

MSC IN PHARMACEUTICAL SCIENCES



MASTER'S PROGRAMME AT THE UNIVERSITY OF COPENHAGEN

- Targeted master's programme for people with a bachelor's degree in the natural and health sciences
- Challenging career opportunities in the pharmaceuticals and biotech industries

MSC IN PHARMACEUTICAL SCIENCES

- A PROFILE IN DEMAND

MSc in Pharmaceutical Sciences, Communications Department, Faculty of Pharmaceutical Sciences

Graphic design: Jens Raadal Photos: Mikal Schlosser, Mads Frederik, Jens Fink Jensen, Heine Pedersen and Copenhagenmediacenter.com

GRADUATES IN HEAVY DEMAND

The pharmaceutical industry is financially strong and growing and developing rapidly. At all times, the industry needs to be able to recruit a sufficient number of graduates with a focused background in the pharmaceutical sciences. Graduates in the pharmaceutical sciences are in demand in the pharmaceutical industry internationally and in the Danish biotech, medico-tech and pharmaceutical industries that hold a key position in the international arena.

A FOCUSED, INTERNATIONAL PROGRAMME

The Faculty of Pharmaceutical Sciences at the University of Copenhagen offers a focused, international MSc programme in Pharmaceutical Sciences in English. Students from Denmark or abroad holding a bachelor's degree with a solid background in chemistry and biology can tailor a two-year master's programme weighted with

drug-oriented courses. The programmes of The Faculty include pharmacy courses not found at other Danish universities. If you are thinking of a career in the pharmaceutical industry, a Master of Science degree in Pharmaceutical Sciences from the University of Copenhagen is an excellent springboard.

CHOOSE YOUR OWN PROFILE

An MSc in Pharmaceutical Sciences will give you an educational combination that will supplement other experts in the field. Your profile will be much in demand thanks to your BSc in one of the technical, natural science or health science fields coupled with an MSc focusing on drugs and drug development. The Faculty offers three lines in the pharmaceutical sciences, which will give you access to that aspect of the field in which you are most interested.

THE PROGRAMME

The two-year MSc in Pharmaceutical Sciences is based on compulsory and elective courses and a final thesis. All courses are taught in English. The programme is offered in three lines that are connected to the various phases of the drug development process:

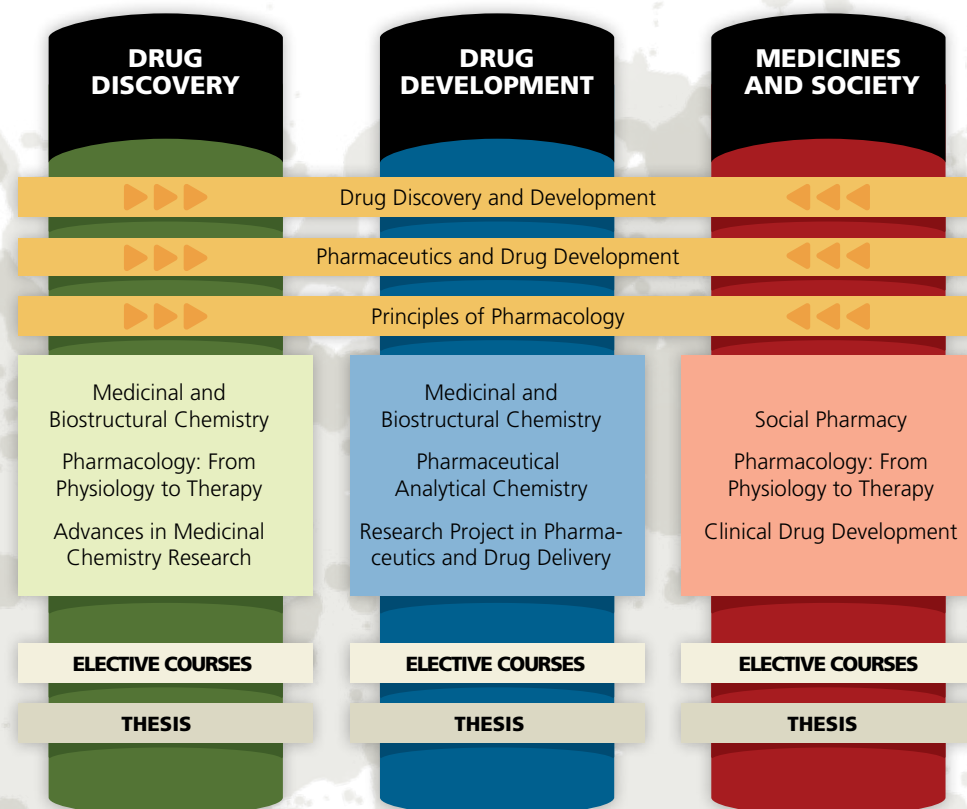
- **DRUG DISCOVERY**
- **DRUG DEVELOPMENT**
- **MEDICINES AND SOCIETY**

The first semester of all three programme lines starts with courses in Drug Discovery and Development, Pharmaceutics and Drug Development and Principles of Pharmacology. These three courses form a common scientific basis regardless of which line you have chosen. You will then take three compulsory courses specific to your line which, together with further specialisation through elective courses and theses, will give you a definitive scientific profile.

Once you have selected your line, you will be able to 'weave' courses from the other two lines into your study plan as electives. That will allow you to gain a multifaceted picture of the pharmaceutical sciences. The flexibility in choice of electives gives you the opportunity to form a programme that is highly focused but also one with a broader palette.

