

# Celebrating

the undergraduate research experience



UNIVERSITY OF  
**ALBERTA**  
EDMONTON, ALBERTA, CANADA



# Undergraduate

For the first time, the offices of the Vice-President (Research) and Vice-President (Academic) have undertaken a focussed examination of exactly how the undergraduate learning experience is enhanced because it is taking place within a vibrant research community... and the results are exciting.

It is only natural that a research-intensive university such as the University of Alberta would be nurturing the next generation of researchers through the integration of undergraduate research and teaching, but the extent of this activity has not been well documented.

The University of Alberta is one of the premier research institutions in the country, with annual research revenues set to top \$400-million this year. But how do those substantial resources, along with 125 Canada Research Chairs and the more than 100 centres and institutes associated with the University, enhance the learning experience of undergraduates? That's what the Working Group on Teaching and Research, under the auspices of the Vice-President (Research), set out to understand. And what they discovered was both gratifying and inspiring.

Research is an important theme that threads its way through the undergraduate experience from the first year through to graduation (although the strength of the thread can vary by Faculty and year of study). Weaving together the threads of what is currently underway provides a powerful basis from which to build an enriched, comprehensive learning environment for undergraduates.

We are pleased to bring you this celebration of the undergraduate research experience. It is an important first step in acknowledging the creativity and vision that faculty bring to the integration of teaching and research, and the benefits it brings to undergraduate students, the University, and the larger community as a whole.

R. Gary Kachanoski,  
Vice-President (Research)

Carl Amrhein,  
Vice-President (Academic)



# research

## is bursting out all over the campus.

### ① The early years

Some students get their introduction to research at the University of Alberta while they are still in high school. For instance, Women in Scholarship, Engineering, Science and Technology (WISEST) runs a program that places Grade 11-12 girls and boys in labs across the campus to work as paid research assistants in project areas that are non-traditional for their gender. This gives them an early introduction to researchers and a taste of what being a researcher is all about.

In a recent initiative, the Faculty of Graduate Studies and Research set up the web-based annual journal *Enquiries*. The Faculty actively recruits research papers from high school students from Grade 10-12 in a variety of areas, including history, political science, health, science and sociology. It also provides Research Mentors to assist with research or manuscript preparation. Such programs play a key role in recruiting top-notch students to the University.

In their first two years at the University of Alberta, undergraduate students are exposed to research primarily through courses designed to teach them the fundamentals of how to do research, as well as through interactions with teachers and instructors (including graduate students and post-docs) who are

actively involved in their own research. While students are learning the foundational material of their chosen area of study, they are also learning the basics of research, such as how to navigate through the library system and databases, how to do experiments, and how to write reports and papers.

Teachers who weave their research experience into the courses they teach, use text books they have written, and bring colleagues into the classroom, are all adding to the quality of the undergraduate learning experience.

There are also courses that provide an immediate and powerful introduction to research as early as the first year. In an introductory psychology course (PSYCO 105), students get a taste of research by obtaining credit for volunteering as research subjects in a number of on-going studies in the Psychology Department. After the volunteer experience, students learn about experimental design, hypothesis testing and the research focus of each study.

In the Philosophy Department, first-year students are exposed to research in a somewhat different manner. The award-winning PHIL 101 "supersection" is taught by senior faculty mem-

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### Students in Professor Connie Varnhagen's psychology classes are quickly introduced to research.

"We do small research projects throughout even introductory courses, mostly within the class. Hypotheses, designs and methods come alive for students as they use research to understand the psychological principles and processes."



Dr. Varnhagen is impressed by the impact that the act of doing research has on students.

"I'm constantly thrilled by their excitement and wonder as they discover the research process and explore their own scientific questions. Experiencing the process seems to be the most exciting – even more than obtaining the results. Students learn that research is not done by boring old scientists sitting in drab labs but involves creativity and humour."



## Cindy Blois is one of those rare students to receive NSERC summer research funding in her first year in the Physics Department.

She approached Dr. Mark Freeman, the head of the Centre for Nanoscale Physics, to see if she could work for him as a summer researcher. He gladly accepted, and she spent her first summer in university conducting tests on the polymerization of microtubules. It was an experience that helped give her a sense of direction.

