Curriculum
“Good Scientific Practice”
for Courses
in Science and Medicine

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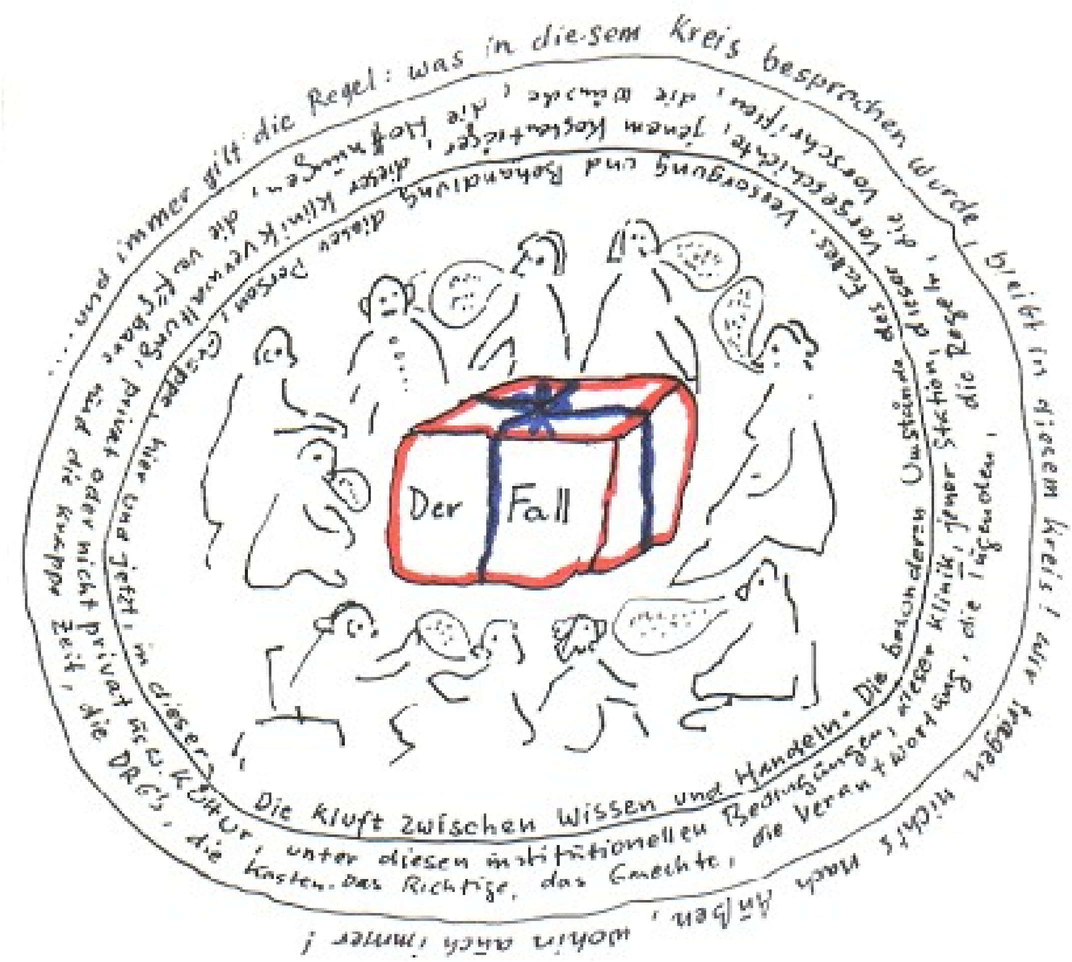

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1. Introduction

Society and the science system depend on the integrity of scientists. “The conduct of science rests on basic principles valid in all countries and in all scientific disciplines. The first among these is honesty towards oneself and towards others. Honesty is both an ethical principle and the basis for the rules, the details of which differ by discipline, of professional conduct in science, i.e. of good scientific practice. Conveying the principle of honesty to students and to young scientists and scholars is one of the principle missions of universities” (DFG 1998, p. 49).

Good scientific practice is the foundation for trust. Unfortunately, trust can be destroyed all too quickly by dishonest conduct and rebuilding it is then a long and arduous process.

The causes of misconduct are manifold and cannot always be readily rectified. However, where misconduct is due to ignorance, to a lack of training and/or a lack of communication, preventative measures can be taken. It is therefore important to alert young scientists to the problem early on in their training. We can no longer assume that the previously customary model of teaching and learning with the “master and his apprentice” can still be universally realised in modern day-to-day research. The size of working groups has grown sharply almost everywhere, the substantive and time demands on supervisors have increased and work processes in many areas of science have expanded enormously and become much more specialised. Heads of institutes can barely afford the systematic induction, supervision and monitoring of the next generation of scientists. In this situation, not just senior staff and their working groups, but all scientists need to be able to trust one another more than ever before. Several cases of misconduct in recent years have shown that while control systems do act as a corrective in as much as they can uncover failings and prevent major problems, they can, however, also prove ineffective or set in too late.

This curriculum should be seen as an offer to:

- Universities, institutions of higher learning and research institutions that wish to introduce their employees to the topic of “good scientific practice”.
- Teaching staff at institutes of higher education who are seeking to supplement their own courses or looking for suggestions for courses or who are interested in encouraging discussion about this issue within their institution.

This curriculum may also be of great interest to students and young scientists, especially if they are receiving little or no supervision as they undertake their first scientific work. They have a high risk of becoming victims of scientific misconduct: They do not know the rules of “good scientific work”, copy and in some cases uncritically adopt methods used by their working group or, without being aware of it, are drawn into questionable practices; all too easily they are cheated of recognition for their work and left to cope with their problems alone. The courses put forward in this proposed curriculum are intended to prevent and deal with conflicts.

This curriculum was commissioned on behalf of the ombudsman of the German Research Foundation in autumn 2008 by his spokeswoman Ulrike Beisiegel. It should be regarded as a work in progress and not as a rigid, finished product. We are proceeding from the concept of spiral curriculum development: The proposals and above all the experiences gained with this curriculum will form the basis for its competent substantive and didactic further development. At the end of this development process we should have a binding curriculum for all German universities and research institutes.

