

English translation of the official publication

# European Master in Comparative Morphology

at the University of Veterinary Medicine, Vienna

## Curriculum 2012

as of 28<sup>th</sup> June 2012

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# 1. General Provision

## 1.1. Legal Basis

The legal basis for Master's Studies can be found in the Austrian Universities Act or *Universitätsgesetz* (UG 2002). It is a program according to § 54 paragraph 9.

## 1.2. Preliminary Remarks

This European Master will be implemented at five European universities: University of Antwerp – Belgium, Justus Liebig University of Giessen – Germany, Poznan University of Life Sciences – Poland, University of Naples – Italy, and University of Veterinary Medicine Vienna – Austria.

With this Master course we will provide education for students on an international level thus being at the core of EU policies that aim for mobility, cultural diversity, knowledge exchange within the EU, as well as European-wide and/or international employability of future graduates.

# 2. Profile of Qualification

The European Master in Comparative Morphology aims to provide the graduates with advanced and up-to-date knowledge and skills within the scientific domain of comparative vertebrate morphology.

Graduates of the European Master in Comparative Morphology are provided with the necessary skills to apply basic and specialized scientific work methods and laboratory technologies. The students will be trained to analyze and answer scientific problems, related to the domain of comparative morphology efficiently and independently using appropriate techniques. Furthermore, graduates will be capable of critically and independently reviewing scientific insights and results so as to apply such knowledge in their own projects. Particular focus is placed on integrating students into current research projects at the University early on. As a result, graduates are introduced to team-oriented work and complex problem-solving at an early stage.

The master of Comparative Morphology can significantly contribute towards advising and designing *ex vivo/in vitro* alternatives to animal experimentation, the most adequate experimental setting for an animal model or the most appropriate animal model, and the precise interpretation of morphological data of an experiment involving animals.

The domain of *in vivo*, non-invasive imaging and molecular imaging is rapidly evolving. This needs to be backed up by a similar increasing knowledge regarding the morphological structures that are visualized via these new techniques. The combination between the expertise the EUCOMOR graduate has gained regarding vertebrate morphology on the macro- and microscopic level and the technical skills via the elective clusters (imaging and cell culture) guarantees that he can identify the structures that are visualized and can advise and design the appropriate imaging techniques for visualizing certain structures.

The innovative interactive approach creates an international teaching platform that is based on mobility of people. The international character of the European Master in Comparative Morphology offers those involved extra-curricular competences that are helpful for teaching and research and provides them with an international network.

### **2.1. Competences**

This European Master in Comparative Morphology will offer in depth knowledge and practical skills associated with comparative morphology (embryology, histology and anatomy) of vertebrates (including laboratory animals, wildlife, lower vertebrates, non-human primates) as well as microscopic techniques in a coherent and relevant program.

The master in comparative morphology needs to possess a number of competences. These competences are part of 5 main competence fields: scientific expert/researcher, scientific advisor/communicator, collaborator, professional and life-long learner. This curriculum will deliver graduates who fulfill these requirements. The focus of this program is mainly research oriented, comprising knowledge gathering, but also practical skills and attitudes. Additionally, transferable skills such as communication and collaboration play vital roles, as the graduate will also need these competences during daily life as a professional. Moreover the mobility periods exert positive effects from the socio-cultural and personal development point of view and add to the competences and competitiveness of the EUCOMOR graduates.

## 2.2. Key Qualifications

The goal of the Master's Program is to introduce students to the most relevant foundations of certain subjects in the fields of comparative morphology.

Within the abovementioned 5 competence fields, 12 key competences have been defined for this curriculum. The graduate