At the University of Copenhagen and abroad

As an MSc student in the pharmaceutical sciences, you will spend much of your time at the Faculty of Pharmaceutical Sciences on the North Campus of the University of Copenhagen. You will become part of the unique student environment at The Faculty. For some semesters it will be possible for you to take courses at other University of Copenhagen faculties or other universities in Denmark and abroad. There are also good opportunities available for you to write your thesis in industry in Denmark or abroad.



Pharmacology is about

- how drug substances are absorbed and distributed in the body
- how they are metabolised and then eliminated from the organism
- the effect drugs have on the organism

Drug Discovery and Development is a course that

- gives an overview of the total drug development process
- describes the phases necessary for developing a new drug

The Clinical Drug Development course is about

- planning a clinical trial in man, for use as the basis for drug registration
- legislative, quality assurance and ethical aspects of these trials

The Pharmaceutics and Drug Development course is about

- how drugs like tablets, creams and eye drops must be formulated so that the active drug substance can be absorbed and transported to that part of the organism where it is to act
- how drugs are produced and which excipients may be used
- how to ensure that drug quality is correct and that drugs contain the right amount of active substance

The Social Pharmacy course is about

- the role of drug experts in healthcare service
- drug legislation
- what kind of system has been established to ensure the population's access to drugs
- ethics regarding all areas of drug administration, testing and use

AN MSC IN PHARMACEUTICAL SCIENCES PROVIDES ACCESS TO ALL AREAS

FROM IDEA TO DRUG

The development of new drugs is a long and complicated process. It usually takes from 10 to 15 years to turn an idea into a product that is approved and marketed, and very few ideas make it that far. Only about one out of every 1000 ideas that become the object of close investigation in the laboratory of a pharmaceutical company reaches the clinical development

phase where it is tested on people. And only one of these drug candidates will actually become a drug.

Bridge builder in a complex process

Persons who work in drug development are typically trained as pharmacists, doctors, engineers, chemists, biochemists or

similar. The majority work in research, development, production, quality assurance and information. Work is project oriented in all phases of drug development and typically involves interdisciplinary cooperation. People with an MSc in Pharmaceutical Sciences are part of this cooperation and key to building bridges between the various professional groups. The figure below illustrates the process underlying the development of a new drug. The phases frequently overlap

and the length of the individual phase varies. Drug development is fuelled by the interest to launch new drugs as quickly as possible – at the lowest cost possible – balanced by the interest to achieve maximum product safety shared by the regulatory authorities and the drug industry. The figure shows the work areas and processes in the drug industry in which a person with an MSc in Pharmaceutical Sciences could make a valuable contribution.



An idea or hypothesis based on an interesting or inexplicable observation is the first step on the way to a new drug. The source of a new idea could come from a university scientist, a researcher in the drug industry's own laboratories or a researcher combing patent literature.

A small team of experts uses biochemical methods and/or animal research to determine whether the idea has potential. If the results of the experiments are positive and the team is able to identify promising chemical compounds, there is a basis for an actual research project that can be used to optimise and further describe the active substance.

Now the chemical compounds must be formulated, that is, modified or combined with excipients that allow the active substance to be absorbed by the organism and transported in the right concentration to the organ in which it is intended to act. Depending on the active substances, excipients and area of efficacy, the finished formulation can be in the form of tablets, creams or liquid for injection.

The potential drug is then tested on animals to see how it affects the intact system. Thorough long-term investigations are made of drug safety in the animal trials. The medical hypothesis is tested via research on human material, that is, tissue or blood. This phase often marks the transition from research to development.

Once the potential drug has been assessed as safe and effective on animals, it is tested on people. Trials are conducted over several years in four different phases, each of which has a purpose. See the diagram below. Regulatory approval may be applied for after phase 3. Phase 4 trials are not initiated until the drug is on the market.

When a drug candidate is considered safe and effective on the basis of phase 3 trials, it must be approved internationally before being marketed. Regulatory Affairs is the area with a broad overview and the responsibility for collecting all data from the development processes and sending it to regulatory authorities.

The drug can now be produced in volume for sale to patients worldwide. The choice of production equipment and process plays a vital role for quality, which is subject to ongoing control to ensure that it lives up to regulatory requirements on uniformity, stability and purity.

A marketing strategy is drawn up to disseminate knowledge about the newly developed drug. The plan must consider differences in drug legislation in the various countries where the drug will be marketed. Drug companies hire people with an education in the pharmaceutical sciences to work in their marketing and information departments in order to prepare the company for a professional dialogue with the healthcare personnel who distribute and prescribe drugs.



CLINICAL DEVELOPMENT

When a drug is being tested on people, we call it a clinical trial. The purpose of all four phases of clinical trials is to find out whether the drug or treatment form is safe and effective for treating a specific condition or illness. Specific international guidelines ensure that ethics and good clinical practice are upheld.



PRE-CLINICAL STUDIES

Before a potential drug can be tested on people, thorough pre-clinical trials of safety and efficacy are conducted on animals. Studies on human material, i.e. tissue or blood, are also conducted in this phase. Trials are conducted all the way to registration of the drug.



PHASE 1

In phase 1 trials the potential drug is studied in a limited number of healthy human volunteers – usually from 10 to 100 people. How the drug is absorbed, distributed and metabolised in the organism are investigated.



PHASE 2

Phase 2 trials test various dosages on people who are ill, usually from 50 to 300. Efficacy and adverse drug reactions are examined to try to find the optimal dosage. The trials must show specifically how the potential drug works in the body and how it influences the illness in question.