1.1 Background and Development of the Curriculum for “Good Scientific Practice”

Following a serious case of scientific misconduct in Germany, the DFG in 1997 commissioned an international group of scientists to draw up recommendations for "Safeguarding Good Scientific Practice.” The commission’s mandate was to “explore possible causes of dishonesty in the science system, to discuss preventative measures, to examine the existing mechanisms of professional self-regulation in science and to make recommendations on how to safeguard them.” (DFG 1998, p. 47). This memorandum “Proposals for Safeguarding Good Scientific Practice (Recommendations of the Commission on Professional Self-Regulation in Science)” addresses German universities and non-university research institutes “because research and the education of young scientists and scholars are their principal mission.” (DFG 1998, p.50). Recommendation 2 refers to universities' responsibility for teaching and educating young scientists in good scientific practice: “Universities and independent research institutes shall formulate rules of good scientific practice in a discussion and decision process involving their academic members. These rules shall

be made known to, and shall be binding for, all members of each institution. They shall be a constituent part of teaching curricula and of the education of young scientists and scholars." (DFG 1998, p. 51). A resolution adopted by the General Assembly of the DFG in 1998 specifies that recipients of DFG funds are obliged, inter alia, to implement recommendation 2.

At two conferences of the ombudspersons from German research institutes (2006 and 2008)[1] one of the topics under discussion was the current training situation with regard to "good scientific practice." On the one hand, the ombudspersons complained that there are too few courses at German research institutes or even non at all. Secondly, they described their experiences at their own institutions: Communicating good scientific practice to students depends to an excessive degree upon the personal commitment and interest of a small number of teachers; there is a danger that the topic might not be dealt with at all.

During the discussion, a desire was expressed to have teaching materials provided for all German universities and non-university research institutes with a view to facilitating the integration of good scientific practice in teaching.

1.2 Experiences in the USA

The intensive development and expansion of an extensive range of courses on good scientific practice [2] in the USA was prompted by the demands of the National Institutes of Health. Since 1990 these institutes (NIH 1989, 1990) have required every institution that applies to the NIH for training grants to offer and implement a teaching programme on the Responsible Conduct of Research. In 2007 this requirement was also adopted by the National Science Foundation (NSF 2007).

In response to these requirements, a multitude of courses were developed in the USA. There are now a vast amount of resources for teaching this subject available on the

[1] "Symposium of the Ombudspersons at Universities and Research Institutes in Germany", 19 and 20 October 2006 in Hamburg.
"Good Scientific Practice in Medical Research, Workshop for Ombudspersons at Research Institutes in Germany", 14 and 15 February 2008 in Hamburg.
Both events were organised by the ombudsman of the DFG.

[2] The courses were also offered under the title: Scientific Integrity, Responsible Conduct of Research, Research Ethics or Survial Skills.

website of the Office of Research Integrity (ORI)[3] that was founded in 1992. Since 1999 ORI has supported the development and implementation of training programmes on scientific integrity. All courses that are recognised by the aforementioned institutions must certify certain criteria as regards their content: "[…] all programs are strongly encouraged to consider instruction in the following areas: conflicts of interest, responsible authorship, policies for handling misconduct, policies regarding the use of human and animal subjects, and data management" (NIH 1992).

The Poynter Center of Indiana University in Bloomington focuses on the development of curriculum content and the training of teaching personal. The annual courses on Teaching Research Ethics are sponsored by ORI and a large number of US universities (Sponholz, Baitsch 1999).

The demands made by the NIH were not initially universally welcomed; indeed their necessity was often doubted. When developing and implementing courses on research ethics, Stern and Elliott (1997) repeatedly experienced the following situation: "In answer to the question, 'Who needs research ethics?', many of us might answer, 'I don't need it, but that guy over there certainly does'."(p. 9). The pressure currently exercised by US funding organisations on applicants and research institutes to hold and take part in such courses has, however, made the question superfluous.

2. Explanations and Recommendations

2. 1 Target Groups

The curriculum developed here addresses teachers at institutions of higher education and those who supervise students and future scientists in the fields of science and medicine.

2.2 Objectives

The overarching educational goal of this curriculum is to acquire and train competences that are important constituent elements of responsible professional

[3] Office of Research Integrity http://ori.dhhs.gov/education/rcr_resources.shtml

conduct as a scientist. This includes empowering students to act independently in their day-to-day research combined with the willingness, ability and discernment to:

- think critically while taking into account norms and values
- engage in open, specialist communication
- have a positive attitude toward communication, cooperation and understanding
- remain constantly alert for everyday problems
- assume responsibility for oneself and for others
- show self-determination, co-determination and solidarity.

One of the curriculum's secondary aims is to stimulate discussion of standards, problems and possible solutions to problems within the research system. The topic of good scientific practice should become part of day-to-day research: That which is taught should also be what is needed in daily research practice.

The curriculum is based upon the general recommendations for curriculum development by Husinga and Lisop (2005), Schewior-Popp (2005) and Knigge-Demal (2001) and upon:

- recognised specialist pedagogical principles and criteria
- national and international professional practice in terms of its content
- practicality and feasibility of implementation
- and picks up the possibilities of organisational and personnel resources.

2. 3 Didactic Principles

As a rule, scientists deal with complex areas of work. Scientific work is carried out in a team, within an organisation, within a national and international context. Erpenbeck and Heyse (1999) call for a competence-orientated approach to learning in order to act appropriately in a demanding professional world: Competences are dispositions of self-organisation (p. 157). The authors differentiate between five basic competencies (p. 159):

- Specialist or subject matter competencies
  Specialist knowledge, factual knowledge, knowledge about special skills and, problem-solving skills.

- Methodological competencies
  Ability to seek and handle information, to be able to apply scientific methods, structured thinking, ability to recognise connections, understanding of reciprocal effects and meanings.

- Social competencies
  Willingness to communicate, reach understandings and cooperate, communication skills, ability to work in teams, conflict management skills.

- Personal competencies
  Willingness to self-development, critical self-perception and reflection, to learn, to show openness, credibility, integrity and accept responsibility.

- Action competence
  Decision-making skills, ability to solve problems using the other four competency categories.