1. is able to compare the different organ systems of vertebrates:
  - a) Can recognize and describe on a macro- and microscopic level the development (embryogenesis, organogenesis), structure and parts of the different organ systems (incl. neuroanatomy) of vertebrates (lower vertebrates, lab animals and non-human primates will receive particular attention).
  - b) Can compare animal species and explain differences in function based upon the morphology of organ systems.
  - c) Can also design new research questions to explain the similar or different morphology of organ systems from a functional viewpoint.
2. applies vertebrate cell biology:
  - a) Can describe and identify the development, structure and parts of the vertebrate cell.
  - b) Can apply the suitable methods to visualize and/or study/analyse the function of vertebrate cells or their components related to their form and tissue/organ/organism they belong to.
3. comprehends the general evolutionary patterns of vertebrate morphology:
  - a) Has knowledge of the evolutionary lines of vertebrate morphology with emphasis on biodiversity.
  - b) Is able to extrapolate knowledge to changes, differences and similarities in vertebrate morphology, which were induced by evolution and ecological changes.
  - c) Can formulate research questions to explain the similar or different morphology due to evolutionary or ecological changes.
4. is experienced with different morphological techniques:
  - a) Is familiar with in vitro/ex vivo experimental techniques, stem cell cultivation, experimental embryology, microscopic techniques and image acquisition/analysis techniques.
  - b) Can select and apply the most suitable technique for scientific research in (comparative) morphology.

5. interprets the scientific literature in vertebrate morphology:
  - a) Can gather, discuss and reflect on scientific literature, i.e. complex scientific matters within the domain of vertebrate morphology.
  - b) Is able to integrate scientific literature in morphology in a research protocol and the reporting of research results.
6. is able to conduct scientific research in the domain of vertebrate morphology:
  - a) Can perform experiments independently and within a team by applying the gained knowledge and experience in a concrete scientific question in the domain of (comparative) morphology.
  - b) Can postulate a complex hypothesis, design a research plan (including advanced technical handling), analyze the results with the suitable methods. He/she can discuss the research results in the currently available scientific context.
7. Knows and can use the legislation regarding animal/biomedical research:
  - a) Knows the national, European and international legislation and guidelines regarding animal/biomedical research and can use it in on-going and future research activities
  - b) Has an open mind for the cultural, ethical and scientific arguments that influence the legislation of animal/biomedical research, which allows him/her to provide advice in a scientific and ethical correct way.
8. can develop animal/cell models:
  - a) Is able to integrate knowledge and skills in order to develop/design and critically analyze new complex animal models
  - b) Can develop in vitro/ex vivo alternatives within biomedical research and education.
9. is able to communicate and provide advice on the design, results and legislation of animal/research models:
  - a) Is able to report (written and verbally) his/her scientific research results and knowledge to colleagues, learners and non-experts from a national and international public.
  - b) Can substantiate his/her advice regarding animal experiments and biomedical research in a scientific and ethically correct manner.
  - c) Listens in an active manner and is able to debate about research models with colleagues, expert groups, policy makers and a broad audience
  - d) Can give convincing and complete advice regarding the value, accuracy and applicability of these models/alternatives.
  - e) Has a basic knowledge of at least 2 EU languages.

10. can function as part of a multidisciplinary team:
  - a) Shows a flexible attitude and the social capability to function in a team
  - b) Possesses the required leadership capabilities to play an active role in a team in a corporate, academic or institutional setting.
11. has a result focused, competitive attitude and critical mind-set:
  - a) Has an open, creative and critical mind-set and is focused on a professional approach, applying his/her knowledge in the domain of comparative morphology.
  - b) He/she is open-minded to the European culture.
12. is able to continue his/her studies in a self-driven and independent manner and recognizes that an attitude of life-long learning is a prerequisite.

To facilitate practical implementation and a work-related application of knowledge, students must participate in at least one project during a research internship offered in the second or third semester. At the same time, such a practical education encourages social and problem-solving skills. Research internships may be performed at the University of Veterinary Medicine Vienna, at one of the partner universities, or at other domestic and foreign universities, as well as appropriate external institutions or corporations.

### 2.3. Occupational Fields

Graduates of the EUCOMOR Program will be found in leading positions in the following fields:

- Research facilities of the pharmaceutical and biomedical industry
- Universities and other post-secondary education facilities
- Public and private pertinent research facilities

## 3. Study Structure

Each academic year comprises 60 ECTS Credits. These 60 ECTS Credits are split in two semesters of 30 ECTS Credits each. The semesters are organized during the academic calendar and run for 17 weeks including teaching units and exams.

The MSc EUCOMOR will last 2 years with a total of 120 ECTS credits, and is divided into 3 course modules and a master thesis.