PHASE 3

In phase 3 trials the drug is tested in a large patient population, where a control group gets a different drug or a placebo. These trials typically include from 1500 to 4000 people. If the phase 3 results are positive, a registration application is sent to the regulatory authorities.



PHASE 4

Phase 4 trials are conducted after the drug has been approved and launched. Treatment experiences are monitored continually, with focus on new indications or special safety issues. These trials typically involve from 500 to 3000 patients.

Timeline (years)



DRUG DISCOVERY

Behind all new drugs lies a good idea, a discovery or a hypothesis. Drug Discovery denotes this early phase where scientists are hunting for new effective pharmaceutical substances. The objective is to discover or synthesize new chemical or biological compounds and to map their therapeutic but also possible unwanted effects in animals and people.

In the discovery phase, work is often conducted in research groups that include experts in pharmacology and medicinal chemistry, among others. With Drug Discovery as a basis, you can continue in a professional position within drug discovery of the pharmaceutical industry, or in a PhD programme at the Faculty of Pharmaceutical Sciences.

Compulsory courses:

- Medicinal and Biostructural Chemistry
- Pharmacology: from Physiology to Therapy
- Advances in Medicinal Chemistry Research.

PROFESSIONAL PROFILES

The Drug Discovery line provides the opportunity for various professional profiles, such as:

Pharmacology

- focuses on that part of the discovery phase that involves biological/ pharmacological topics such as identification and validation of new drug targets, elucidating the mode of action of the drug substance,

and investigating its effect on cloned receptors in test tubes, cell cultures, isolated organs and/or laboratory animals that mimic a specific human disease. All of these efforts are aimed at predicting the therapeutic effect of novel compounds in humans.

Examples of electives:

- In-vitro Techniques in Biochemistry and Pharmacology
- Clinical Drug Development
- Pharmacokinetics and Pharmacodynamics
- Laboratory Animal Science

Medicinal Chemistry





- focuses on that part of the discovery phase involving chemical techniques, such as design and synthesis of new chemical compounds partly with the purpose of identifying potential drug substances and partly with the purpose of optimizing the pharmacological activity and selectivity of the compounds. Work in this phase of drug discovery also involves improvement of the physico-chemical properties of the compounds so that they will become potential drug substances with optimal characteristics.

Examples of electives:

- Structural and Computational Medicinal Chemistry
- Advanced Spectroscopy
- Drug Metabolism
- Intellectual Property Rights in Pharmaceutical Sciences.

EXAMPLES OF STUDY PLAN FOR LINE I

FIRST YEAR		2. ÅR	
BLOCK 1	BLOCK 3	BLOCK 1	BLOCK 3
Drug Discovery and Development (7,5 ECTS)	Pharmacology from Physiology to Therapy (15 ECTS)	Thesis	Thesis
Principles of Pharmacology (7,5 ECTS)		In-vitro Techniques in Biochemistry and Pharmacology (7,5 ECTS)	
BLOCK 2	BLOCK 4	BLOCK 2	BLOCK 4
Pharmaceutics and Drug Development (7,5 ECTS)	Advances in Medicinal Chemistry Research (7,5 ECTS)	Structural and Computational Medicinal Chemistry (7,5 ECTS)	Thesis
Medicinal and Biostructural Chemistry (7,5 ECTS)	Individualised Study Unit	Thesis	

 Compulsory course for all lines  Compulsory course for this line  Elective course  Thesis



Pamela Wilson, with a bachelor's degree in biology from Lehigh University, Pennsylvania, has chosen Drug Discovery as her area of specialisation.

FIRST LINK IN THE CHAIN

The search for new drug candidates is often carried out in uncharted territory. In what can be a nerve-wracking and dramatic ‘drug hunt’, a research team gradually moves in on an active substance that must be isolated, further developed and tested. I want to be there when the exploration begins, which is why I selected *Drug Discovery*. It is exciting to work with drug development at an early stage when it is often crucial to get a really good idea that is perhaps a bit untraditional. I see it as a huge strength that students working on their master’s degree in the pharmaceutical sciences have widely different academic backgrounds. And we who come from foreign universities also have other approaches to the material. There is a great deal of synergy in the programme and group projects and presentations provide good opportunities for us to bring our different backgrounds into play. It can provide the catalyst for creative thinking that is necessary when you’re the first link in the chain.

Dialogue and discussion

I have never been in doubt about my choice of *Drug Discovery*, even though there are also interesting subjects in the other two areas of programme specialisation. It is great that the framework is so flexible that you can plan an individual course of study. At the Faculty of Pharmaceutical Sciences you get your hands dirty from day one. In the USA theory and laboratory practice are strictly separate, but here they merge and there are lots of hands-on projects that give us a greater understanding of the subject. For example a course like drug formulation is unique and has been an important part of building my academic foundation. There is also a lot of freedom in Danish labo-

ratories and classrooms – you discuss with your teachers and there is room to think for yourself.

Mentor scheme opens doors

The programme provides good job opportunities for me back home in the USA, but I would like to stay in Denmark after I graduate. I dream of a research position in one of Medicon Valley’s many pharmaceutical companies. The innovative environment in the Oeresund region provides good opportunities to share knowledge. And the Scandinavian healthcare system in which everyone is registered is a perfect framework for developing clinical trials. I have been assigned a mentor through the University of Copenhagen. She works in protein research at Novo Nordisk A/S, which gives me insight into the Danish job market. The network can help open some doors for me in future as well. My thesis project will be about designing semi-synthetic proteins, and I have already made an agreement with the research group in chemical biology at the Faculty of Pharmaceutical Sciences.

