

## Training programme for recognition as an SMBWO Immunologist

The immunology training programme is one of the recognized training programmes under the auspices of SMBWO, the National Foundation for the Promotion and Maintenance of a System of Training Programmes for Biomedical Scientists. The establishment of these SMBWO training programmes has two goals. Firstly, training institutes which want to provide training programmes of this kind must meet requirements which show that they are able to provide broad theoretical and experimental training in the field in question, such as immunology, at a sufficiently high academic and scientific level. In addition, the biomedical scientists who receive their training at a training institute of this kind are assured of adequate training as biomedical scientists.

During their training programmes at one of the current eight training institutes, candidates are supervised by trainers appointed by the SMBWO. On behalf of the SMBWO the Immunology Supervision and Assessment Committee (*Commissie van Toezicht en Beoordeling* = CTB) monitors the training programmes and the qualification requirements to be met by the candidates by the end of these programmes. In the past few years (2000-2009) a total of 110 individuals have been recognized as SMBWO Immunologists. A small number of these proceeds to the medical immunology training programme, for which completion of the SMBWO immunology training programme is a requirement. The medical immunology training programme comes under the responsibility of the Training and Registration Committee (*Commissie Opleiding en Registratie* = COR) of the Dutch Society for Immunology.

In practice the training programme leading to SMBWO recognition as an Immunologist is done in four years, in combination with scientific research culminating in a PhD. Becoming effective at 2008, the General Terms and Conditions and the Regulations of the training programme and its Learning Outcomes have been updated and made more transparent. This updated information may be found on the websites of the SMBWO and the Dutch Society for Immunology. An overview of the training institutes and the trainers may also be found on these sites. In view of the general standards set by the SMBWO for the training programmes it recognizes and the specific requirements set for the training programme for SMBWO Immunologists, recognition as an SMBWO Immunologist guarantees high qualifications.

Unfortunately 'Immunologist' is not a protected title. Nationally and internationally the first cautious steps have been taken to attain recognition of this title. At present the only intrinsic value of having completed the SMBWO immunology training programme is that successful candidates are assured of good training as researchers in medical biology in general and in immunology in particular, in a training programme which is broader and goes further than the candidate's own PhD research. However, this is not to be underestimated; moreover, it is expected that the value of this broad training in immunology will become even greater because of the growing significance and range of this field in medical biology and because of the increasing tendency towards specialization. If appropriate, leaders of immunology research groups will therefore expressly ask SMBWO-recognized Immunologists to apply for vacant positions.

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## SMBWO: Regulations for the immunology training programme

Regulations for the immunology training programme in the context of the General Regulations of the Foundation for the Promotion and Maintenance of a System of Training Programmes for Biomedical Scientists (*Stichting ter bevordering van instelling en instandhouding van een stelsel van opleidingen tot Medisch-Biologisch Wetenschappelijk Onderzoeker* = SMBWO).

### I. GENERAL TERMS AND CONDITIONS AND REGULATIONS FOR THE IMMUNOLOGY TRAINING PROGRAMME

#### 1. Objective

The objective of the training programme is to provide post-Master's training, that is training for candidates who have already obtained a *doctoraal* or Master's degree. The aim is to educate scientifically and methodologically trained immunologists in order to perform immunological research in Medicine, Biomedical Science and Medical Biology. The general programme requirements, the specific programme requirements (including the requirements set for trainers) and the establishment of a Supervisory and Assessment Committee (*Commissie van Toezicht en Beoordeling* - CTB) are regulated in accordance with Articles D, E and F respectively of the General Regulations of the SMBWO.

#### 2. Previous training and qualifications

The SMBWO Immunology training programme is open to candidates who have obtained a *doctoraal* or Master's degree in a university training programme included in the area of Biomedical Sciences.

If the candidate has qualifications from abroad, he or she must be able to show that these qualifications are equivalent to the corresponding university training programme at a Dutch university in accordance with the international agreements which apply. If there is no such agreement, then on the basis of a detailed description – to be furnished by the candidate – of the candidate's prior training in the required supporting subjects and general scientific training the Immunology CTB will make a binding decision as to whether or not the candidate will be admitted to the programme.