The program comprises **60 ECTS credits for compulsory courses, 30 ECTS credits for elective courses and 30 ECTS credits for the Master thesis**. Within the compulsory courses, a cluster of 30 ECTS credits (morphology core courses) is offered at two different universities and students can choose where to follow this cluster. Additionally the elective courses (organized in two clusters) as well as the Master thesis are offered at different universities and require mobility of the students and teachers (see below for a schematic representation of the possible **mobility tracks**).

### 3.1. Semester 1

Bridging courses, update of student's knowledge (30 ECTS): The first semester intends to provide a theoretical basis for the entire program and to update the bachelor graduates entering the master program. It consists of 30 ECTS compulsory courses, which are offered as e-lectures. Working via e-lectures, e-instructions, virtual microscopy and anatomy, the students are guided and monitored via scheduled feedback sessions using the e-learning platform.

### 3.2. Semester 2 or Semester 3

Morphology core courses (compulsory, 30 ECTS), cell culture (elective, 30 ECTS), imaging (elective, 30 ECTS): In the 2nd and 3rd semester, the mobility tracks chosen by the students come into play as three clusters are offered simultaneously at different institutions (see detailed description and mobility tracks).

The final 4 weeks of the elective clusters in the 2nd and 3rd semester consist of a research internship (9ECTS) during which the students participate in an active manner in a research lab affiliated with the 'organizing' institution, with an expertise related to the elective cluster that was chosen. This ensures that the students acquire a more in depth training and integration of the knowledge, skills and attitudes regarding the elective cluster course's contents. Additionally, this research internship is intended to provide the student with the skills for conducting an own research topic/protocol as part of the Master thesis during the final semester.

### 3.3. Semester 4: Master's Thesis

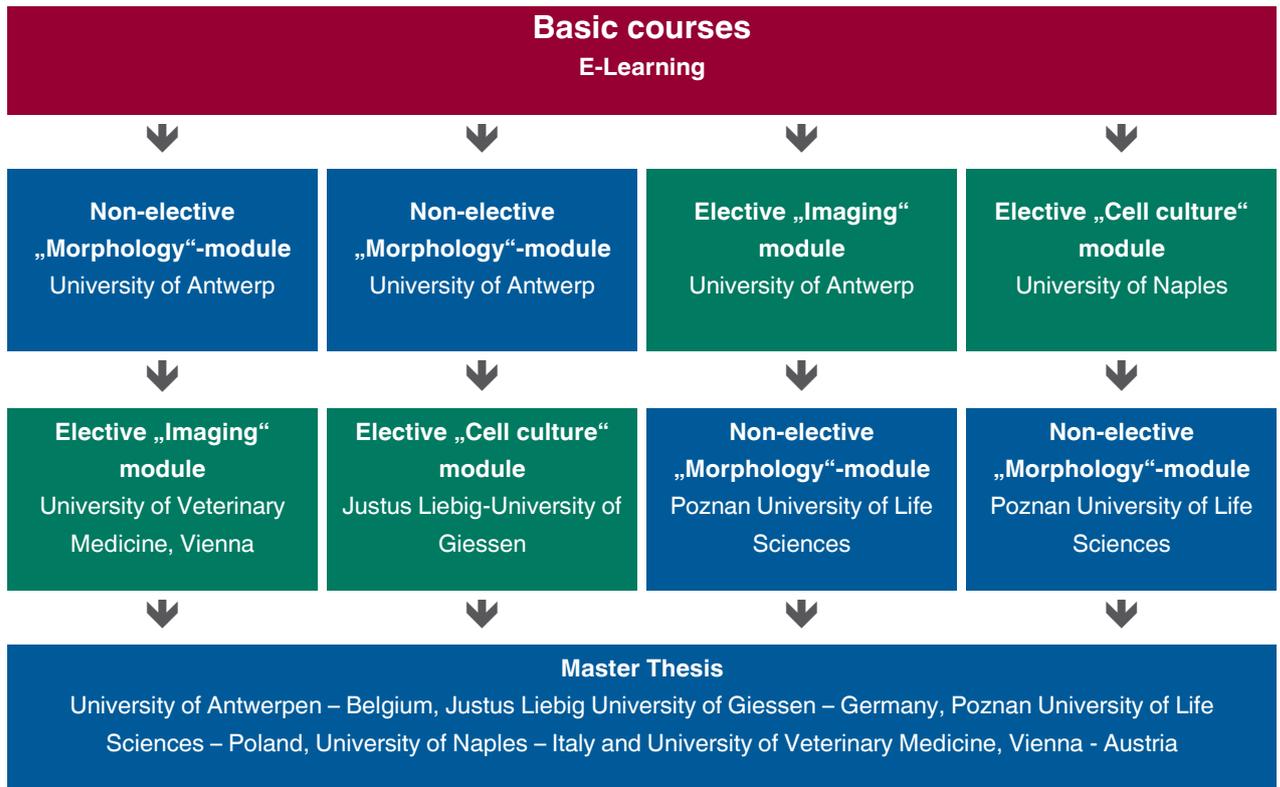
All students are required to compile a Master's thesis which covers 30 ECTS credits. Writing a master thesis aims to evaluate, on the basis of knowledge and skills learned during the previous years, if the student is able, under supervision, to carry out research activities based on scientific literature in morphology. Students need to choose a topic that is offered by a research group from the participating universities or affiliated research groups related to the field of Comparative Morphology.