Competencies must be acquired and continuously trained in a manner that is action and context-based. Staudt and Kriegesmann (1999) suggest learning situations that closely approximate real job situations and tasks or which actually take place on the job. Instruction, i.e. frontal tuition can communicate information but does not foster the development of competencies in their entire breadth. Case studies, i.e. working through real or realistic problem situations with a high degree of active participation by the learners, focus on training practical skills while taking into account theoretical foundations and foster the simultaneous integration of reflection and interaction processes. Competencies are gradually acquired, i.e. students must pass through similar learning situations several times during the educational process.

Nowadays, a variety of case study methods, simulation games, role playing games, problem-orientated learning (POL) are accepted and established at all universities.

2.4 Composition and Structure of the Curriculum

A multi-stage approach is well-suited to the diverse tasks, experiences, conflicts and the demands of the students and doctoral candidates that have to be managed. The process of competency development in terms of self-organised, responsible action

during study programmes and in day-to-day research can be structured in a way that is tailored to either disciplines or people.

The training should comprise at least two parts:
The first part should be offered between the beginning and the middle of the studies. By then science students will have had their first experience of scientific work in laboratory classes with all the many difficulties and problems it entails. In the case of medical students, a suitable time would be just before they take their intermediate exams, as this is when the decision-making process about a dissertation takes place and the first contacts to scientific institutions are generally made. Both groups can therefore be expected to have a certain awareness of the problems involved with scientific work and "good scientific practice."

At this stage it will be important to raise students' awareness and to inform them about:

- What rules there are
- What problem areas are known
- What the university and scientific community expect from them
- What rights and obligations do students have
- Which institutions offer help in the event of problems and violations of the rules
- The possible consequence of scientific misconduct

Case studies will heighten awareness, illustrate the problems and facilitate learning. In this connection, it is important not simply to teach the rules, but to explain the background and discuss the rationales (why are they meaningful? Upon which ethical principles are they based?). It should also become clear to young scientists how and in which areas their rights are strengthened by these rules.

This first part of the training programme can be offered as a two-hour information session with time for discussion and should be compulsory for all students.

The second part of the training programme should take place within the framework of thesis work (in the case of bachelor's or master's courses) or during post-graduate training. A modular approach is suggested for this element as this meets the requirements of the differing educational situations and offers all institutions sufficient flexibility with regard to content and planning (Ministerium für Arbeit, Soziales, Familie und Gesundheit Rheinland-Pfalz, 2005). Depending on the field of study and the

overall curricula and training programmes available at the universities, the modules can be integrated into doctoral training or post-graduate programmes.

In terms of content, the topics dealt with in the first part of the training course are picked up and dealt with in greater detail. The content of the modules may also overlap, as real-life conflict situations frequently feature a combination of several problems The modules are geared to the recommendations and rules on good scientific practice of the German universities and research institutes, of the DFG, the German Rectors' Conference, the NSF, NIH and ORI.

The modules in the second part deal with the competencies acquired in the first part of the training programme in significantly greater depth. A number of learning objectives therefore appear several times in the individual modules so that the various competencies can be trained and consolidated.

It is recommended that this second part of the training programme is taught as a block course over 2 days with at least 14 hours. Ideally, groups should have between 12 and 20 participants. This course must be made compulsory for all doctoral students.

2.5 Teachers' Qualifications

Both parts of the programme must be organised and carried out by university teaching staff who should receive appropriate support from their institutions.

The first part of the programme (information session) can be planned and carried out by a single member of the university's teaching staff.

In addition to the person who is mainly responsible for the programme, a number of other scientists, and in individual cases, advanced doctoral students, may also be involved in the formal realisation of the second part of the course. Within a team, specific individuals may specialise in particular thematic areas. Scientists and scholars must, however, be individuals who are thoroughly familiar with the topic and who are capable of critical self-reflection (this is especially important in cases where there is to be a relationship of dependence with the teachers).

We recommend that the ombudsman at the respective institution, a member of the Ethics Committee, a member of the Animal Research Centre or the Animal Welfare Officer [4] should be invited to participate in some modules These people should serve as contacts and discussion partners for selected problems; they do not have to be present throughout the entire module.

[4] This can be an option if the modules offer research on human beings or animal experiments.

2.6 Literature and Sources

German Research Foundation (1998) Safeguarding Good Scientific Practice Wiley-VCH, Weinheim

Erpenbeck J, Heyse V (1999) Die Kompetenzbiographie: Strategien der Kompetenzentwicklung durch selbstorganisiertes Lernen und multimediale Kommunikation. Waxmann, Münster, New York, München, Berlin

Hochschulrektorenkonferenz, Empfehlung des 185 Plenums vom 6. Juli 1998 „Zum Umgang mit wissenschaftlichem Fehlverhalten in den Hochschulen“ http://www.hrk.de/de/beschluesse/109_422.php?datum=185.+Plenum+am+6.+Juli+1998+

Huisinga R, Lisop I (2005) Curriculumentwicklung im Strukturwandel. 1. Auflage. Verlag der Gesellschaft zur Förderung arbeitsorientierter Forschung und Bildung, Frankfurt aM

Knigge-Demal B (2001) Curricula und deren Bedeutung für die Ausbildung. In: Sieger M (Hrsg.) Pflegepädagogik. Hans Huber, Bern. S: 41-55

Ministerium für Arbeit, Soziales, Familie und Gesundheit Rheinland-Pfalz (Hrsg.) Rahmenlehrplan und Ausbildungsrahmenplan für die Ausbildung in der Gesundheits- und Krankenpflege und Gesundheits- und Kinderkrankenpflege des Landes Rheinland-Pfalz. September 2005

National Institutes of Health (1989) NIH Guide for Grants and Contracts. Requirement for Programs on the Responsible Conduct of Research in National Research Service Award Institutional Training Grants. Volume 18, N. 45

National Institutes of Health (1990) NIH Guide for Grants and Contracts. Requirement for Programs on the Responsible Conduct of Research in National Research Service Award Institutional Training Grants. Volume 19, N. 30

National Institutes of Health (1992) NIH Guide Reminder and Update: Requirement for Programs on the Responsible Conduct of Research in National Research Service Award Institutional Training Grants. Volume 21, N. 43