#### *Explanatory note*

*In the first instance those eligible for the immunology training programme will be trainee research assistants, including scholarship students, and trainee medical specialists who are working at an institute with a recognized immunology training unit. If a degree from abroad has to be assessed, the candidate will have to apply to the Nuffic (Netherlands Organisation for International Cooperation in Higher Education). Any charges for this assessment will be payable by the candidate. If necessary the Immunology CTB will also ask Nuffic for information about the assessment of university degrees obtained abroad.*

#### 3. Curriculum

The SMBWO training programmes are professionally oriented programmes to train biomedical scientists. The immunology training programme is one of the recognized SMBWO training programmes and follows on from a *doctoraal* or Master's degree in one of the Bio-medical Sciences. The SMBWO immunology training programme is available at several university medical centres in the Netherlands under the responsibility of a local trainer. These trainers are appointed by the SMBWO on the recommendation of the Immunology CTB.

The training programme for biomedical scientists specializing in immunology consists of three components, namely:

1. Additional training in supporting subjects (in some cases) and supplementary broad scientific training (see Article 3.1)
2. Theoretical and experimental training in immunology (see Article 3.2)
3. A period of scientific research relating to immunology (see Article 3.3).

After a total of four years of training, the candidate will complete the programme by writing a PhD thesis and obtaining a PhD.

*Explanatory note*

*It cannot be assumed that the post-Master's immunology training programme will be available at every university. An Appendix to these regulations includes an overview of the university medical centres where the SMBWO immunology training programme is now offered and of the local trainers. This overview is updated regularly. With respect to the first two components of the immunology training programme, every candidate must be supervised by an immunology trainer who monitors the training programme and the candidate's progress and keeps the Immunology CTB informed.*

*3.1 Training in supporting subjects and general scientific training*

If the candidate has not had sufficient training in these subjects in the context of his or her *doctoraal* or Master's degree programme (see under Article 2), he or she will have to have additional training in the support subjects Human Physiology, Cell Biology and Histology, Biochemistry, Genetics, Microbiology, General Pathology and Statistics, and in aspects of general scientific training, such as writing a research proposal, presenting papers in English both orally and in writing, and Epidemiology (see part II: Learning Outcomes, Section 2). The candidate does not have to complete this supplementary training in supporting subjects and general scientific training before beginning specific training in immunology and scientific research.

Before a candidate begins the training programme, he or she must provide the trainer with detailed information about his or her prior training in the supporting subjects and general scientific training during his or her university training programme. For this purpose the candidate will fill in the SMBWO immunology training programme application form. The trainer will check that the form has been filled in completely and will send the application form on to the Immunology CTB. The CTB will assess this information and indicate in which components additional training is needed.

*Explanatory note*

*It will be clear that the character of this training programme depends on the candidate's prior training. For the training required in supporting subjects and elements of general scientific training, the Research Major degree programmes of the Dutch university programmes in Biomedical Science and Medical Biology may serve as a frame of reference.*

All candidates who wish to do the training programme must provide the trainer with a detailed overview of their prior training in the supporting subjects and general scientific training. On the basis of this overview the Immunology CTB will assess whether supplementary training is needed and if so in which supporting subjects and/or elements of general scientific training. If a considerable amount of supplementary training is necessary, the Immunology CTB may advise the candidate to consider deciding not to embark on the SMBWO immunology programme.

If applicable, it is recommended that the candidate concentrate on the general part of the programme, that is supplementary training in the supporting subjects (if necessary) and general scientific training (if this was not included in the candidate's prior university training) in the first two years of the post-graduate training programme.

*3.2 Theoretical and experimental training*

The programme includes broad theoretical training in immunology at a higher level than during the candidate's prior university training, and training in immunological techniques. A thorough and broad knowledge of immunology is gained by studying a comprehensive textbook. Integration of and critical and creative application of this knowledge takes place during various activities relating to scientific training in immunology. The candidate extends his or her theoretical knowledge by acquiring skills in the execution of techniques used in immunological research. After completing

the training programme the candidate must have attained the level of theoretical knowledge of immunology and the technical skills set out in the Learning Outcomes of the post-Master's immunology training programme (see part II: Learning Outcomes, sections 3 and 4).