“Summer research allows students to try new fields and gives them a feel for what they’d like to do. My research was meaningful work, and it gave me a real sense of how research works and gave me direction in what I wanted to do.”

Cindy is now a third-year Honours physics student and, in just three short years, she has received \$28,000 in grants and awards.

“Undergraduates appreciate the opportunities for research, and it’s really great that we have these opportunities at the University of Alberta.”

bers and uses a team of Graduate Teaching Assistants, thereby ensuring that undergraduates are exposed to senior researchers in their very first philosophy class.

In the School of Business, all students are required to take BUS 201. The class has an enrolment of more than 400 students, each of whom collaborates in a small group to research and develop a business plan, publish it on the web and present it to an audience. The class routinely produces business plans, according to teacher Dr. Erhan Erkut (Vargo Teaching Chair), that entrepreneurs could happily take to the bank. And in the Department of Human Ecology, students participate in a mini-study on intimate relationships (HECOL 210) that introduces them to the research process, including topics such as ethical issues in conducting research, interpreting data and writing a research report.

But the classroom is not the only place first- and second-year undergraduates learn about research. In some faculties, field research is integral to the discipline, and that means there are opportunities for students to get their hands dirty, literally and figuratively.

There are many summer research opportunities for undergraduates at the University of Alberta, the majority funded by

the Natural Sciences and Engineering Research Council (NSERC), the Alberta Heritage Foundation for Medical Research (AHFMR), the Canadian Institutes of Health Research (CIHR) and WISEST. Although most of these opportunities go to third- and fourth-year students, it is not unknown for first- and second-year students to be awarded research funding. They just have to be unusually determined.

## ② The research explosion

By the time undergraduates are entering their third year of studies, the opportunities to be involved in research simply explode. Once students have begun to master the requisite knowledge base, they’re ready to take an active role in research. Almost every faculty has a range of senior-level courses that are specifically research-oriented, particularly in the Honours programs. Professional programs also acknowledge the specialized nature of research particular to their disciplines. The Faculty of Law, for instance, requires all its first-year students to take a course in how to do legal research (LAW 401); the Faculty of Nursing requires students to take courses in nursing research and statistics; and the Faculty of Physical Education and Recreation offers research courses focussed on physical education and kinesiology.

For some undergraduates, it is a special teacher who gets them excited about research, a teacher who has a particular appreciation for the role of undergraduate research.

Summer research plays a key role in training the next generation of researchers. The Faculty of Medicine and Dentistry, for instance, conducts one of the largest summer student research programs in Canada, with more than 130 undergraduates participating. Most of these positions are funded by the Alberta Heritage Foundation for Medical Research (AHFMR), the rest by supervisors. The Faculty holds a twice-weekly summer seminar series, with July and August reserved for summer student presentations. The Faculty of Agriculture, Forestry and Home Economics boasts more than thirty research centres, labs and field stations, most highly amenable to undergraduate research opportunities.

Individual researchers, as well as research units, employ a large number of undergraduates for the summer, ranging from limited research exposure as animal care technicians to fully research dedicated roles. Most positions are funded by NSERC, as well as the Institute for the Advancement of Science, Technology and Economics (IASTE) and WISEST. About 160 undergraduates in the Faculty of Science are funded annually by summer research grants from NSERC and AHFMR, along with support from supervisors.

## Dr. Tom Chacko knows he's training the next generation of researchers.



He holds the Vargo Teaching Chair in Earth and Atmospheric Sciences and normally works only with fourth-year students.

"The well-formulated undergraduate research experience demonstrates to students that they can make an original contribution to the field. This experience also provides students with a transition experience from exam-based tasks that are characteristic of most of their educational career to the project-based tasks of the workplace and graduate school."

## Nick Wolanski didn't plan an academic career involving chickens and turkeys, even though he carried some guilt about the "mysterious disappearance" of a pet chicken he'd once had but didn't quite know how to care for.

It was a second-year course taught by Dr. Frank Robinson that set him on that particular path.

"He's one of the main reasons I'm doing what I'm doing now. He's such an interesting professor and the way he approaches a subject is so interesting, and that kind of shaped me to want to pursue research in chickens."

A research-based course (AN SCI 471) solidified his interest in poultry and led to an internship in Ontario and a four-month research position in Holland. He's now doing a Master's degree at the University of Alberta, once again working with Dr. Robinson.