National Science Foundation (2007) NSF Authorization Act of 2007. H: R. 1867. Sec. 9 Responsible Conduct of Research

Schewior-Popp S (2005) Lernsituationen planen und gestalten. Handlungsorientierter Unterricht im Lernfeldkontext. Thieme, Stuttgart

Stern J E, Elliott D (1997) The Ethics of Scientific Research. A Guidebook for Course Development. New England Press, Hanover, London

Sponholz G, Baitsch H (1999) Teaching research ethics (TRE). EthikMed 11:190-194

Staudt E, Kriegesmann B (1999) Weiterbildung: Ein Mythos zerbricht. In: QUEM-Arbeitsgemeinschaft Qualifikations-Entwicklungs-Management (Hrsg.) Kompetenzentwicklung ’99. Aspekte einer neuen Lernkultur. Waxmann, Münster. S: 17-59

3. Specific Suggestions for Implementation

3.1 Structure of the First Part of the Programme

Title of the Course

Suggestions for a published title are: “Introduction to Good Scientific Practice”, “Good Scientific Practice and its Problems” or "Scientific Integrity”. By way of an introduction to the topic, the announcement of the class might include a brief case study taken from everyday scientific work or study.

Time, Form and Scope

For science students this part of the training programme should take part in the first third of their course, for medical students we recommend that it should take place before their intermediate exams (e.g. in the 3rd semester). We suggest that it take the form of an information session for all students in a year to be held once in the academic year. Duration: 2 hours

Learning Objectives: In the first steps, students acquire
Specialist or subject matter competencies: Broad knowledge of the definitions of “good scientific practice” and “scientific misconduct“, the rules of their own institution and the recommendations of the DFG. The duties and responsibilities of their future profession as a scientist or research physician are addressed.
Methodological Competency: Structured planning, shaping and documenting of the research process; students learn ways to recognise, evaluate and appropriately raise the subject of critical situations during their courses and how to react and act in the event of problems or if they suspect misconduct..
Social Competency: Students are encouraged to structure their own learning and work in a responsible manner, to ask questions, initiate a change of perspective: to be aware of the interests, rights and obligations of other participating parties.
Personal Competency: Create a critical awareness, the students’ own values and norms are placed within the context of science and that of the scientific profession. Students are encouraged to develop an understanding of the fact that addressing ambiguities early on causes fewer problems than solving intractable conflicts
Content
Overview of - The rules and guidelines for “good scientific practice” of the students’ own institution [5]. Explanation of the definition of good scientific practice. The basic principles and core values of science such as honesty, trust and fairness.

- Definition of misconduct. - Information about the recommendations of the DFG; reasons behind the formulation of the Memorandum to Safeguard Good Scientific Practice. - Brief information about the statutory provisions and declarations concerning experiments on human beings (Nuremberg Code, Declaration of Helsinki) and animals (animal protection law).
Work through - a number of key areas of conflict that are already relevant to students during their studies: Brief example concerning plagiarism or the manipulation or falsification or invention of data in laboratory tests, student research projects or other first small projects. - students' experiences with supervision problems in lab classes and student research projects. - the interests, rights and obligations of those persons who make decisions in the research process or who are affected by decisions.
Examination of - the consequences of scientific misconduct - specific measures at the institution applicable to members of staff or students - consequences for colleagues, the organisation, loss of trust
Information about the functions of the - Ombudspersons with names and telephone numbers - Difference to the DFG liaison officers - Commissions to provide assistance or resolve conflicts and investigate suspected cases of misconduct at the institution

Didactic-Methodological Recommendations for Course Design

In addition to the customary method of communicating information in a lecture, it is also useful to include one or two brief case studies. Opportunities and time for discussion must be included; the students' own experiences must also be picked up on. The information phase should not use up more than half the available time.

Students should be addressed in their role as future colleagues. Problem areas in lab classes (the aim being to learn to carry out scientific work and not reproduce finished results) and written work (the aim being to learn scientific writing and not produce the

[5] **The universities use different terms to denote their guidelines or rules for safeguarding good scientific practice. These can frequently be found on the university websites.**

best plagiarism) should be explained and students' understanding for scientific integrity should be awakened and strengthened.

Teachers and Resources

Arrangements are made through the dean's office or ombudspersons as to which member of the university staff should carry out this task for the faculty or whether the ombudsperson should, if necessary, hold the course themselves. It must be guaranteed that all students take part in the information session; thus it is above all those departmental representatives who offer a compulsory class at the relevant stage of the degree course who are called upon. This task can also be entrusted to the respective key qualification centres[6] ; but once again, it must be ensured that all students take part in the compulsory class.

[6] The key qualification centres at the universities generally offer a large number of inter-disciplinary courses for students who are taking bachelors' and master's degree courses.

Materials and Sources

(Status October 2009)

Materials and case studies for the course are available on the website of the office of the Ombudsman für die Wissenschaft.

http://www.ombuds-wissenschaft.de

Books

Broad W, Wade N (1984) Betrug und Täuschung in der Wissenschaft, Birkhäuser, Basel

Djerassi C (1996) Cantor's Dilemma. Wilhelm Heyne, München

Finetti M, Himmelrath A (1999) Der Sündenfall. Betrug und Fälschung in der deutschen Wissenschaft. Raabe, Stuttgart

Memoranda, Declarations, Rules, Laws

German Research Foundation, Safeguarding Good Scientific Practice. Memorandum (1998) Wiley-VCH, Weinheim: Recommendation 1; Problems in the Science System
http://www.dfg.de/antragstellung/gwp/index.html

Handbuch der Deklarationen
Hier sind u.a. der Nürnberger Kodex sowie die Deklaration von Helsinki zu finden
http://www.bundesaerztekammer.de/downloads/handbuchwma.pdf

Tierschutzgesetz
Bundesministerium der Justiz
http://www.bundesrecht.juris.de/tierschg/

Names, Addresses of the Ombudspersons and Commission Members

These can generally be found on the university websites (usually under the university administrations). At some universities, the ombudsperson is called the ombudsman or liaison officer.