### *3.3 Scientific research*

In addition to the aspects listed in Article 3.2, scientific training in immunology also includes conducting scientific research in the field of immunology during a period of at least 4 years. The research project (PhD project) does not necessarily have to be carried out entirely or partially within one of the SMBWO immunology training units. Before the training programme begins, the trainer must also submit the trainee's research project to the Immunology CTB for assessment of its relevance to immunology. For this purpose the title of the research project and a short description of the research questions and the intended experimental approach must be included with the application form for the SMBWO immunology training programme. The research project must culminate in a PhD and several publications in internationally recognized academic journals, in accordance with Article D, Paragraph 2 of the General Regulations of the SMBWO.

#### *Explanatory note*

*The trainee's scientific training will take place during a period of active scientific research as a trainee researcher or in some other capacity. The research involved may be either fundamental or applied, but it must be sufficiently theoretical, experimental and innovative in character for scientific training in immunology to be guaranteed. This will be assessed by the Immunology CTB before the training programme begins, so that the candidate can be notified at an early stage of the project whether or not the research period can be regarded as part of the SMBWO immunology training programme. It should be noted that the CTB cannot and does not wish to exert any influence on the content and programming of the research project. Responsibility for this lies entirely with the project leader or PhD supervisor.*

At least four publications in the field of immunology with the candidate as first author, or three publications with the candidate as first author and two publications with the candidate as second author, must appear in international peer-reviewed academic journals (see part II: Learning Outcomes, section 5). In the case of papers which have been accepted but not yet published when an application for recognition as an SMBWO Immunologist is submitted, proof of acceptance must be furnished.

The candidate's defence of his or her PhD thesis must already have taken place before the final application for recognition as an SMBWO Immunologist is submitted.

## **4. Assessment**

After completing the training programme, the candidate fills in an application form for recognition as an SMBWO Immunologist and reviews it with the trainer. The trainer, who is appointed by the SMBWO on the recommendation of the Immunology CTB, checks that the candidate's statement of his or her theoretical and scientific training in immunology and his or her training in immunological techniques is correct and complete. The trainer sends the form, along with a copy of the candidate's PhD thesis, to the Immunology CTB. In an accompanying letter the trainer states that he or she supports the application, thus implicitly indicating that in his or her opinion the application form has been filled in completely and truthfully. The Immunology CTB assesses whether the candidate's training in the supporting subjects and his or her general scientific training satisfy the Learning Outcomes of the SMBWO immunology training programme. The Immunology CTB also assesses whether the candidate's theoretical and scientific training in immunology and his or her training in immunological techniques satisfy the Learning Outcomes. Finally the Immunology CTB assesses whether the candidate's scientific research is sufficient immunological in character and whether the candidate's publications meet the requirements formulated in the Learning Outcomes (see part II).

## **5. Certificate**

Candidates whose prior training satisfies the requirements listed in Articles 3.1 and 3.2, who have had the scientific training set out in Article 3.3 and who have received positive assessments from their trainer as regulated in Article 4 will, on the recommendation of the Immunology CTB, be given certificates by the SMBWO certifying that they are biomedical scientists specialized in immunology.

The Immunology CTB nominates a candidate to the SMBWO after a positive assessment of the candidate's application for recognition. This assessment is based on the Learning Outcomes of the post-Master's graduate training programme for biomedical scientists specializing in immunology (see part II).

## **6. Exceptions**

Candidates with prior university training who enter the field of immunology after obtaining their PhD must also satisfy all the Learning Outcomes, including a demonstrable period of 4 years in which they have been intensively engaged in research in the field of immunology. In consequence of this such candidates must also submit a list of publications which meets the criteria listed in Article 3.3.