### 3.4. Detailed Description

1 <sup>st</sup> semester	2 <sup>nd</sup> semester	3 <sup>rd</sup> semester	4 <sup>th</sup> semester
<b>e-learning</b>	<b>In Antwerp</b>	<b>In Giessen</b>	
<b>Basic biology and cell biology</b> 6 ECTS credits by Vienna	<b>Laboratory animal morphology</b> 6 ECTS credits by Antwerp/Poznan	<b>Cell culture</b> 6 ECTS credits by Giessen	<b>Master Thesis</b> 30 ECTS credits
<b>Basic vertebrate anatomy</b> 6 ECTS credits by Naples	<b>Comparative neuroanatomy</b> 6 ECTS credits by Naples/Antwerp	<b>Stem cells</b> 3 ECTS credits by Giessen	
<b>Basic vertebrate histology</b> 6 ECTS credits by Giessen	<b>Functional and ecological morphology</b> 6 ECTS credits by Antwerp/Poznan	<b>Experimental embryology/morphology</b> 6 ECTS credits by Giessen/Naples	
<b>Basic vertebrate embryology</b> 6 ECTS credits by Antwerp	<b>Morphology of non-human primates</b> 6 ECTS credits by Antwerp	<b>Advanced molecular techniques in morphology</b> 6 ECTS credits by Giessen/Naples	
<b>Scientific methodology</b> 6 ECTS credits by Vienna/Antwerp	<b>Morphology of lower vertebrates</b> 6 ECTS credits by Antwerp/Poznan/Naples	<b>Research internship</b> 9 ECTS credits by Giessen	
	<b>OR</b>	<b>OR</b>	
	<b>In Antwerp</b>	<b>In Vienna</b>	
	<b>Microscopical imaging</b> 6 ECTS credits by Antwerp/Vienna	<b>Microscopical imaging</b> 6 ECTS credits by Vienna/Antwerp	
	<b>Principles in vivo imaging</b> 6 ECTS credits by Antwerp/Vienna	<b>Principles in vivo imaging</b> 6 ECTS credits by Vienna/Antwerp	
	<b>Image analysis</b> 6 ECTS credits by Antwerp/Vienna	<b>Image analysis</b> 6 ECTS credits by Vienna/Antwerp	
	<b>3-D Rendering</b> 3 ECTS credits by Vienna	<b>3-D Rendering</b> 3 ECTS credits by Vienna	