Ombudsman of the German Research Foundation
http://www1.uni-hamburg.de/dfg_ombud/

Case Studies and Teaching Material from the USA

For engineers and scientists
http://onlineethics.org/CMS/profpractice/ppcases/NSPEcases.aspx

From the National Institutes of Health
http://www1.od.nih.gov/oir/sourcebook/ResEthicsCases/cases-toc.htm

Office of Research Integrity ORI, Responsible Conduct of Research, Educational Resource Products
http://ori.dhhs.gov/education/rcr_resources.shtml

3.2 Structure and Modules of the Second Part of the Training Programme

Title of the Course

Depending on the focus, the workshop/block course could be called:" Good Scientific Practice", "Scientific Integrity", or "Research Ethics".

Time

We recommend that medical students are offered the course once they have registered for the conferral of their doctorate, i.e. within the scope of their doctoral thesis. This can be during their medical studies or afterwards. In the case of science students, this course can be held while they are working on their bachelors' thesis or at the start of the masters' thesis. At any rate, the aim should be to ensure that doctoral students in the sciences attend the course no later than in the first year of writing their doctoral thesis. In the long term, it must be ensured that each doctoral candidate has attended a course on "good scientific practice" by the time they receive their doctorate.

Suggested Course Form and Group Size

A two-day workshop with at least 14 course hours is recommended. The doctoral students should have the opportunity to explore the topic in greater depth at this block event. Ideally, a group should have 12 to 20 participants.

Suggestions for Didactics for all Modules

If they are to acquire action competency as well as specialist and subject-matter competency it is important that doctoral candidates actively participate in the learning process. All forms of teaching that encourage students to become actively involved may be used: Discussion in the group while observing discussion rules, structured or chronologically sequenced case studies, division of the group into smaller groups with different tasks, as well role playing games and simulation games. Information and discussion phases should alternate with individual work and work in small groups. A key aspect is the rehearsal of methods of conflict recognition and conflict management.

Choice of Modules

The modules presented here may, but do not have to be, worked through completely during the two-day class. It also makes sense to focus on specific modules in greater depth and to emphasise specific areas within the modules depending on the field of

study and the stage the participants have reached in their education. The modules “Research on Humans, Clinical Studies” and “Animal Research” are optional, they can be included depending on the participants' field of study.

Room Requirements

Suitable rooms must be reserved for this course. Ideally there should be several rooms or seating areas that permit variable seating arrangements to support work in small groups.

Teachers

This course is the responsibility of a member of the university teaching staff. We also strongly recommend involving the local ombudsperson. If the modules “Research on Humans, Clinical Studies” and “Animal Testing” are implemented, a member of the ethics commission and the animal welfare officer may be invited for a discussion with the participants in the relevant module. Furthermore, an experienced scientist from the participants’ respective fields of study should take part at least in the modules "Handling Data" and "Publication Process and Authorship."

In the long term, it can be helpful to form a team comprising members of the university’s teaching staff, young scientists and students. They should plan the modules together and support the implementation of the course.

Learning Objectives and Content of the Following Modules

A proposal for the allocation of time

- Introduction 1-2 hours
- Misconduct in Research 2 hours
- Handling Data 2-3 hours
- Publication Process and Authorship 2-3 hours
- Responsibility of Supervisors and the Supervised 2 hours
- Research on Humans, Clinical Studies 2 hours
- Animal Research 2 hours
- Conflicts of Interest, Scientific Cooperation 1 hour
- Resolving Conflict 1 hour

Module: Introduction

Learning Objectives: Acquisition and Training of Competencies
Specialist or subject matter competencies: Familiarisation with the definitions of “good scientific practice”.
Methodological Competencies: Analysis and comparison of the different definitions and personal experiences of the participants.
Social Competencies: Recognising different ideas, values and norms; respecting different opinions and moral concepts; evaluation and consensus building within the group.
Personal Competencies: Raising awareness, recognising and critical reflection upon own ideas and norms; own evaluation of differing views.
Action Competencies: Participating in a discourse; adequate examination of different values and norms.
Content
• Areas of Conflict in Research • Participants’ differing ideas about "good scientific practice"; formulation of own rules; comparison with the rules of the university and the scientific community (DFG, learned societies). Participants’ views of their own responsibility as scientists, relationships of trust within and outside science. Attempts to explain why integrity in day-to-day scientific work is indispensible. Rights and obligations of scientists. • The science system is part of a complex society, overview of the differing interests and financing of the sciences. • Overview of legal provisions, the recommendations and rules of scientific institutions, professional codes, and the guidelines of scientific journals. • Models for the analysis and handling of conflicts in day-to-day scientific work
Didactic Hints The participants’ own ideas about "good scientific practice" should be included; participants’ experiences with scientific work should be compared with the content of the definition of their own university.

Module: Misconduct in Research

Learning Objectives: Acquisition and Training of Competencies
Specialist or Subject Matter Competencies: Familiarisation with the different definitions of scientific misconduct, the distinguishing features of serious misconduct and questionable scientific practices.

Methodological Competencies: Structured analysis of conflicts, possibilities for developing and evaluating different courses of action.
Social Competencies: Appropriate discussion in the group of the different ways of interpreting or evaluating things. Ability to change perspectives, i.e. to recognise and respect or critically judge the interests, rights, obligations and areas of responsibility of other participating institutions, groups and individuals.
Personal Competencies: The student's own values and norms are placed in the context of the scientific profession. Recognition of the student's own preferences when dealing with professional pressure, unexpected results and disappointments; understanding why honesty makes sense.
Action Competencies: Adequate examination of the different forms of misconduct, structured analysis of conflicts, development and evaluation of different courses of action.
Content
• The participants' own ideas and experiences of scientific misconduct, distinguishing between intent and error. • Definition of scientific misconduct at the participants' own institution. Comparison with other definitions (national and international) • Differences between serious misconduct (forging, fabrication, invention of data, plagiarism) and questionable scientific practice. • Misconduct when applying for funding, submitting abstracts, conducting research, presenting scientific results and in the review process. • Connections between misconduct and harming individuals and institutions. • Causes of misconduct.
Didactic Hints Existing knowledge but also opinions and experiences can be activated in individual and group work.

