlands
• BACHELOR OF SCIENCE – PHYSICS, MATHEMATICS. HONOURS COLLEGE. Sep. 2022 – Jun. 2026
Results: On track for Summa Cum Laude. Currently achieved 171 ECTS.
Courses:
- Riga State Gymnasium No. 1** Riga, Latvia
• GENERAL UPPER-SECONDARY EDUCATION Sep. 2019 – May 2022
Results: Outstanding results (10/10) in all STEM subjects, very good (8/10) in most others.
Courses: Mathematics (advanced level), calculus, physics, chemistry, biology, English, history, Latvian, economics.
- Ikšķile Secondary School** Ikšķile, Latvia
• GENERAL PRIMARY AND LOWER-SECONDARY EDUCATION Sep. 2010 – May 2019
Courses: Mathematics, physics, chemistry, biology, Latvian, English, history, art, IT.

PROJECTS

- Fast conformational dynamics of sugar molecules:**
My Honours College research project is on developing the theory of 2 dimensional infrared spectroscopy for chemically labeled sugar molecules—to examine the lifetimes of the dynamics of chair switching as well as vibrations and rotations. This work is conducted under the direct supervision of Prof. Thomas L.C. Jansen (page). The work consists of a high-precision molecular dynamics simulation of the sugar system using **Gromacs**, computing the vibrational Hamiltonian with **AIM**, and then computing the spectrum using **NISE**, and then writing Python scripts for data analysis and automation of tasks. The project involves writing scripts from scratch in order to take slices of spectra, compute difference spectra, integrate, find peaks and slopes of the peaks. Overall this allows obtaining novel results regarding conformational dynamics not previously reported in literature, and as such the results are being compiled for publishing soon. (Nov. 2023 – ongoing)
- Evaluation of Methods of Enzyme Structure Preparation in Computational Enzyme Engineering:**
This internship-based project was done in the computational enzyme engineering group at the University of Groningen led by Asst.Prof. Maximilian J.L.J. Fürst (page) under the supervision of the PhD student Kerlen T. Korbeld, MSc (page). In the protocol for finding stabilising mutations (**FRESCO**) on a protein structure Protein Data Bank (pdb) file hydrogens are added, double-occupied amino acids deleted, and in unoccupied sites the correct amino acid added, among other steps. This protocol is by default done on the licensed software **Yasara**; in this project the protocol was rewritten to work on the open-source software **Gromacs** and compared the difference in the output, determining the applicability of Gromacs. (Apr. 2023 – Oct. 2023)
- Biotin Consumption in Baker's Yeast *Saccharomyces Cerevisiae* Strains Auxotrophic for Biotin:**
Student Scientific Research Work (ZPD) project carried out in the lab of Dr.biol. Janis Liepins (page). The metabolism and growth kinetics of several yeast strains was studied upon starvation of an essential nutrient biotin; the project involved extensive wet labs in microbiology, precision data gathering, and large data set statistical analysis. Numerical methods and equations had to be developed and derived, respectively, by myself. The project earned an outstanding evaluation (117/120 points, gold) at the Riga student scientific work conference, and similarly in the national stage (silver); the project was selected for participation at the Regeneron International Science and Engineering Fair (**ISEF**) in Atlanta, Georgia, USA. (Aug. 2020 – Jan. 2022)
- A Novel Proposal for Inducing Controllable Magnetotactic Movement in the Ciliate *T. Thermophila*:**
As part of the 33rd International Biology Olympiad (2022) International Group Project (page), a research proposal was developed and presented at the Olympiad (poster). In a team of 4 people we investigated the state of the field on magnetoreceptors and genetic engineering, to be able to insert the relevant genes into a ciliate, and afterwards developed tests to determine whether each step of the experimentation was successful; while developing it, we utilised bioinformatics techniques to investigate the DNA sequences. (Jun. 2022 – Jul. 2022)

SKILLS AND ABILITIES

- Python:** Very skilled in Python, especially using Numpy, Pandas, Scipy, Matplotlib, Pygame. (GitHub)
- c:** Basic ability to code in c.
- Gromacs, Yasara:** Ability to run molecular dynamics simulations and work with structures. Ability to parameterise and use solvents other than water.
- FoldX, Rosetta:** Ability to run free energy calculations from folding.
- Quantum mechanics:** Understanding and abilities to perform non-relativistic calculations on simple and complicated systems, use of perturbation theories; all chap. of Griffiths.
- NMR predictions:** Experience from predicting 1H spectra up to 3–4 atoms ($J = 0, A, AX, AB$); Günther Ch.6.
- Lab skills:** Ability to conduct precision experiments in physics, synthesis of compounds and NMR, IR analysis in chemistry, and work with cell cultures and biotechnology in biology.
- Mathematical ability:** Single and multivariable calculus, real analysis, axiomatic linear algebra, Fourier analysis and transforms, solving various ODEs and PDEs with ordinary methods and power series, qualitative analysis—root existence theorems. Naive set theory and modular arithmetic.
- Spectroscopy:** Ability to interpret basic NMR, IR, UV/Vis, and mass spectra and assign peaks to molecular structure. Understands term symbols, including their application to electronic spectra of *d*-metal complexes.
- Electrodynamics:** Ability to solve electrostatics and magnetostatics problems of various configurations of conductors and insulators. Ability to solve electrodynamics problems in the quasistatic and relativistic regime; Griffiths full book.
- English C2:** IELTS score 8.5, corresponding to a C2 proficiency.