In exceptional circumstances, to be assessed by the Immunology CTB, candidates who have completed a training programme at HBO level may be admitted to the training programme. It must be stressed that for these candidates training in the supporting subjects and general scientific training (see part II: Learning Outcomes, section 2) at the level of one of the *doctoraal* or Master's degree programmes referred to in Article 2 (Biomedical Science and Medical Biology) are also required. The candidate must submit proof of this training in the supporting subjects at university level and of general scientific training. Before the training programme begins, the trainer must submit the candidate's complete training programme, including the candidate's past or intended training in the supporting subjects and general scientific training, to the Immunology CTB for approval.

The SMBWO may recognize an individual who does not satisfy all the components listed in Article 5 as a biomedical scientist specialized in immunology if the candidate has special theoretical knowledge and practical competence in this field. The Immunology CTB will determine whether this is the case and nominate the candidate.

### *Explanatory note*

*The SMBWO may recognize individuals as Immunologists even though they have not completed the training programme referred to in Article 3 of the Regulations for the SMBWO Immunology Training Programme and specified in detail in the Learning Outcomes (see part II). Such individuals will be nominated for recognition by the Immunology CTB on the grounds that in the course of their work they have gained thorough and sufficiently differentiated theoretical knowledge and practical skills in the field of immunology and further that they have conducted eminent scientific research in this field which has resulted in publications in international peer-reviewed scientific journals. This option may in exceptional cases also be applied to individuals who have completed a training programme abroad which, in the opinion of the Immunology CTB, is equivalent to the training programme outlined in Article 3.*

## **7. Updating the curriculum**

All requirements laid down in the Regulations for the SMBWO Immunology Training Programme and the Learning Outcomes will be reassessed every four years by the Immunology CTB in the light of new developments and adjusted wherever necessary. Any changes in the Regulations and the Learning Outcomes will, after approval by the SMBWO, apply to candidates who begin the programme from that time point onwards.

## 8. Other

All regulations regarding the training programme, training institutes and trainers will be adopted in accordance with the General Regulations of the SMBWO.

## II. LEARNING OUTCOMES OF THE POST-MASTER'S TRAINING PROGRAMME FOR BIOMEDICAL SCIENTISTS IN IMMUNOLOGY

### 1. Introduction

By the end of the SMBWO Immunology postgraduate training the candidate must have brought the level of his or her training in the supporting subjects and general scientific training up to the level indicated in Article 2. The candidate must by then also have gained a broad theoretical and practical knowledge of immunology (see Articles 3 and 4) and specific scientific training in the field of immunology (see Article 5). This must be evidenced by the candidate having accomplished a PhD thesis in the field of immunology and the publication of articles in international peer-reviewed academic journals associated with immunology.

The Learning Outcomes of the SMBWO Immunology training programme set out below will be evaluated periodically by the Immunology CTB and revised if necessary on the basis of developments in university teaching programmes.

### 2. Prior academic training

#### 2.1. Supporting subjects

The learning outcomes of the supporting subjects are based on those of the *doctoraal* or Master's degrees in Biomedical Science or Medical Biology in the Netherlands. It is assumed that candidates who have obtained a *doctoraal* or Research Master's degree in one of these two university training programmes have sufficient knowledge of the supporting subjects. This also applies to candidates who have obtained these degrees abroad, provided that those degrees are equivalent to the Dutch degrees according to international treaties. For candidates who have completed other university programmes in the life sciences in the Netherlands or elsewhere or who have completed a university programme in biomedical science or medical biology abroad which is not considered to be equivalent to the corresponding Dutch programme, the Immunology CTB will determine whether or not the candidate needs supplementary training in the supporting subjects and if so in which subjects.

The application form for recognition must be accompanied by proof that the candidate has had sufficient training in each of the supporting subjects for which supplementary training was necessary. This proof may consist of an examination pass slip, a certificate, or a short note from the lecturer who conducted the oral examination.

One or more textbooks for each supporting subject are listed below. This list may serve as an indication of the required level and depth. In principle the textbooks which are currently listed as compulsory core textbooks for the subjects in question in the study guides for the training programmes in Biomedical Science or Medical Biology at the various university medical centres in the Netherlands will suffice.