Dynamic student environment

I came to Copenhagen for the first time as an exchange student while I was working on my bachelor's degree, and I was sold. Copenhagen is a lovely and dynamic city – big and little at the same time. It is easy to get around, but there are masses of cultural and recreational options. Copenhagen is also a beautiful city with centuries of history. Just recently I saw a postcard that read: *University of Copenhagen founded in 1479 – Columbus discovered America 13 years later.* That really made me laugh!

DRUG DEVELOPMENT

There is continuous development of new chemical substances that act effectively on their targets, such as brain receptors. However, most of them are useless as drugs because they will never reach their target in the organism. They may be degraded or metabolized too quickly, or they cannot penetrate biological barriers and reach the tissue they need to affect, such as brain tissue. Here is where pharmacy comes into the picture. When pharmaceutical scientists know the chemistry of substances, how they interact with the body, how they are metabolized and eliminated, they can develop drugs that release the right amount of active substance at the right point in the right place in the body. Advanced analytical chemistry is an integral part of drug development work.

Compulsory courses:

- Medicinal and Biostructural Chemistry
- Pharmaceutical Analytical Chemistry
- Research Project in Pharmaceutics and Drug Delivery

PROFESSIONAL PROFILES

The Drug Development line provides the opportunity for various professional profiles, such as:

Drug Metabolism and Pharmaceutical Analytical Chemistry

- focuses on investigating how the active substance is released from the drug, absorbed and distributed in the body, and how it is eliminated. Very rapid elimination or conversion to metabolites can mean that a potential drug must be abandoned in the development process. Detailed knowledge of metabolism and metabolites is a prerequisite

for optimizing the properties of the drug and selecting the ideal formulation. Investigations are most often done by determining metabolites in biological material such as blood, serum or urine samples from animals and humans. This detective work requires advanced analytical chemical techniques able to separate and identify the metabolites.

Examples of electives:

- Applied Drug Metabolism
- Principles and Practice of Bioanalysis
- Statistical Design and Analysis of Experiments

Pharmaceutics and Drug Delivery

- focuses on the development of the drug formulation. Many drug substances cannot be absorbed directly in the body. Others are absorbed, in a therapeutic context, in the wrong places and therefore have no effect or perhaps even a harmful effect. Here is where formulation experts enter the picture with their knowledge about relevant drug formulations, their understanding of drug chemistry and their knowledge about how the body absorbs different substances. Interdisciplinary work involves the areas of chemistry, physiology and pharmacology in order to find a formulation – a composition – that can put the substance on the right track in the organism.

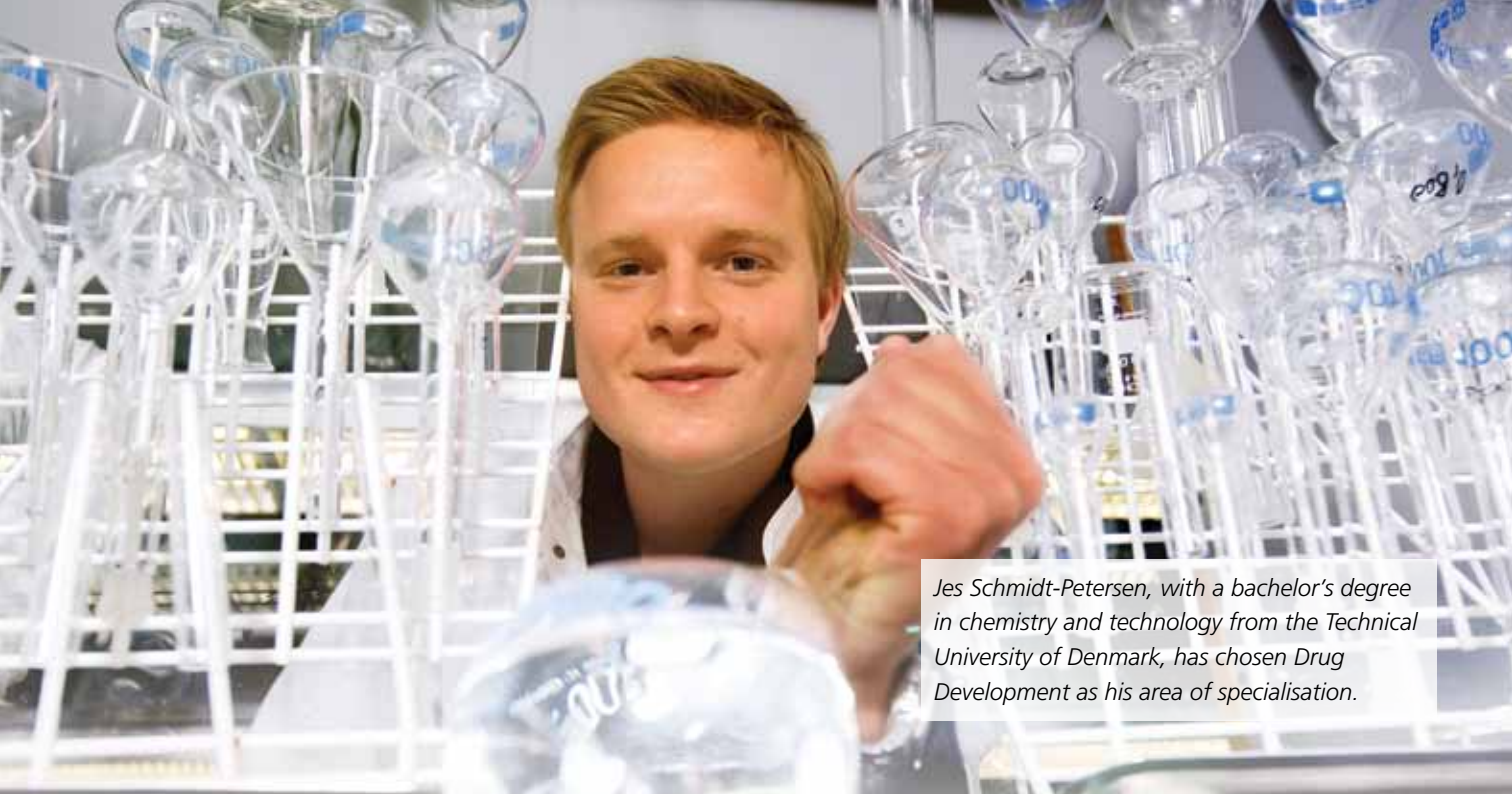
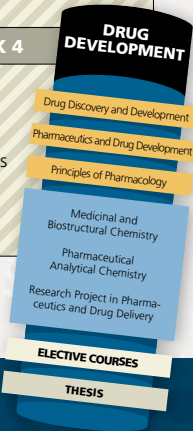
Examples of electives:

- Pharmaceutical Preformulation
- Advanced Manufacturing of Pharmaceuticals
- Pharmaceutical Formulation of Peptides and Proteins
- Advanced Drug Delivery.

EXAMPLES OF STUDY PLAN FOR LINE II

FIRST YEAR		2. ÅR	
BLOCK 1	BLOCK 3	BLOCK 1	BLOCK 3
Drug Discovery and Development (7,5 ECTS)	Pharmaceutical Analytical Chemistry (7,5 ECTS)	Pharmaceutical Formulation of Peptides and Proteins (7,5 ECTS)	Thesis
Principles of Pharmacology (7,5 ECTS)	Intellectual Property Rights and Innovation in Pharmaceutical Sciences (7,5 ECTS)	Advanced Manufacturing of Pharmaceuticals (7,5 ECTS)	
BLOCK 2	BLOCK 4	BLOCK 2	BLOCK 4
Pharmaceutics and Drug Development (7,5 ECTS)	Research Project in Pharmaceutics and Drug Delivery (15 ECTS)	Pharmaceutical Preformulation, profiling drug substances for the biomedical sciences (7,5 ECTS)	Thesis
Medicinal and Biostructural Chemistry (7,5 ECTS)		Advanced Drug Delivery (7,5 ECTS)	

- Compulsory course for all lines
- Compulsory course for this line
- Elective course
- Thesis



Jes Schmidt-Petersen, with a bachelor's degree in chemistry and technology from the Technical University of Denmark, has chosen Drug Development as his area of specialisation.

CHEMISTRY BENEFITS THE BODY

I changed my academic direction, because I wanted to use my chemistry training specifically for drug development. I needed the biological dimension, which is a large part of the academic programme at the Faculty of Pharmaceutical Sciences. When I was studying engineering, I did a lot of calculations for process equipment, for example, but now my collection of formulas will be used to benefit the body, and that really appeals to me.

Thesis project on proteins

I chose the Drug Development line because the subjects are core pharmaceutical disciplines like drug formulation and production, which are unique to this Faculty. My favourite subject is protein and peptide formulation. Biological drugs based on human proteins are undergoing dramatic development, and about one-third of all new drugs in clinical trials are proteins or peptides. Protein drugs are really nature's own design, with the advantage that they can have a highly selective effect in the organism on a par with the body's own hormones or enzymes. In the spring I will start writing my thesis with the cooperation of Novo Nordisk, where I will be working with protein formulation trying to increase the stability of a special preparation for haemophilia.

Input from industry

I'll be writing the thesis project together with a pharmacy student, and I hope we can use our differences as a catalyst for generating new ideas. I have taken some elective courses that pave the way for the thesis. But

the great flexibility of the programme has also made it possible for me to choose a course such as Registration, which is part of the Medicines and Society line. It is a great way to gain full understanding of the entire drug life cycle. All the lecturers on the Registration course work in the drug industry and, in general, the close relationship with industry is typical of the Faculty of Pharmaceutical Sciences. In my future career I hope to be able to work further on producing biological drugs, for example protein formulation. But I am also interested in economics and will start working on a business degree this summer. In the long term I hope I will be able to combine these two fields in a dream job with focus on drug development and drug economics. While there are many opportunities here in Copenhagen, I am also considering taking a job in the USA at some point.

Friends from all corners

The biology courses were a challenge in the beginning, but I haven't regretted my choice of master's programme for a second. I have taken many of the courses with pharmacy students, and I've made a lot of friends from various fields and class years. When I started at the Faculty of Pharmaceutical Sciences I signed up to play on a student soccer team, and that gave me a bunch of friends in record time. The student environment at the Faculty is very social, and it is great to look forward to coming to the university every day. I have also gotten to know many of my fellow students through my student job in the registration department of Ferring Pharmaceuticals.

MEDICINES AND SOCIETY

Medicines have enormous impact on the people and societies that use them. Before new medicinal compounds can be approved for the Danish market, their efficacy and safety must be documented in clinical trials. Both patients and society have an interest in getting the most effective, safest and cheapest drugs from manufacturers to users. Next, the optimal use of the drugs is essential in order to avoid overuse, misuse or other irrational use. Information and communication are vital factors here.