1 <sup>st</sup> semester	2 <sup>nd</sup> semester	3 <sup>rd</sup> semester	4 <sup>th</sup> semester
	<b>Research internship</b> 9 ECTS credits by Antwerp	<b>Research internship</b> 9 ECTS credits by Vienna	
	<b>OR</b>	<b>OR</b>	
	<b>In Naples</b>	<b>In Poznan</b>	
	<b>Cell culture</b> 6 ECTS credits by Giessen	<b>Laboratory animal morphology</b> 6 ECTS credits by Poznan/Antwerp	
	<b>Stem cells</b> 3 ECTS credits by Giessen	<b>Comparative neuroanatomy</b> 6 ECTS credits by Naples/Antwerp	
	<b>Experimental embryology/morphology</b> 6 ECTS credits by Naples/Giessen	<b>Functional and ecological morphology</b> 6 ECTS credits by Poznan/Antwerp	
	<b>Advanced molecular techniques in morphology</b> 6 ECTS credits by Naples/Giessen	<b>Morphology of non-human primates</b> 6 ECTS credits by Antwerp	
	<b>Research internship</b> 9 ECTS credits by Naples	<b>Morphology of lower vertebrates</b> 6 ECTS credits by Poznan/Antwerp/Naples	

### 3.5. Mobility Track



Schematic representation of the mobility tracks. Each of the lines represents a semester:  
 red box: e-lectures/basic courses, blue boxes: compulsory courses or master thesis, green  
 boxes: elective cluster.

## 4. Study Admission

Students will be admitted to the European Master in Comparative Morphology after a joint application procedure implemented by the Consortium.

Admission to the European Master in Comparative Morphology requires completion of a relevant university or university of applied sciences (Fachhochschule) degree in the amount of at least 180 ECTS credits, i.e. corresponding to a minimum of 3 years of bachelor study. Admitted are bachelor students in Life Sciences (e.g. chemistry, biology, biomedical sciences, bioengineering, biochemistry, veterinary medicine, medicine, dentistry, zoology, pharmacy). The bachelor program should have contained a minimum of 6 ECTS credits of cell biology, biology and/or animal morphology. Students in their last year of such a bachelor program will also be considered.

English, both spoken and written is necessary. All non-native speakers are required to submit an English proficiency test. IELTS (academic version) overall band score of at least 6.5 or a TOEFL score of at least 580 (paper based) or 237 (computer based) or 92 (internet based) are considered sufficient.

The admission policy is intended to ensure equal opportunity of access to higher education for qualified European and third country students.

## 5. Types of Courses and ECTS

**E-lectures, Lectures** or *Vorlesungen* serve to convey basic concepts and elaborate certain content in a didactically appropriate manner with modern audio-visual support.

**Lab sessions/Practical courses** or *Übungen* serve to communicate practical skills and special capabilities needed in a professional environment.

**Assignments/Seminars** or *Seminare* serve to facilitate scientific discussion. Participants are expected to provide oral and/or written participation. Students are expected to actively participate in seminars, where learning in small groups provides the ability to apply knowledge for analysis and problem-solving.

**Research internship** or *Projektmitarbeit* constitutes co-work on a scientific subject under instruction and assistance of an instructor. Regular summarized presentations of work progress are expected.

### **ECTS credits**

The European Credit Transfer System (ECTS) serves to facilitate inter-university and inter-European accreditation. ECTS credits are allotted based on the necessary work load (both in and outside class). Both Research internship and master's theses are allotted ECTS credits as well.

The ECTS requires 120 credits for a two-year master's program.

ECTS credits for lectures including examinations as well as classes with immanent examination are listed separately. Should a class with immanent examination be part of a class including regular examination, then all ECTS credits stated are deemed included in the overall points for the relevant subject.

Student workload is reflected in the ECTS credits, 1 ECTS credit = 25 – 30h student work load according to national legal regulations. The student workload per course is depicted in the table below. From this it becomes clear that the student workload is between 1500 h and 1800 h/academic year (in accordance with ECTS guidelines). The number of hours lecturing, lab sessions and contact time for the assignments (instruction, feedback, discussion) is set and included in the course information.

All students need to earn 30 ECTS credits per semester for a total of 120 ECTS credits. ECTS credits are used to record students' mobility transfers.

## 6. Regulations for Examination

In the exams the students must proof that he or she has mastered the backgrounds and methods of the comparative morphology fields and that he or she is able to apply them in a scientific manner within a selected area. Exam results obtained at any partner university are fully recognized at all the partner universities within the consortium. The EUCOMOR consortium uses the ECTS grading table for equal grading across EU countries.