Funding for summer research is critical for undergraduates and their supervisors. To that end, the Vice-President (Research) has introduced partnerships with faculties to fund undergraduate research awards. The Faculty of Arts and the School of Native Studies have taken advantage of the opportunity and now have undergraduate research awards in place which have recently been named in honour of former Vice-President (Research) Roger Smith. The Faculty of Arts Undergraduate Student Researcher program funds about fifteen undergraduates in the Faculty to work with researchers for the summer. The most recent competition attracted about 80 proposals.

The volume of course-related and summer research being done by undergraduates is reflected in the proliferation of Research Days, poster days, colloquia and symposia across the campus. Many such forums feature presentations by researchers and graduate students, with undergraduates able to participate if they want. The Department of Earth and Atmospheric Sciences and the Faculty of Physical Education and Recreation are considering introducing research symposia designed specifically for undergraduates.

Co-op programs and industrial partnerships offer valuable research opportunities to undergraduates, as well as experience working in a business or industrial environment. The Co-op program is a flagship for the Faculty of Engineering, the second

largest such program in Canada. Most of the 1200 students who take part in the program work in industry, although many also work in research labs with faculty members. The School of Business also has a substantial co-op program, placing about 190 students in business environments each year. Some co-op situations offer significant research opportunities. The Industrial Internship Program in the Faculty of Science offers about 100 undergraduates the opportunity to work in a corporate setting, under the supervision of a faculty advisor.

### ③ Sharing the knowledge

One of the most profound aspects of the undergraduate research experience is the recognition that students can — even as undergraduates — make an original contribution to knowledge in their chosen discipline, and to the larger community. Undergraduates benefit when they are able to engage the larger community in what they're doing, whether it's the 400 students in the Music Department who present about 60 concerts annually (on-campus, in Edmonton venues, or in national and international concert tours), or the 125 posters displayed by undergraduates at the Faculty of Medicine and Dentistry's Annual Summer Research Day.

## One of the most exciting days in Lee Graham's research with Dr. Arthur Prochazka in third-year Honours Physiology came when it was time to test his work.

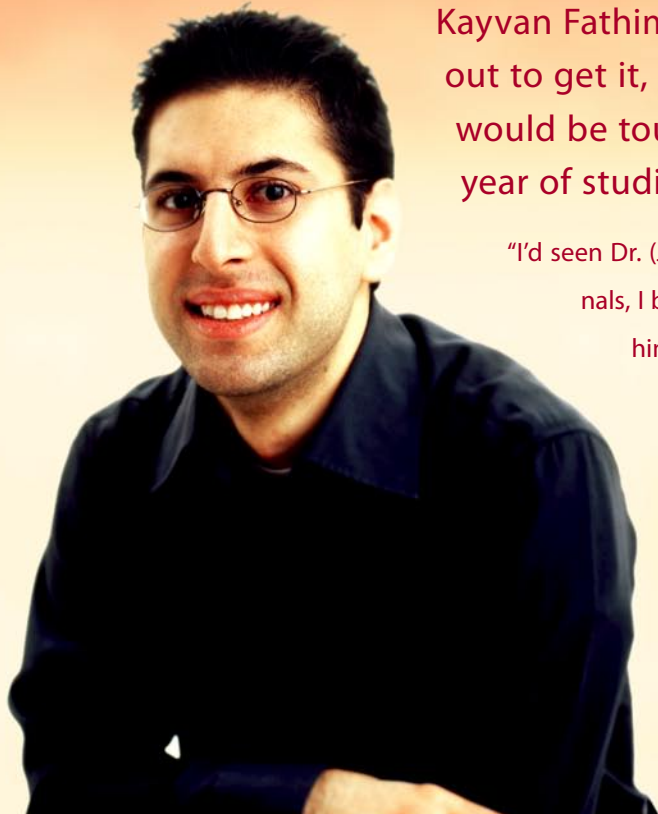
Lee's project was to look at the way people with hemiplegia (paralysis on one side of the body, often caused by a stroke) did simple tasks such as turning a door knob or faucet or unscrewing the lid on a jar. People with hemiplegia can wear a special glove that is activated by tapping it with the other hand — but that means it takes two hands for a simple task. The solution? Dr. Prochazka has been researching the use of a tooth click to create an electro-stimulation of the glove, with a receptor attached to the skull to transmit the click to the glove.