#### Physiology

Fundamentals of human physiology, including the physiology of blood and circulation, the respiratory system, the digestive system, the nervous system, endocrine organs and the urogenital system, as set out for example in:

*Medical Physiology: A Cellular and Molecular Approach*, W.F. Boron & E.L. Boulpaep, Elsevier Saunders, or

*Pathophysiology of Disease: An Introduction to Clinical Medicine*, S.J. McPhee, V.R. Lingappa & W.F. Ganong, McGraw-Hill.

### Cell Biology/Histology/Molecular Biology

Fundamentals of cell biology and histology, as set out for example in:

*Molecular Biology of the Cell*, B. Alberts et al., Garland, or

*Histology: A Text and Atlas with Correlated Cell and Molecular Biology*, M.H. Ross & W. Pawlina, Lippincott Williams & Wilkins.

### Biochemistry

Fundamentals of biochemistry, as set out for example in:

*Biochemistry*, M.K. Campbell & S.O. Farrell, Thompson Brooks/Cole.

### Genetics

Fundamentals of medical and molecular genetics as set out for example in:

*Human Molecular Genetics 3*, T. Strachan & A.P. Read, Garland or

*Emery's Elements of Medical Genetics*, P. Turnpenny & S. Ellard, Elsevier Churchill Livingstone.

### Microbiology

Fundamentals of microbiology as set out for example in *Medical Microbiology*, P.R. Murray, K.S.

Rosenthal and M.A. Pfaller; Elsevier Mosby, or *Sherris Medical Microbiology: An Introduction to*

*Infectious Diseases*, K.J. Ryan and C.G. Ray, McGraw-Hill.

### Pathology

Fundamentals of general pathology, including inflammatory reactions and growth abnormalities.

Also the specific pathology associated with autoimmune diseases, transplantation and diseases

of the lymphohaemopoietic system (including leukaemias and lymphomas), as set out for

example in *Robbins and Cotran Pathologic Basis of Disease*, V. Kumar, A.K. Abbas and N.

Fausto, Elsevier Saunders.

### Statistics

Fundamentals of medical statistics as set out for example in *Medical Statistics at a Glance*, A.

Petrie and C. Sabin, Blackwell.

## 2.2 Broad scientific training

The candidate must be able to show that he or she has had instruction in the following aspects of general scientific training:

- Writing a research proposal
- Presenting papers in English both orally and in writing
- Methodology in research: Statistics (see also Supporting Subjects) and Epidemiology.

If these aspects have not been raised during the candidate's previous university training, the candidate will have to receive this training during his or her SMBWO immunology training programme.

If possible the candidate should gain teaching experience in the form of assisting students with both the theoretical and practical aspects of research internships and writing an initial plan for a student project.

## 3. Theoretical knowledge of immunology

This broad theoretical training in immunology consists of two components:

### 3.1. Thorough and integrated theoretical knowledge of immunology

The candidate must have a thorough and integrated knowledge of immunology, so that he or she is able to relate molecular and cellular mechanisms to the functioning or dysfunctioning of cells and organs and to clinical disorders in which the immune system is involved. This knowledge can be acquired to the desired standard by integral studying the material set out in the most recent editions of textbooks such as:

- *The Immune System*, P. Parham, Garland.

- *Immunology*, D. Male, J. Brostoff, D.B. Roth and I. Roitt, Elsevier Mosby.
- *Cellular and Molecular Immunology*, A.K. Abbas and A.H. Lichtman, Elsevier Saunders.
- *Immunobiology: The Immune System in Health and Disease*, C.A. Janeway, P. Travers, M. Walport and M. Shlomchik, Garland.

### 3.2. Scientific training in immunology

The knowledge acquired in accordance with 3.1 will serve as the basis for further scientific training in immunology. This training will be put into practice by active participation in the activities listed below:

- Participation in advanced immunology courses such as those organized in various training institutes
- Regular participation in lecture series such as those organized by various training institutes
- Participation in specific courses, Capita Selecta, mini-symposia and masterclasses
- Working visits to research groups in the Netherlands and elsewhere
- Participation in the Lunteren symposium and the Annual Conference organized annually by the Dutch Society for Immunology
- Participation in national and international scientific conferences related to Immunology; preferably active participation in the form of a poster or oral presentation.