OTHER EXPERIENCE

- **Task Maker for the Latvian State Biology Olympiad:**

Since September 2022 (the year after I last competed) I have prolifically written problems for the Regional and National stages as well as the final selection for the International Biology Olympiad of the State Biology Olympiad in Latvia. The problems I have written for the 45-th Olympiad were on elucidating protein structure by mutagenesis, the biophysics of a bacterium coasting (swimming) in aqueous solution, and the Ramachandran-plot analysis of the structure of the zinc-finger motif. The problems for the 46-th Olympiad were on the mechanism of photosynthesis in plants, the biophysics of the movement of motor proteins on microtubules and the resulting biological consequences, as well as Mendelian genetics. (Sep. 2022 – ongoing)

- **Organisation of the Biology Teams Olympiad in Latvia:**

During the 33rd International Biology Olympiad us—the Latvian team of 4—decided to host a Teams Biology Olympiad in Latvia of which we were the sole organisers. From my part it was making problems; I was the most prolific task maker for this Olympiad, writing lengthy and detailed problems on deciphering biochemical reactions, species from a description, the statistical analysis of sea life distribution, the water potential in roots and shoots, as well as a lab on the dissection of a chicken heart. This Olympiad has been successfully continued by bringing additional organisers. My role is that of the Lead Editor, where I have to make sure the problems are compiled in an attractive and professionally typeset manner; moreover, to check that the problems have been tested and meet quality criteria. For the 2nd Olympiad I wrote a lengthy problem on Mendelian and post-Mendelian genetics, which was evaluated to be the most successful problem (highest correlation between points in the problem and total points of the team). In addition, I once again wrote a fun problem on deciphering species. (Aug. 2022 – ongoing)

- **Website development for the Biology Teams Olympiad:**

I am currently developing the website for the Biology Teams Olympiad, which is hosted on GitHub Pages. The website is still under development and has not yet entered the Beta version stage. (Apr. 2024 – ongoing)

- **Development of a Chess engine:**

I wrote a chess engine completely from scratch in Python. It is available on my GitHub ([here](#)). (Apr. 2024)

HONORS AND AWARDS

- **Riga City Council Golden Fund Stipend:**

(2023)

Awarded to the 20 most outstanding graduates from secondary schools and gymnasiums throughout all of Riga. The award is mostly based on performance in academic competitions and Olympiads, however in the determination other criteria, such as the results at school and centralised examinations, as well as medals in sport, involvement with the community and event organisation. I was awarded the Diploma and a stipend of €1200. Out of the 20 awardees, a total of 11 graduated Riga State Gymnasium No. 1 alongside myself.

- **Latvian Cabinet of Ministers Prize 2023:**

(2023)

This the most prestigious of all academic prizes in Latvia is awarded only to the medal winners of international Olympiads in mathematics and the natural sciences alongside their mentors, with a total of under 20 students awarded. Recipients of this prize are deemed the most outstanding among their peers in Latvia, for both students and teachers alike. I was awarded the prize of 2023 for my bronze-medal-winning performance at the 33rd International Biology Olympiad.

- **Latvian Cabinet of Ministers Prize 2022:**

(2022)

I was awarded the prize of 2022 for my bronze-medal-winning performance at the 32nd International Biology Olympiad.

ACHIEVEMENTS

In Biology

- **33rd International Biology Olympiad (bronze):**

(2022)

This is the most prestigious of biology Olympiads, being the final stage of competition for participants worldwide. Only 4 students are allowed to participate per country, thus the competition to participate is fierce. The students are tested on problems, which assume university-level knowledge and test the students' ability to quickly understand the theory behind each problem, the motivation behind every experiment, and, combined with the students' own knowledge, answer most difficult questions in each problem. In addition, laboratory skills are tested; this year the experiments were on enzyme kinetics, plant anatomy and physiology, fish taxonomy, and bioinformatics. The venue of the Olympiad this year was Yerevan, Armenia. I was able to attain a score larger than the majority of the participants, and was thus awarded bronze for my performance.

- **32nd International Biology Olympiad (bronze):**

(2021)

This year the Olympiad was organised by Portugal, however it was held online. I was able to attain a score larger than the majority of the participants, and was thus awarded bronze for my performance.

- **Regeneron International Science and Engineering Fair (upper bracket employing statistics):**

(2022)

ISEF is a world-renowned and largest pre-college science competition, evaluating the students based on their science projects presented. My project was on the metabolism of biotin in baker's yeast (see above). I was awarded a special reward for being in the upper bracket (75 / 1400) of projects employing statistics by the American Statistical Association after the competition – a year-long student membership to the ASA.