"My project was how we were going to attach this device," says Lee. "Where's the best place on the skull to attach it? What's the physiology of a tooth click?"

The team took the new glove, with the device housed in a golf visor, to the Glenrose Rehabilitation Hospital in Edmonton to share with stroke patients. At first it didn't work, but after a little tinkering, it was a great success.

"The patients were really excited about it. They were laughing and joking. They were able to cognitively understand how to use it... It's pretty remarkable seeing someone with a paralyzed arm able to do something."





Kayvan Fathimani knew what he wanted and set out to get it, even though he'd been warned that it would be tough for someone finishing his second year of studies to do research.

"I'd seen Dr. (Jonathan) Lakey on TV, and after reading a couple of journals, I became very interested in the Edmonton Protocol. I sought him out and told him I was interested in islet research."

Kayvan's persistence paid off with an AHFMR summer research award and the opportunity to work on groundbreaking research in the treatment of Type 1 diabetes.

"The clinical application, to be part of Dr. Lakey's research group and the Surgical Medical Research Institute, I still feel is incredible."

Professor Sean Caulfield believes the dynamic relationship he shares with his undergraduate classes fuels his own creativity. He holds the only Canada Research Chair in Fine Arts (Printmaking) in the country, and he regularly teaches second-year courses.



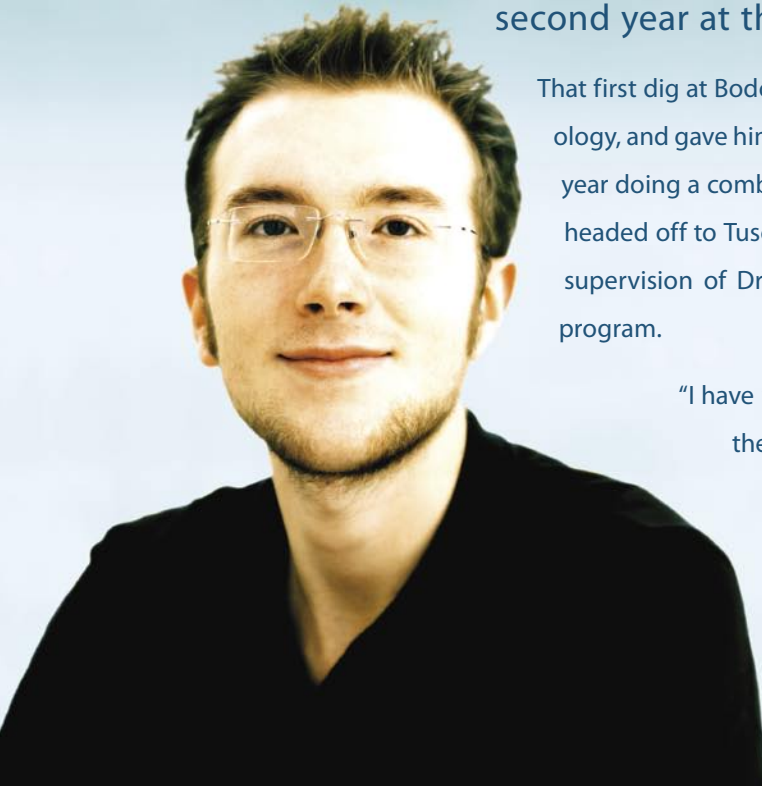
"It is my strong belief that research and teaching are really not separate activities, and by exposing students to hands-on research, a unique process of sharing and dialogue is developed. To my mind, this is vital, as it demonstrates to students the struggles, frustrations

and joys that go into the creative/research process."

And the creative process is a two-way street.

"The more engaged I am with my own studio research, the more passion, enthusiasm and insight I bring to my students. The act of teaching fundamental visual principles such as composition to beginning level students always makes me rethink my own understanding of the subject. Inevitably I take the experiences I have in the classroom and apply them to my own work in the studio."

## C. Myles Chykerda went on his first archaeological dig in his second year at the University of Alberta.



That first dig at Bodo, Alberta, helped him understand the workings of archaeology, and gave him some solid technical skills to use on other digs. In his third year doing a combined Honours degree in Classics and Anthropology, Myles headed off to Tuscany to work on the excavation of a Roman villa under the supervision of Dr. Helena Fracchia, the head of the Classical Archaeology program.