The application forms for recognition must include a detailed overview of the activities carried out for the purpose of broad scientific training in immunology. Credits are attached to each activity. As a general guideline, 1 credit per hour and 6 credits per day can be earned.

During the 4-year training period a minimum of 250 credits must be earned. The activities classified under scientific training in immunology are listed below. There are compulsory and optional components. During the training period of an SMBWO Immunologist the following components are compulsory: the candidate must do an advanced course in immunology which lasts at least two weeks, and must participate twice in the Lunteren symposium and in the Annual Conference of the Dutch Society of Immunology. To attain a balanced distribution of the various activities a minimum number of credits are required for each activity.

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|---|------------|
| - Advanced course in Immunology (30 credits a week):                                      | 60         |
| - Attendance at lecture series on Immunology (1 credit per hour):                         | 40         |
| - Attendance at courses, Capita Selecta, mini-symposia, masterclass (6 credits a day):    | 24         |
| - Participation in Society's Lunteren symposia (6 credits per event):                     | 12         |
| - Participation in Society's Annual Conference (12 credits per event):                    | 24         |
| - Participation in national or international scientific conference (6 credits a day):     | 36         |
| - Active participation in the form of a poster (5 credits per presentation):              | 10         |
| - Active participation in the form of an oral presentation (10 credits per presentation): | no minimum |
| - Other activities:   | no minimum |

The trainer is responsible for providing a correct specification of these activities on the application form for recognition.

### 4. Experimental knowledge of and skills in immunology

Experimental skills and familiarity with a wide range of techniques are acquired in short internships during which the candidate becomes acquainted with various immunological subjects and gains practical experience of various techniques which are used regularly in immunological research. These short internships can take place in various laboratories of the candidate's own immunological training unit or training institute, but also elsewhere. After completing these internships the candidate should be able to perform a sufficient number of techniques from each of the categories listed below independently. He or she must also have cursory practical or theoretical knowledge of the other techniques included in the overview shown below.

#### 4.1. *Techniques included in experimental training in Immunology*

During the training programme the candidate must acquire extensive theoretical and practical knowledge of a large number of techniques from each of the following 4 categories. The trainer must ensure that the candidate's levels of knowledge, in which distinctions can be made between independent practical performance and theoretical knowledge (A), cursory practical knowledge (B) and theoretical knowledge (C) are filled in truthfully. The components which must be attained at level A are indicated with an asterisk.

##### *Category 1: Immunochemical techniques*

- Haemagglutination (blood group typing, Coombs test)
- Determination of antibodies to blood cells (except anti-HLA antibodies, for example to thrombocytes)
- \* HLA or H-2 typing (by serology and molecular biology)
- Quantification of factors (such as cytokines, chemokines and their receptors) in serum/plasma or culture supernatants by multiplex assay
- Nephelometric/turbidimetric techniques to quantify serum proteins such as immunoglobulin (Ig) (sub)classes
- \* ELISA techniques to quantify antigens or antibodies
- RIA techniques to quantify antigens or antibodies
- \* Western blotting
- \* Purification of antigens, immunoglobulins (Ig) and Ig subunits by protein separation techniques (electrophoresis, column chromatography (for example affinity chromatography), isoelectric focusing, HPLC, FPLC)
- Immunodiffusion and immunoprecipitation, qualitative (for example Ouchterlony) and quantitative (for example Mancini)
- Zonal electrophoresis and immunoelectrophoresis for the qualitative analysis of immunoglobulins in serum
- Immunofixation or immunoblotting for the analysis of M proteins in serum and urine
- Metabolic labelling of cells and analysis by means of immunoprecipitation and electrophoresis techniques.
- Preparation and testing of antibody conjugates (labelling with enzymes or fluorochromes)