- **International Group Project 2022 as part of the 33rd IBO (silver):**

(2022)

As IBO participants we had the chance to participate in writing a proposal for a research project. Our project was on introducing magnetoception (the ability to sense a magnetic field) in a ciliate (single-celled organism). Our success was in incorporating both bioinformatics techniques and AI into our proposal, as well as writing in the style of experienced researchers, for which we were awarded second place out of all projects.

- **46th Latvian Conference of Student Research (silver):** (2022)
This was the national stage for presenting student research, for which I was selected to participate in Regeneron ISEF. The projects are selected from regional conferences (myself – Riga), with a total of 244 projects selected.
- **46th Riga Conference of Student Research (gold):** (2022)
The regional stage for presenting student research projects. From the 14 projects in the biology section of the Riga conference, I scored the best result (117/120 points) and was awarded gold. Such a score is most outstanding, usually attained by less than 15 projects; this year a total of 595 projects were presented.
- **44th Latvian State Biology Olympiad (silver):** (Jan. 2022)
The highest stage of biology Olympiads in Latvia. From each grade only the 30 best students nation-wide are selected to participate. The problems feature all major fields of biology and are designed to be extremely challenging.
- **43rd Latvian State Biology Olympiad (silver):** (Jan. 2021)
- **42nd Latvian State Biology Olympiad (bronze):** (Jan. 2020)
- **44th Riga State Biology Olympiad (gold):** (Nov. 2021)
- **43rd Riga State Biology Olympiad (gold):** (Nov. 2020)
- **42nd Riga State Biology Olympiad (gold):** (Nov. 2019)
- **A. Valtners Competition “Know Your Organism” Final (merit):** (2019)
In this competition the students’ understanding of human physiology was tested. The material had to be learned at an early bachelor’s level using a book written by physician A. Valtners. Only around the best 30 students were selected to compete.
- **A. Valtners Competition “Know Your Organism” Regional Stage (silver):** (2019)
- **Latvian School of Young Biologists (winner of the season; gold, gold, silver, bronze):** (Sep. 2019 – May 2020)
This was a series of lectures with a competition each time that tested the students’ abilities on the topic of each corresponding session, with only the top 3 students awarded each time. I had the best result in the introductory and microbiology stages. At the end of the season, I had attained the highest sum score, thus I was the overall winner of the 2019/2020 season.

In Physics

- **3rd Latvian Teams Physics Olympiad (gold & best experiment):**
This is a most challenging physics Olympiad for teams of 5 students solving problems of great difficulty and beauty. One of the problems involved explaining a demonstration of coupled oscillators, whereas the experiment was about heat conduction through a clay mug. The other problems ranged from an electrical circuit in a hexagonal pattern, throwing exploding potatoes out of a cannon, a satellite orbiting Earth, a spinning rocket released into orbit, relative motion of two cars, and a mug floating in a pot of boiling water. Overall the problems were extremely challenging, however through the excellence of our team and my superb result from doing the experiment, we won Gold and received a special award for the best experiment. (2022)
- **47th Latvian Open Physics Olympiad (merit):**
This is a challenging physics Olympiad available to all secondary school students. There were a total of 10 challenging problems available [here](#). I solved the problems for the 11th–12th grades. The problems ranged from explaining optical experiments, predicting trajectories, optics, electrical circuits, and others. Overall this was a great experience solving problems that require creative solutions. (2022)
- **72nd Riga State Physics Olympiad (merit):** (2022)

In Chemistry

- **33rd International Meme Chemistry Teams Olympiad (silver):** (2022)
This was an open Olympiad, with the level of the problems adjusted to that of national chemistry Olympiads. I solved the problems of organic chemistry, scoring quite close to the maximum on the problems. The competition was quite fierce, with a large amount of points being difficult to attain in the allocated time, however our performance landed us in a comfortable silver.
- **63rd Latvian State Chemistry Olympiad (bronze):** (2022)
Similarly to national stage Olympiads in other subjects, this is the final stage of national chemistry Olympiads. Only the best 30 students in each grade are allowed to participate.
- **63rd Riga State Chemistry Olympiad (gold):** (2022)
- **62nd Riga State Chemistry Olympiad (merit):** (2021)
- **61st Riga State Chemistry Olympiad (silver):** (2020)
- **2nd Latvian Teams Chemistry Competition Chemists Garden (grand finalist):** (2021)
Similarly to the International MemeCho, this is a teams chemistry competition, testing the students’ abilities in chemistry beyond the secondary school curriculum.
- **1st Latvian Teams Chemistry Competition Chemists Garden (grand finalist):** (2020)

In Bridge Championships

- **Latvian U20 Bridge Student Championships (silver):** (2020)
- **Latvian U20 Bridge Student Championships (silver):** (2019)
- **Latvian Open Junior Bridge Championships Druvas Duzis Pairs Tournament (silver):** (2019)
- **Riga Technical University Cup: Bridge (silver):** (2019)