The assessment methods are chosen in function of the teaching method and the learning outcomes formulated.

The assessment method for compulsory courses is prominently assessing the knowledge of the students using a written exam with open questions and multiple choice questions. The 'morphology' compulsory courses give a more in depth and specialized training, resulting in a master of comparative morphology that can function as a scientific advisor and communicator. Accordingly the assessment methods include, besides an assessment of the knowledge and understanding of the course content, a continuous and peer assessment for the lab sessions and group assignments.

During the elective courses, the students are trained more in depth in specific morphologic techniques and acquire more advanced research skills during the research internship. The latter confronts the student with his/her skills/attitude as a professional expert of comparative morphology. In consequence, oral exams, continuous and peer assessment are the core method for assessing the student's progress, skills, and knowledge.

The corner-piece of the program, the Master thesis, combines all knowledge, skills and attitudes and enables the student to show he/she has acquired all the learning outcomes. During the Master thesis the student is further trained in becoming a master of comparative morphology who can collaborate, be a professional, a scientific advisor/communicator and a life-long learner.

Thus, the program gradually shifts from a more 'classic' concept of teaching and learning towards a placement during which the student is self-responsible for the acquirement of the necessary skills, attitudes and competences.

### 6.1. Requirements for Admission to Courses and Examinations

Successful completion of the exams outlined under the module 'Bridging courses' is compulsory for admission to the 2nd semester. 30 ECTS credits need to be acquired.

Additionally, for final admission to the 4th semester, successful completion of the exams of the 'Core morphology courses' and either elective 'Cell culture' or 'Imaging' is required before commencing Master's Thesis work. 90 ECTS credits need to be acquired.

Positive evaluation of the master thesis is required for admission to the Master's exam.

The defense is an oral presentation of the master thesis by the student that takes place after approval of the written thesis by the examination committee.

\*SH = semester hours

## 6.2. Bridging courses

Course Name	Course Type	Assessment Method	SH	ECTS-credits
Basic biology and cell biology	e-lectures	Written	3	6
	e-instruction	Assignment (continuous assessment)		
Basic vertebrate anatomy	e-lectures	Written	2	6
	e-instruction	Assignment (continuous assessment)		
Basic vertebrate histology	e-lectures	Written	2	6
	e-instruction	Assignment (continuous assessment)		
Basic vertebrate embryology	e-lectures	Written	2	6
	e-instruction	Assignment (continuous assessment)		
Scientific methodology	e-lectures/ instructions	Assignments - Continuous assessment	1	6

### 6.3. Core Morphology courses

Course Name	Course Type	Assessment Method	SH	ECTS-credits
Laboratory animal morphology	lectures	Oral	2	6
	lab sessions	Continuous	2	
	assignments	assessment	0,5	
Comparative neuroanatomy	lectures	Oral	2	6
	lab session (dissection)	Continuous	1	
	assignments	assessment	0,5	
Functional and ecological morphology	lectures	Written	2	6
	assignments	Continuous assessment	1	
Morphology of non-human primates	lectures	Written	1,5	6
	assignments	Continuous assessment	1,5	
Morphology of lower vertebrates	lectures	Written	1,5	6
	lab session (dissection)	Continuous	2	
	assignments	assessment	0,5	

### 6.4. Elective courses – imaging

Course Name	Course Type	Assessment Method	SH	ECTS-credits
Microscopical imaging	lectures	Oral: open questions	2,5	6
	lab sessions	Continuous assessment	1,5	
Principles of in vivo imaging	lectures	Oral: open questions	2,5	6
	lab sessions		0,5	
Image analysis	lectures	Oral, open questions	2,5	6
	assignments		1,0	
3-dimensional rendering	lectures	Written: short answer open questions and multiple choice	1	3
	assignment		1	
Research internship	placement	Continuous assessment Assignment (quality of the lab journal and the presentation of the results)	16	9