Compulsory courses:

- Social Pharmacy
- Pharmacology: from Physiology to Therapy
- Clinical Drug Development

PROFESSIONAL PROFILES

The Medicines and Society line provides the opportunity for various professional profiles, such as:

Clinical Development

- focuses on investigating under controlled conditions the effect of drugs on healthy research subjects and on groups of patients. The controlled clinical trial is the gold standard for this process and provides the basic documentation for the efficacy and adverse effect profile of a drug.

Examples of electives:

- Pharmacokinetics and Pharmacodynamics
- Research Methods in Social and Clinical Pharmacy
- Statistical Design and Analysis of Experiments
- Pharmacotherapy

Regulatory Affairs

- focuses on setting registration strategies as well as on guiding and coordinating drug development. The regulatory authorities set stringent requirements to the efficacy and quality of medicines, and before a new medicinal product is approved, companies must document that their product meets these many requirements. Regulatory Affairs is responsible for submitting documentation and for the communication between the authorities and companies.

Examples of electives:

- Drug Regulatory Affairs
- Intellectual Property Rights and Innovation in Pharmaceutical Sciences
- Quality Control of Medicines
- Toxicology
- Pharmacotherapy

Social Pharmacy

- focuses on the position of medicines in society, with regard to use, economy and healthcare policy. The perspectives of both patients and of the healthcare services on the use of drugs are central. Key topics are marketing, economics, distribution, communication, compliance (the extent to which patients follow the instructions given), monitoring (control and supervision), and the individualization of drug use.

Examples of electives:

- Research Methods in Social and Clinical Pharmacy
- Pharmacotherapy
- Statistical Design and Analysis of Experiments

EXAMPLES OF STUDY PLAN FOR LINE III

FIRST YEAR		2. ÅR	
BLOCK 1	BLOCK 3	BLOCK 1	BLOCK 3
Drug Discovery and Development (7,5 ECTS)	Pharmacology from Physiology to Therapy (15 ECTS)	Toxicology (7,5 ECTS)	Intellectual Property Rights and Innovation in Pharmaceutical Sciences (7,5 ECTS)
Principles of Pharmacology (7,5 ECTS)		Thesis	Thesis
BLOCK 2	BLOCK 4	BLOCK 2	BLOCK 4
Pharmaceutics and Drug Development (7,5 ECTS)	Clinical Drug Development (7,5 ECTS)	Research Methods in Social and Clinical Pharmacy (7,5 ECTS)	Thesis
Social Pharmacy (7,5 ECTS)	Regulatory Sciences in the Pharmaceutical Industry (7,5 ECTS)	Statistical Design and Analysis of Experiments (7,5 ECTS)	

- Compulsory course for all lines
- Compulsory course for this line
- Elective course
- Thesis



COMBINING BIOCHEMISTRY AND COMMUNICATION

My aim is to put together a master's programme that combines the natural and social sciences, and my ambition is to be the link between 'the real world' and science. I became interested in biochemistry early on as an undergraduate and I wrote my final project on protein chemistry. At almost the same time I got a job as a student counsellor, where communication skills were crucial, and I had to draw on my understanding of human nature and ability to resolve conflicts. I really liked the challenge and started to dream about an education that would allow me to combine the natural sciences with communication and administrative skills.

Window to the world

I'm keenly interested in clinical trials, and I have taken many elective courses in clinical research. It is super that students at the Faculty of Pharmaceutical Sciences can work so closely with industry. For example, in the course on pharmacokinetics, we made theoretical calculations on the possible effect of drugs in the body. Later a scientist from industry visited the class and showed us that they use exactly the same methods. That direct coupling to the real world is really effective. My individually tailored curriculum includes marketing, which has also given me insight about the many players on the drug scene. There is no reason to hold back. There is a wealth of opportunity to follow your own ideas in building an interesting curriculum – and there are academic advisers to guide you on your way.

Medicine use by pregnant women

I will be writing my thesis in cooperation with Copenhagen University

Hospital on medicine use by pregnant women. New drugs are almost always tested on healthy young men, which is why we don't know much about the consequences of pregnant women's medicine consumption. My job will be to extract statistical data from the hospitals' databases in order to obtain an overview of how much prescription medicine pregnant women take nationwide. The project is right down my alley – I'll be getting a mountain of numbers to crunch, but it will be possible to draw some social science conclusions from the results. The drug industry is the most highly regulated industry in the world after aviation. I have an interesting and relevant student job at Sandoz, the international drug company, where I handle the registration of unintended drug reactions. After I graduate, I would also like to work with clinical monitoring. That means monitoring clinical trials all over the world, having contact with the doctors conducting the trials and making sure that everything is being done for the benefit of the patient.

Student politics

I've been interested in student politics for years, and have continued my involvement at the Faculty of Pharmaceutical Sciences. It has been a real pleasure to work with academic staff and my fellow students on the structure of the programmes and research strategy for the future. I have been at the table with the Study Board as well as the Academic Council. The experience has been very positive, even though I have a different academic background than most of the others. There is good teamwork at the Faculty of Pharmaceutical Sciences and the Faculty's advisory bodies take a highly professional approach to their work. There is plenty of opportunity to influence programme content.

A SOLID PLATFORM WITH MANY OPPORTUNITIES

Grith Krøyer Wood, age 31, is a formulation chemist at Statens Serum Institut. Grith has a bachelor's degree in Chemical Engineering from the Technical University of Denmark and earned her MSc in Pharmaceutical Sciences with Drug Development as her area of specialisation.