“I have really enjoyed my entire academic career,” says Myles, “but the dig (in Tuscany) was special. It was the first time I was out of the country. It was good to go out to another part of the world and see a different culture first hand. It’s well worth providing opportunities like digs as they make for well-rounded people. Well-rounded students are an asset for both the school and the province of Alberta.”

Many faculties regularly take part in national and international competitions. Engineering actively encourages undergraduates to participate in international design competitions such as the Solar Vehicle Project. More than 100 Engineering students, along with 90 students from other faculties, worked on a solar-powered race car that was then entered in a North American competition. Law students participate in the National Competitive Moots, where about 25 students argue moot appellate cases before national and international panels.

Not only are undergraduates doing research. They’re also taking their work to conferences and, in a number of cases, publishing their work in academic journals, on their own or with their supervisors. Last year, for instance, undergraduates in Earth and Atmospheric Sciences had one paper published in a peer-reviewed journal, one paper accepted for publication, and two others in preparation for submission.

It’s very gratifying to undergraduates — as it is to all researchers — to see the impact of their work in the larger community. Native Studies undergraduate students working on the *matriX* project, for instance, provide unique research on Métis land title issues that is highly valued by the Aboriginal community. Students in programs such as *GeriActors* (Drama) and *Designing with Children* (Art and Design) work directly with seniors’ groups and school children, a collaboration that is enriching for everyone involved.

## ④ A wealth of resources

The fact that the University of Alberta is a research-intensive university means that it offers a multitude of resources that are generally unavailable to many other universities and colleges. There are, for instance, about 10-million volumes in its libraries, giving the University the highest number of holdings per student of any university in Canada.

The University boasts hundreds of facilities that owe their presence to the fact that it is a centre of research and, in many cases, the equipment, collections, etc. were funded by grants obtained by researchers. This wealth of resources includes research institutes, research centres, collections, libraries, studios, computer facilities and state-of-the-art laboratories.

Resources paid for by endowments and research grants play a huge role on campus. More than 12,000 people are employed at the University of Alberta, and fully one-third owe their salaries to funding obtained through research grants, endowments and trusts. In the Faculty of Medicine and Dentistry, for instance, nearly one-third of the faculty of 479 are funded through their research grants and the Faculty’s 35 endowed Chairs, such as the Henri M. Toupin Chair in Neurological Sciences, the Alberta Cancer Foundation Chair in Palliative Care and the Firefighters Chair in Burn Research.

David Schindler's undergraduate research experience changed the course of his life. His work on environmental issues is well known throughout the world. Indeed, the Killam Memorial Chair and Professor



of Ecology is one of the most visible researchers at the University of Alberta. But he knows very well the importance of the undergraduate research experience.

"This is how students learn what people really do, rather than taking courses focussed on learning skills. I myself switched from engineering physics to ecology because of a summer job. I would never have followed this path if I had not."

Dr. Schindler is a good example of a researcher taking his own undergraduate experience and passing it on to the next generation.

"I myself published two papers from work that I did as an undergraduate, one in *Science* and one in *Nature*. As a result, I got a Rhodes Scholarship and went on to a career that has been very rewarding. I have had undergraduate co-authors on several papers. Several of my undergrad assistants have gone on to become professors and scientists, some of them rather famous."

## Anna Lund's research in Political Science is not for the faint of heart.

With funding from a Faculty of Arts Undergraduate Student Researcher award and the supervision of Dr. Andy Knight, Anna delved into the grim reality of the sexual exploitation of children in conflict zones. Her work with Dr. Knight focussed on Rwanda, Sierra Leone and the Congo, and investigated issues such as the plight of child soldiers, child orphans, rape, violence, blood diamonds and HIV/AIDS. They were preparing for the April, 2004 international conference in Edmonton, "Children and War: Impact", anticipating the publication of a book and a documentary to come out of the conference.

"Some of the material was really hard to be reading because it was very graphic," says Anna. "But it was really good to feel that you were doing something that matters. It felt like I was contributing something to a project that would be published."

Anna has now set her sights on law school because she wants to make a difference.

"Legal recourse is the only way to protect these people."



Frank Robinson, Professor of Agricultural, Food and Nutritional Science, is a strong believer in the value of undergraduate research.