##### *Category 2: Cell biology techniques*

- \* Isolation of lymphocytes and granulocytes from blood (and possibly from bone marrow) by means of gradient centrifugation
- \* Leukocyte count and differentiation by light microscopy
- \* Preparation of single-cell suspensions from biopsies of lymphoid organs
- Cell culture for the generation of cell lines or clones
- \* Phenotyping of lymphocytes, monocytes or granulocytes to investigate subpopulations, stages of maturity and activation by flow cytometry (FACS) after membrane and intracellular staining
- Separation of well-defined cell populations by flow cytometry or magnetic bead techniques
- \* Proliferation assays (3H-thymidine incorporation, CFSE staining) after stimulation with mitogens, antigens or alloantigens
- Cytotoxic testing for T or NK cells (51Cr release assay)
- Apoptosis assays on tissues (for example TUNEL, caspase 3) and in cell suspensions (for example Annexin V, 7AAD)
- ELISPOT assays to detect Ig or antibody-producing B cells or cytokine-producing T cells
- Detection of antigen-specific T cells by means of tetramer technology and flow cytometry
- \* Functional investigation of granulocytes (for example degranulation, phagocytosis of microorganisms, NBT reduction assay, killing of microorganisms)
- Migration of lymphocytes or granulocytes in vitro
- \* In situ analysis of immune reactivity: preparation, staining and assessment of tissues by microscope techniques (immunohistochemistry). Assessment of lymphoid organs, inflammatory areas and other immunopathology
- Confocal fluorescence microscopy, immunoelectron microscopy, in vivo imaging

### *Category 3: Animal experiment techniques*

The candidate will be considered to have sufficient expertise in this category if he or she has gained the certificate in animal experimentation in accordance with Article 9 of the Experiments on Animals Act. For candidates who are unable to obtain this certificate because of the nature of their previous university training programme or HBO training programme, proof of participation in the course in question will suffice. Candidates who have ethical objections to experiments on animals must include a written statement of their reasons with their application form for the SMBWO immunology training programme. If this statement is accepted, the Immunology CTB will propose an alternative assignment of similar difficulty for this category.

### *Category 4: Molecular biology techniques*

- \* Isolation of DNA and RNA
- \* PCR techniques (RT-PCR and quantitative PCR)
- \* Southern blotting
- DNA sequencing
- DNA microarray (expression array, SNP typing)
- RNAi/siRNA techniques

### *4.2 Medical immunology internship*

A 1-week internship at a medical immunology laboratory is a compulsory component of experimental training in immunology. This internship is not intended as a prelude to the medical immunology training programme. It has two objectives: a) it is a way to acquire theoretical and practical knowledge of some of the techniques referred to in 4.1, and b) performing determinations is integrated with the assessment of the results in the context of various clinical issues.

The following components must be addressed during this internship:

- Qualitative and quantitative investigation of immunoglobulins, including M proteins
- Specific cellular immunity (immunophenotyping and functional assays)
- Allergy (total and allergen-specific IgE)
- Complement activation, immune complexes
- Non-specific cellular immunity (functioning of phagocytic cells)
- Organ-specific and systemic autoantibodies

The medical immunology laboratory may be an independent unit, but it may also be part of a central clinical chemical or central clinical haematology laboratory.

## **5. Scientific training in immunology**

### *5.1 Publications*

At least four articles in the field of immunology with the candidate as first author, or three publications with the candidate as first author and two publications with the candidate as second author, must have been published (or been accepted for publication) in international peer-reviewed scientific journals. Candidates who have started the SMBWO immunology training programme after completing their PhD must also submit a list of publications of research in the field of immunology which satisfies the criteria indicated above.

The Immunology CTB will assess whether the content of these publications is sufficiently immunological and also assess the standard of the scientific journals in which the articles were published. This assessment will be based on the Journal Citation Reports prepared by the ISI Web of Knowledge. The impact factors of the publications must add up to at least 10.0.

### *5.2 PhD thesis*

An application for recognition as an SMBWO Immunologist must be accompanied by a copy of the candidate's PhD thesis.

These Learning Outcomes for the SMBWO immunology training programme will come into force as of 1 January 2007. Candidates who have applied to the Immunology CTB before this date and have already started the SMBWO immunology training programme will fall under transitional regulations. These regulations will remain in force for four years and as a consequence these individuals will be assessed for recognition as SMBWO Immunologists on the basis of the previous version of the Learning Outcomes.

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