I am certain that my MSc in Pharmaceutical Sciences gives me a solid platform for an exciting career. I get the distinct impression from talking to colleagues that I made a good decision when I added a master's in Pharmaceutical Sciences to my engineering degree. My original plan was to get a master's in civil engineering. My main interest is medicine and drugs and therefore I wanted to take as many electives as possible at the Faculty of Pharmaceutical Sciences. While I was searching for electives on the Faculty's site, I discovered their master's programme. Suddenly here were all the courses I was looking for, so I applied to the Faculty of Pharmaceutical Sciences instead of taking the engineering route.

Drugs in focus and quality as second nature

The chemical engineering programme studies many different substances, anything from paint and plastic to ketchup. In contrast, all of the courses at the Faculty of Pharmaceutical Sciences are focused on drugs. That is a major strength for students who already know they want jobs in the pharmaceutical industry.

Another difference that struck me right away is that quality assurance is integrated into all the courses at the Faculty of Pharmaceutical Sciences. That provides an extra dimension and has equipped me well for work in the drug industry, where there is heavy focus on quality assurance.

Fast-track from thesis to job

My supervisor at the Faculty helped me make a thesis agreement with Statens Serum Institut. My thesis topic was about vaccine research and dealt with protein binding to liposomes and lipid layers. I was offered a job at Statens Serum Institut as an extension of my thesis. I work here now as a formulation chemist in vaccine development. One of my responsibilities is to produce and investigate tuberculosis vaccines for pre-clinical and clinical trials. Here in the vaccine development department, we follow vaccines from early development to clinical testing. Typical of our work is upscaling and finding a stable formulation for a promising vaccine or vaccine component from the research department. In our department we develop and optimise methods and analyses to make the product profitable in production. I handle many different tasks, and I really appreciate the variation that comes from switching between laboratory work and paperwork.

Well prepared for the future

I can't really say exactly where I will be in 10 years, but right now I see a future in which I am working in drug development or production. Statens Serum Institut has a very exciting research and development environment that offers many different career opportunities, so I certainly have a wealth of opportunities for development right here at my current workplace.

"The drug industry worldwide needs graduates with a strong academic background. An MSc in the Pharmaceutical Sciences, which combines a solid foundation in the natural sciences and a broad overview of the drug development process with detailed knowledge in the student's area of special interest, will serve the needs of industry extremely well."



Klaus Bøgesø, Vice President, Lundbeck Research
Lundbeck is an international pharmaceutical company conducting research into, developing, manufacturing, marketing, selling and distributing pharmaceuticals for the treatment of neurological disorders. Lundbeck employs 5,500 people in 55 countries, and their products are registered in more than 90 countries.

Nanna Feldborg Mortensen works in clinical development at Novo Nordisk A/S. Nanna has a bachelor's degree in Pharmaceutical Chemistry from the University of Southern Denmark.

VERSATILE JOB WITH INTERNATIONAL OUTLOOK

I got my job five days before I got my master's degree – and now I'm part of the *Global Development Graduate Programme* at Novo Nordisk. The company encourages selected natural science graduate students to take a two-year position that will guide them through all of the stages of the long process involved in developing a new drug.

Direct access to industry

I wanted a master's programme that would provide direct access to the drug industry, so I moved to Copenhagen to study at the Faculty of Pharmaceutical Sciences. My starting point was the *Drug Discovery* line, but I also took many elective courses from the Medicines and Society line. The programme is so flexible that you can combine elements from various disciplines. I was crazy about long-haired science, basic research and laboratory work – but I also wanted to work with clinical development. Today I have my spotlight on phase 1 studies,

a relatively early stage of the drug development process, but where there is still room for surprises.

World traveller in clinical studies

During my two years as a *graduate*, I rotate between various departments. The first eight months I worked in *Regulatory Affairs* in Copenhagen, and in 2009 I spent seven months with a subsidiary in the USA. I was a *local trial manager*, the title for someone in charge of a clinical trial for a selected drug. Now I'm back working with *international trial management* – and have just returned from a short trip to Hong Kong, where I monitored and advised on a large clinical study. The graduate programme will prepare me for a position as an international trial manager based in Denmark. I'll be monitoring and coordinating clinical studies all over the world. I'll also meet many different people and communicate worldwide. There are a variety of nationalities at my workplace, so globalisation goes on *in house*, you might say. In the long-term I would like to be more involved with strategic management regarding future drug development.

Targeted education

I wrote my thesis on haemostasis pharmacology in cooperation with Novo Nordisk. I work in a completely different area now, but it has been a big advantage for me to get to know the company so well. I was able to establish a good network with managers and colleagues already while I was a student. At the Faculty of Pharmaceutical Sciences you are in close contact with reality and it is my impression that drug industry management values graduates in pharmaceutical sciences precisely because their education is targeted at a career in the pharmaceutical industry.

"Developing new drugs requires expertise in a wide variety of natural science disciplines. A solid academic grounding in chemistry, physics or biology, for example, coupled with a master's degree in the Pharmaceutical Sciences is a highly attractive skills profile for students considering a career with Novo Nordisk."



Børge Diderichsen, Vice President, Novo Nordisk
Novo Nordisk is a healthcare company and a world leader in diabetes care. In addition, Novo Nordisk has a leading position within areas such as haemostasis management, growth hormone therapy and hormone replacement therapy. With headquarters in Denmark, Novo Nordisk employs more than 29,000 people in 81 countries, and markets its products in 179 countries.



UNIVERSITY OF COPENHAGEN

THIS IS WHERE IT'S AT!