“Students will be the researchers of tomorrow. Let them learn this by doing. Research provides a great forum to ‘learn when you least expect to’. I think the students get a rush out of finding out something they did not know before. They gain respect for published research and the effort that has gone into it. They learn to question research results and gain confidence in this questioning.”



But this is a shared experience. He figures students help him by bringing a new perspective to a research problem.

“Students provide a fresh, unbiased look into something a researcher may be studying in minute detail. Students often ask questions that spur one to think in new ways because they are not encumbered by traditional dogma.”



Tina Sawchuk was one of the first ten recipients of the Faculty of Arts Undergraduate Summer Researcher awards, and that enabled her to work with Dr. Ian MacLaren, a professor of History and Classics.

“They gave me \$5000 to conduct independent research over the summer, so I wasn’t part of a team. I worked essentially on my own with my supervisor all summer.”

Her summer research focussed on travel in the far north of Canada, particularly the successful and the ill-fated expeditions from the early 20th century. That research, making good use of the Canadian Circumpolar Institute library on campus, has established the basis for her Honours thesis.

Endowed chairs play an important role in bringing top-notch researchers to the University and retaining those already here, and so do the federally-funded Canada Research Chairs (CRCs). There will be 125 CRCs on campus (85 positions are now filled and another 40 appointments are pending). CRCs teach undergraduate courses, mostly senior level and Honours courses, but some do teach first- and second-year classes. In the Faculty of Science, for instance, about one-third of the Chairs teach at least one first- or second-year course, including David Bundle (Strathcona County RU Lemieux Chair in Carbohydrate Chemistry), Jonathan Schaeffer (CRC and iCORE Chair), John Vederas (CRC), Hong Zhang (iCORE Chair) and David Hik (CRC). Research Chairs are acknowledged leaders in their fields, and having these faculty available to undergraduates early in their studies provides a valuable exposure to research.

In many cases, the work that senior researchers and Chairs do with senior undergraduates prepares students for graduate school, an integral part of training the next generation of researchers.

Some professors bring a wealth of personal and professional experience to their undergraduate teaching. Kim McCaw's background as a director in Canadian theatre, for example, and David Ley's vocal coaching at Stratford bring home the real world of theatre to Drama students.

## 5 Celebrating undergraduate research

The celebration of undergraduate research at the University of Alberta is growing, and will continue to expand. The Vice-President (Research) portfolio is encouraging that growth with its faculty partnerships for undergraduate summer research awards. Another example is found in the Faculty of Pharmacy and Pharmaceutical Sciences, which has just instituted the Merck Summer Student Award, funded by Merck USA. This award offers a \$4000 salary, as well as \$1500 in travel expenses to attend the annual meeting of the Canadian Society for Pharmaceutical Sciences. Other faculties have been acknowledging undergraduate research for some time. The Faculty of Engineering, for instance, has been offering the Dean's Research Awards for about twenty years. This program enables undergraduates to participate in faculty members' research programs. The award is open to students starting with their second year, and offers a stipend of \$250. Students present their work in a forum at the end of the term. The best project is awarded the K. Šabol Memorial Prize of \$500. The Faculty of Medicine and Dentistry's Annual Summer Student Research Day awards cash prizes of \$300 each to the top ten undergraduate posters, along with a certificate. Two of

the ten also receive travel grants to represent the University at the National Students Research Forum Poster Competition in the United States.

The Faculty of Arts and the School of Native Studies have undergraduate student summer research awards, offering \$5000 per student, and the Faculty of Education is considering instituting an undergraduate research award as well.

Such awards recognize — with honours, certificates and money — that the research done by undergraduates is important and worthy of being celebrated.

The University of Alberta has immense potential for the development of an enhanced, vibrant, comprehensive and formalized program of undergraduate research. Research makes sense for students, and in fulfilling the public trust of training the next generation of researchers, it also makes sense for the University, the community and the country. And it is abundantly clear that undergraduates attending the University of Alberta do indeed have a greatly enriched educational experience because it's taking place in such a dynamic learning community.

**The University of Alberta is proud to celebrate its undergraduate research through this publication. The learning experience of undergraduates is enhanced because it is taking place within a vibrant research community, and this is a partnership with a very exciting future.**



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