Module: Handling Data

Learning Objectives: Acquisition and Training of Competencies
Specialist or Subject Matter Competencies: Overview of the rules for handling scientific data at the participants' own institution; immersion in recognised national and international standards for the respective field. Locating guidelines for the participants' own field of study and the learned societies.
Methodological Competencies: Structured planning, conducting and documenting the research process. Structured analysis of conflicts, possibilities for developing and evaluating different courses of action.

Social Competencies: Appropriate discussion of the different ideas and practices of scientific work. Change of perspective: Recognising and respecting the interests, rights and obligations of other participating institutions, groups and individuals.
Personal Competencies: Reflection upon the participants' own values, norms and priorities with regard to data management. Development of a value system that guides actions and is also appropriate in the case of conflict situations, unexpected results and disappointments.
Action Competencies: If necessary change of one's own data management; rehearsal of conflict (resolution) dialogues, discussion of different approaches, interpretations and possible consequences
Content
• Data survey, data collection and suggestions for documentation (lab log, data processing) • Appropriate data storage and backup • Rules for data management within the team, at one's own institute, national and international standards • Ownership of data and lab log book. Ownership of published data and images • Information about legal provisions governing data protection, copyright, patenting • Agreements and rules concerning the exchange of methodological knowledge, data and materials
Didactic Hints As there are considerable differences between the various fields, examples from the participants' own fields of study must be deliberately selected; on the other hand, it is also instructive for young doctoral candidates to become acquainted with cases from completely different areas of science. Changing perspectives by using role playing games can do much to support work.

Module: Publication Process and Authorship

Learning Objectives: Acquisition and Training of Competencies
Specialist or Subject Matter Competencies: Overview of the publication process, about the rules of publishing practice at the participants' own institution, the learned societies and the most important scientific journals. Familiarisation with the criteria that qualify an individual to be named as the author.
Methodological Competencies: Structured planning of the publication process, possibilities to access the guidelines for authors and publication standards of

various institutions and journals; dealing with unforeseen problems in the publication process. Ways of dealing with strong pressure to publish.
Social Competencies: Recognising and respecting the rights and obligations of other scientists, scientific institutions, the media and the public. Appropriate communication to avoid and manage conflicts.
Personal Competencies: Understanding and acceptance of the principle of “fairness”. Recognition of one’s own rights and obligations in the publication process. Appropriate setting of priorities in conflict situations.
Action Competencies: Development of different potential courses of action for conflicts that can arise during the publication process.
Content
• Stages of the publication process: Registration for lecture and poster sessions at congresses, publication in scientific journals • Overview of the guidelines and rules of a number of scientific journals and the Committee on Publication Ethics (COPE) • Selection and presentation of data, dealing with previous work or information upon which the work is based. Problem areas: Citations, plagiarism, processing images, copyright • Peer review process and responsibility of the reviewers. Loss of trust if privileged information is misused. • Authorship: Tasks and areas of responsibility of authors; differing criteria for defining authorship. Problem areas: Denial of authorship, honorary authorship, co-responsibility for articles where falsification is suspected. • Handling unpublished information, public announcements prior to publication • Dealing with errors and corrections
Didactic Hints As misconduct in this area occurs in a wide variety of forms, we recommend working through several case studies and examples or a very complex case in sequence. If students already have experience with publications or registering presentations, their experience with everyday practice can be compared with the guidelines of their own institution and journals’ guidelines for authors.

Module: Responsibility of Supervisors and the Supervised

Learning Objectives: Acquisition and Training of Competencies
Specialist or Subject Matter Competencies: Overview of the rights and obligations of those receiving supervision (doctoral candidates, students) and supervisors (also institute heads), the principle of mentoring.

Methodological Competencies: Structured analysis and management of conflicts between students and their supervisors. Rehearsal of the future role as a supervisor.
Social Competencies: Recognising the differing rights, interests and obligations of the various individuals. Appropriate communication to avoid and manage conflicts, ability to cooperate with others.
Personal Competencies: Recognition and reflection upon one's own ideas about the interests, rights and obligations from the perspective of the individual receiving supervision, from the perspective of the supervisor or from the perspective of the mentor.
Action Competencies: Training of conflict (resolution) dialogues, first rehearsal of the responsible role of a supervisor. Shaping the role of the mentor. Developing creative possibilities for implementing suggestions for improvement.
Content
• Everyday conflicts in laboratory routine, in lab classes, when writing a doctoral thesis. When and for what do students or doctoral candidates require a supervisor? • Criteria for selecting a supervisor • Criteria for selecting a mentor • Criteria for selecting a doctoral student • Relationships of dependence between those receiving supervision and their supervisors • Areas of responsibility and multiplicity of tasks, diverse obligations, potential conflicts of interest for supervisors (instruction, monitoring, support, encouragement, criticism, "socialisation" of the individual being supervised). • Areas of responsibility and possible conflicts of interest for mentors • Influence of the laboratory atmosphere, the "organisational culture" on everyday scientific work
Didactic Hints Participants' own experiences with the different roles (doctoral candidates frequently supervise students in lab classes) must be included. Role playing games make it possible to recognise and rehearse new roles.

Module: Research on Humans, Clinical Studies

Learning Objectives: Acquisition and Training of Competencies
Specialist or Subject Matter Competencies: Introduction to the most important declarations, codes, guidelines and the legal regulations governing research on

humans, the rules and areas of responsibility for research on human tissue. Overview of the tasks and working methods of an ethics commission. Familiarisation with the main areas of conflict.

Methodological Competencies: Analysis of conflicts, dealing appropriately with ethical conflicts, procedures for applying for research projects on humans. Important methods of data protection such as anonymising and pseudonymising.

Social Competencies: Respect for and critical discussion of the interests, rights and obligations of test persons, family members or legal carers, researchers, financial backers and society.

Personal Competencies: Students should critically analyse their own value systems and interests and see them in context to the values of others. Develop motivation to assume one's own responsibility. Dealing responsibly with unforeseen problems.

Action Competencies: Weighing up differing interests, inclusion of the rights of test subjects, dealing with informed consent.