An MSc in Pharmaceutical Sciences will give you an educational ballast that will supplement other experts in the field. Your educational profile will be much in demand thanks to your BSc in a technical, natural science or health science field combined with a pharmaceuticals-oriented MSc that focuses on medicines and the development of drugs and related products. The University of Copenhagen is located in the midst of one of the world's leading biotech areas – Medicon Valley – home to almost 300 life science companies. The Faculty of Pharmaceutical Sciences is known for its extensive cooperation with industry. One of these cooperative endeavours is the Faculty's own Drug Research Academy (DRA), where a number of

Danish biotech and pharmaceutical companies co-finance PhD scholarships. DRA covers all key research areas in drug development from research, development and production to clinical testing. This close concentration of biotech and pharmaceutical companies in the region coupled with the Faculty's cooperation with industry provides good opportunities for students to build contacts to future employers already while they are studying. The location presents optimal opportunities to find student jobs related to the field and to initiate thesis projects at one of the many companies in the area.

Founded in 1479 the University of Copenhagen is Denmark's largest educational institution today with more than 37,000 students and 7,000 employees. The university occupies four campuses in central Copenhagen, and was ranked no. 52 in the world on the QS 2011 ranking list.

The university's website is: www.ku.dk

COPENHAGEN

Copenhagen is the capital of Denmark. There are 1.7 million inhabitants in Greater Copenhagen, which encompasses the city itself and surrounding suburbs.

Copenhagen's special features:

- a lively city with many young people
- a green city with many parks and green oases
- a blue city with a long waterfront, canals and lakes
- a bicycle city with clean air
- a city with good public transport and high public service levels

- a city whose inhabitants speak good English
- a city whose inhabitants enjoy a high degree of personal safety.

The official tourist website for Copenhagen:
www.visitcopenhagen.dk

THE FACULTY OF PHARMACEUTICAL SCIENCES

The Faculty of Pharmaceutical Sciences was founded in 1892 as an independent pharmaceutical college, 'Den Farmaceutiske Læreanstalt', which merged with the University of Copenhagen in 2007 to become a Faculty.

Drugs are at the core of all research and teaching at the Faculty of Pharmaceutical Sciences at the University of Copenhagen. The Faculty's research and teaching are based on the interdisciplinary integration of the natural, health, social and technological sciences. This approach equips graduates for work as experts in research, development testing, production, assurance and the use of drugs.



The Faculty offers programmes in pharmacy and the pharmaceutical sciences to about 1,300 students working on their bachelor's or master's degrees and 110 students in the PhD programme. The Faculty has about 350 employees, of whom half are academic staff distributed among three departments, the library and administration.

The Faculty of Pharmaceutical Sciences is a European leader in its field. It is known for high-quality research and teaching, good laboratory and classroom facilities, and its unique close cooperation with the pharmaceutical industry, which means that the majority of its graduates find work in the industry.

International cooperation is high on the Faculty's agenda. As well as participating in international research projects and offering an international student environment, the Faculty is a member of the ULLA consortium, a research and teaching

collaboration of eight leading pharmaceutical institutions in Europe.

The Faculty of Pharmaceutical Sciences is centrally located on the North Campus in Copenhagen, close to all the natural science and health science departments.

The Faculty of Pharmaceutical Sciences' website:
www.farma.ku.dk

STUDENT LIFE AND FACILITIES

The MSc in Pharmaceutical Sciences is an international programme that admits a maximum of fifty students from all over the world annually. A good introduction programme, joint networking activities and group work in courses help create a warm study environment both socially and academically. The Faculty of Pharmaceutical Sciences is known for its

unique study environment. In 2011 Helle S. Waagepetersen, head of the MSc in Pharmaceutical Sciences programme has been awarded the prestigious University of Copenhagen International Study Environment Award for her networking and career planning initiatives for international students. In 2008 the Faculty received the Danish Ministry of Education's award for teaching milieu. The good student milieu is reflected in good facilities and numerous social activities such as sport, choral group, Friday 'happy hour' and many unique student traditions. You won't be lonely at the Faculty of Pharmaceutical Sciences.

TEACHING METHODS

Academic staff at the Faculty of Pharmaceutical Sciences conduct research as well as teach, which means that all teaching is research based and that students are introduced to the latest new research.

Another feature is problem-based learning focusing on an active problem-solving approach. Teaching is often a combination of lectures, classroom teaching, hands-on laboratory exercises and report, article and poster preparation. Group projects are common. The underlying philosophy is to ensure that programme graduates acquire the competences required by the job market.

ACADEMIC YEAR

The academic year at the Faculty of Pharmaceutical Sciences starts in the last week of August and ends on approx. 30 June. The year is divided into four 9-week blocks (15 ECTS credits in each block). Most courses are valued at 7.5 ECTS credits, in other words, the basic workload is two courses per block.

For detailed information on teaching periods and holidays see: www.farma.ku.dk/msc

PRACTICAL INFORMATION

Application deadlines

- 1 March for non-EU/EEA citizens
- 15 May for EU/EEA citizens (including Danish citizens)

Application form:

Download the application form from www.farma.ku.dk/msc

Admission requirements: A bachelor's degree in natural, health, pharmaceutical or technical sciences and a solid background in chemistry and biology.

For more details about admission requirements and selection criteria see www.farma.ku.dk/msc

Tuition: All EU/EEA citizens are exempt from tuition fees for the MSc in Pharmaceutical Sciences programme, which are covered by the Danish state.

Non-EU/EEA citizens must pay tuition for Danish educational programmes. The annual fee for the MSc in Pharmaceutical Sciences programme is DKK 108,000/EUR 14,400 (2012 level).

Living costs: The average cost of living for students in Copenhagen is DKK 7000/EUR 930 per month depending on housing expenses and general living standard.

Would you like to know more?

Find more detailed information at www.farma.ku.dk/msc

Or contact:

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