### 6.5. Elective courses – cell culture

Course Name	Course Type	Assessment Method	SH	ECTS-credits
Cell culture	lectures	Oral: open questions	2	6
	lab sessions	Continuous assessment	2	
Stem cells	lectures	Oral: open questions	1	3
	lab sessions	Continuous assessment	1	
Experimental embryology/ morphology	lectures	Oral: open questions	2	6
	lab sessions	Continuous assessment	1,5	
	assignments		0,5	
Advanced molecular techniques in morphology	lectures	Oral: open questions	2	6
	lab sessions	Continuous assessment	1,5	
	assignments		0,5	
Research internship	placement	Continuous assessment Assignment (quality of the lab journal and the presentation of the results)	16	9

## 7. Master's Thesis

Master's theses may be submitted following successful completion of the above-mentioned examinations. The thesis consists of a document of approximately 50 pages of publishable quality.

The subject of a thesis must reflect a topic within the field of Comparative Morphology covered in the course of the master program.

Assessment is performed on the basis of the ECTS grading scale by the examination committee.

Master thesis project may be carried out at the University of Veterinary Medicine Vienna, at one of the partner universities, or at other domestic and foreign universities, as well as appropriate external institutions or corporations.

## 8. Academic Degree

After completing all mandatory classes (or accredited respective classes visited abroad) and receiving a passing grade for the Master's Thesis and its defence, studies are deemed completed and the consortium will issue a **Joint Degree** and a joint **Diploma Supplement** which includes the mandatory and elective clusters and mobility tracks of each student. This certificate allows graduates to carry the title Master of Science (MSc.).

Furthermore, completion of Master's Studies in Comparative Morphology empowers students to enroll in a doctorate or PhD program and pursue a profession in a leading capacity in the above-mentioned occupational fields.

## 9. Quality assurance

This curriculum was tailored based upon the results from a survey with different stakeholders (students, academia, biomedical and pharmaceutical industry). The drafted learning outcomes were sent to the student groups and potential employers for discussion and evaluation and consequently the comments were discussed within the international consortium. A periodic re-evaluation of the learning outcomes is part of the quality assurance of the curriculum.

The consortium has installed the following bodies of function:

### ■ Academic board

- Membership: a representative of each partner institution (full partners), two representatives of the students, one representative of the Advisory board.
- Meeting: at least twice a year
- Tasks: agrees annually on the curriculum and on the number of study places offered, appoints the lecturers and the coordinating and administrative staff, organizes the selection procedure and selects the students, allocates students to study places, research internships and Master thesis subjects, monitors students' achievements and ensures feedback to the students, awards the final scores for the thesis and delivers the joint degree, is responsible for the overall quality assurance of the program.

### ■ Advisory board

- Membership: representatives of the working field (including professional organizations, other institutions, research institutes, biomedical and pharmaceutical companies) and at least 2 alumni. The advisory board constitutes of at least 15 members and elects amongst its members a representative to the Academic board and chairperson.
- Meeting: at least annually (the academic coordinator provides the platform for this meeting and the reporting to the Academic board).
- Tasks: issues recommendations to the Academic board on the curriculum (including dissertation topics), appoints representatives to take part in the dissertation examination committee.

### ■ Examination committee

- Membership: per student the commission is composed out of the Master thesis supervisor, two members of the academic staff belonging to the partner institutions, one member of the Advisory board and the peer students involved in the same research project.
- Task: recommend a score for the Master thesis

■ **Academic coordinator**

Tasks: presides the Academic board (drafts the agenda and is in charge of the minutes), governs the daily academic coordination of the program, governs the quality assurance of the program, delivers preparatory input for the selection and enrolment procedures of the students and for the meeting of the Advisory board.

■ **Administrative coordinator**

Tasks: responsible for the administrative and financial processing of the program, responsible for the document flow between the participating institutions and communication lines.

■ **Quality assurance manager**

Task: carries out the internal quality assurance measurements and follows the quality assurance policy as described in the quality assurance handbook, and reports to the Academic board.

The program needs to get national accreditation in each of the participating countries. Since these procedures vary, the local accreditation procedure forms a kind of external quality assurance for the other participating countries/universities. In some European countries (e.g. Flanders) the program is externally evaluated every eight years.

## 10. Enactment

This curriculum comes into force at the beginning of the academic year following its approval by the Senate.