Content

- Codes, declarations, historical background
- Current legal provisions (Medicines Act, Medical Products Act, Data Protection)
- Methods of anonymising and pseudonymising
- Tasks and working methods of an ethics commission (Institutional Review Board, IRB)
- Important aspects when submitting applications for a research project
- Areas of conflict in research on humans: Informed consent, research on individuals who are unable to give consent, research on embryonic stem cells, discontinuing studies, data protection and data sharing. Therapeutic studies, multi-centric studies, pharmaceutical studies initiated by scientists (IIT) and studies commissioned by companies
- Conflicting duties in the case of attending physicians who simultaneously conduct clinical studies
- Conflicts in everyday clinical practice due to research projects
- Particular problems experienced by doctoral candidates when carrying out clinical studies.

Didactic Hints

If resistance, prejudices and one-sided representation of interests crop up, these must be dealt with constructively. We recommend that a member of the ethics commission be invited to participate in this module. However, these persons do not have to be present for the entire module.

Module: Animal Research

Learning Objectives: Acquisition and Training of Competencies
Specialist or Subject Matter Competencies: Overview of the legal provisions governing the treatment of animals in research projects. Rules and more advanced events organised by the participants' own organisation, possibilities for cooperating with other institutions, procedures for submitting applications and conducting animal experiments.
Methodological Competencies: Modalities for submitting applications for research projects involving animals. Analysis of conflicts, dealing appropriately with the ethical conflicts surrounding animal experiments.
Social Competencies: Responsible treatment of animals and tissue samples, respect for the opinion of others (e.g. colleagues, opponents of animal testing) Appropriate forms of dispute, willingness to develop alternatives jointly with others.
Personal Competencies: Reflection upon one's own values, interests and obligations, openness, integrity and courage in professional actions. Further development of one's own possibilities for dealing constructively with conflicts.
Action Competencies: Cooperation with experts in order to conduct animal experiments and take tissue samples appropriately. Development of options for dealing with conflicts in day-to-day research. Rehearsal of constructive confrontation with fundamentally different views.
Content
• Dealing responsibly with animals in the planning, conduct and evaluation of animal tests • Basic principles of making applications • Institutional and generally applicable legal provisions: Animal Protection Act, Laboratory Animal Registration Ordinance • Institutions and contact persons: Animal Research Centre, Animal Welfare Officer and their assistance when planning and conducting animal research • The ethical challenges of research projects involving animals: personal way of dealing with such challenges, in the team, in the organisation, in collaborative scientific projects, release and exchange of animals. • Individual, social and societal conflicts surrounding animal research
Didactic Hints We recommend that the Animal Welfare Officer or a member of the Animal Research Centre be invited to participate in this module. However, these persons do not have to be present for the entire module.

Module: Conflicts of Interest, Scientific Cooperation

Learning Objectives: Acquisition and Training of Competencies
Specialist or Subject Matter Competencies: Familiarisation with the complex mixture of potential conflicts of interest. Overview of the rules at the participants' own university, the contracts between different research teams, between industry and the university. Problems between the high-minded claim to scientific cooperation and the prevailing climate of competition
Methodological Competencies: Analysis of conflicts of interest, negotiating between different interests
Social Competencies: Recognising and respecting the interests and rights of others. Appropriate engagement with these interests. Ability to cooperate and build consensus
Personal Competencies: Reflection upon one's own interests, wishes in respect of career and scientific cooperation. Development of skills that contribute to an adequate recognition of conflict and conflict resolution
Action Competencies: Rehearsal of conflict analysis within the group. Testing the possibilities for conflict prevention, managing conflicts and the ability to adequately build consensus
Content
• Interests, rights and obligations of the participating individuals and organisations, the financial backers or clients in the research process. Advantages and potential sources of conflict relating to cooperation with other scientific organisations, cooperation with non-scientific organisations, contract research. Contracts with clients, with cooperation partners • Institutional rules governing contract research • Conflicts regarding ownership of data and the passing on of data and results, restrictions on publication, patent protection, holding back of inconvenient/undesired results, authorship, insider knowledge, grey area to corruption. Fairness toward collaborators • Conflicts arising from increasing competition between research institutes and the desire for cooperation. Social changes (e.g. funding, penalties) • Possible conflicts of interest for doctoral candidates
Didactic Hints A case study should be used that also involves doctoral candidates.

Module: Resolving Conflict

Learning Objectives: Acquisition and Training of Competencies
Specialist or Subject Matter Competencies: Familiarisation with the various possibilities for resolving conflicts in day-to-day scientific work. Procedural paths and institutions or commissions that can be called upon in suspected cases of scientific misconduct (own university, DFG). Content of codes of practice and possible sanctions of the various institutions.
Methodological Competencies: Dealing with complex systems of self-administration in science. Analysis of the advantages and disadvantages of the individual ways of resolving conflicts. Important aspects of professional mediation.
Social Competencies: Ability to build consensus when drawing up rules. Ability to analyse and resolve conflicts with others. Dealing appropriately with pressure, stress, dishonest behaviour within the group.
Personal Competencies: Reflection upon one's own values. Critical analysis of suspected/observed irregularities. Discretion and boldness when addressing difficult situations. Dealing constructively with criticism, pressure, stress and dishonest conduct.
Action Competencies: Constructive action when drawing up rules. Rehearse dealing respectfully with one another in conflict situations. Confiding in a person one trusts about one's own difficulties and incidents that one has observed in a timely and appropriate manner. Meeting with the ombudsperson in the event of problems.
Content
• Possible courses of action in cases where individuals suspect, have observed or participated in possible scientific misconduct. • Tasks and working methods of the ombudspersons and commissions at the universities • Protection of the accused and protection of the observer. Complex problem of whistle-blowing • Rules of participants' own university and DFG recommendations for dealing with cases of suspected scientific misconduct. • Principle of fairness in conducting investigations in cases of suspected misconduct. • What is the reality of day-to-day research? Do people experience a gap between the rules and procedures that have been formulated and reality? Which procedures do participants want? • The consequences of misconduct, proportionality of sanctions
Didactic Hints Allowing doctoral candidates to draw up their own rules or discuss their own

suggestions for investigative procedures will put them in the position of a real actor. This will enable them to critically reflect upon victim roles, tendencies to resign, the rapid ascription of power and powerlessness.
We urgently recommend that the ombudsperson or a member of the commission that becomes active where scientific misconduct is suspected should be invited to participate in this module. However, these persons do not have to be present for the entire module.

Literature, Basic Principles, Material for the Modules

Rules, Definitions, Declarations for all Modules

The rules and guidelines of the universities for "Good Scientific Practice", "Dealing with Misconduct" (the titles of the rules may vary) can generally be found on the websites of the university administrations.

Akademien der Wissenschaften Schweiz (2008) Wissenschaftliche Integrität, Grundsätze und Verfahrensregeln
http://www.akademien-schweiz.ch/downloads/Layout_Integritaet_d_online_000.pdf
Available in English

Bundesministerium für Bildung und Forschung; Bundesbericht Forschung 2004
http://www.bmbf.de/pub/bufo2004.pdf

Deutsche Forschungsgemeinschaft (1998) Sicherung guter wissenschaftlicher Praxis. Denkschrift. Wiley-VCH, Weinheim
http://www.dfg.de/antragstellung/gwp/index.html
Available in English

Hochschulrektorenkonferenz, Empfehlung des 185 Plenums vom 6. Juli 1998 „Zum Umgang mit wissenschaftlichem Fehlverhalten in den Hochschulen"
http://www.hrk.de/de/beschluesse/109_422.php?
datum=185.+Plenum+am+6.+Juli+1998+

Leibnitz-Gesellschaft – Wissenschaftsgemeinschaft Gottfried Wilhelm Leibnitz e.V. (19. 11. 1998) Empfehlungen zu guter wissenschaftlicher Praxis
http://www.leibniz-gemeinschaft.de/

Max-Planck-Gesellschaft (24. 10. 2000), Regeln zur Sicherung guter wissenschaftlicher Praxis
http://www.mpg.de/pdf/procedures/regelnWissPraxis.pdf
Available in English

Office of the President. Office of Science and Technology Policy. "Federal Policy on Research Misconduct," *Federal Register* 65 (6 December 2000): 76260-64.
http://www.ostp.gov/html/001207_3.html

Richtlinien der österreichischen Rektorenkonferenz zur Sicherung einer guten wissenschaftlichen Praxis. 2004
http://www.sbg.ac.at/aff/recht/documente/par27/RichtlOesterrRektorenkonferenz.pdf

Satzung der Gesellschaft Deutscher Chemiker e.V., Verhaltenskodex
http://www.gdch.de/gdch/satzung.htm

Satzung der Deutschen Physikalischen Gesellschaft e.V.
http://www.dpg-physik.de/dpg/statuten/satzung.html

Ausführungsbestimmungen zu § 12 (Verhaltenskodex für Mitglieder) der Satzung der Deutschen Physikalischen Gesellschaft e.V.
http://www.dpg-physik.de/dpg/statuten/kodex_deutsch.html

Books, Articles and Brochures for all Modules

Beach D (1996) The responsible Conduct of Research. VCH Weinheim, New York, Basel, Cambridge, Tokyo

Broad W, Wade N (1984) Betrug und Täuschung in der Wissenschaft. Birkhäuser, Basel

Committee Science, Engineering, and Public Policy: National Academy of Sciences, National Academy of Engineering, Institute of Medicine (1995) On Being A Scientist. Responsible Conduct of Research. National Academy Press, Washington D.C.

Deutsche Forschungsgemeinschaft (2004) Wissenschaftliches Fehlverhalten – Erfahrungen von Ombudsgremien. Tagungsbericht. Wiley VCH, Weinheim

Djerassi C (1996) Cantor's Dilemma. Wilhelm Heyne, München

Elliott D, Stern J E (1997) Research Ethics. A Reader. New England Press, Hanover, London

Finetti M, Himmelrath A (1999) Der Sündenfall. Betrug und Fälschung in der deutschen Wissenschaft. RAABE, Stuttgart

Institute of Medicine, Nation Research Council of the National Academies (2002) Integrity in Scientific Research. The National Academies Press, Washington D.C.

Macrina F L (2005) Scientific Integrity. Third Edition. ASM Press, Washington D.C.

Korenman S G, Shipp A C (1994) Teaching the Responsible Conduct of Research through a Case Study Approach. A Handbook for Instructors. AAMC, Washington D.C.

Penslar R L (1995) Research Ethics, Cases & Materials. Indiana University Press, Bloomington

Sponholz G, Baitsch H (2001) Die sequenzierte Fallstudie – unterwegs zum selbstorganisierten Lernen. Ethik und Unterricht 4: 21-25

Sponholz G, Baitsch H (2005) Zum wissenschaftlichen Fehlverhalten – man hat es geahnt. Arzt und Krankenhaus 78: 310-317

Stegemann-Boehl S (1994) Fehlverhalten von Forschern. Enke, Stuttgart

Stern J E, Elliott D (1997) The Ethics of Scientific Research. A Guidebook for Course Development. New England Press, Hanover, London

Wiesing U, Simon A, Engelhardt D v. (2000) Ethik in der medizinischen Forschung. Schattauer, Stuttgart, New York

Online Materials

Case Studies from the National Institutes of Health
http://www1.od.nih.gov/oir/sourcebook/ResEthicsCases/cases-toc.htm

Online Ethics Center for Engineering and Science,
Umfangreiche Lehrmaterialien und Fälle
http://www.onlineethics.org/

Office of Research Integrity ORI, Responsible Conduct of Research, Educational Resource Products
http://ori.dhhs.gov/education/rcr_resources.shtml

Poynter Center for the Study of American Institutions, Indiana University, Bloomington. Resources for Teaching Research Ethics
http://poynter.indiana.edu/tre/resources.shtml

Responsible Conduct of Research Education Consortium, Online Resource for RCR Instructors
http://rcrec.org/

Steneck, N H (2003) ORI Introduction to the Responsible Conduct of Research. DHHS Office of Research Integrity
http://ori.dhhs.gov/publications/ori_intro_text.shtml

Laws, Rules, Recommendations for Individual Modules

Publication Process and Authorship
Committee on Publication Ethics.
http://publicationethics.org/

International Committee of Medical Journal Editors (2008) Uniform Requirements for Manuscripts Submitted to Biomedical Journals: Writing and Editing for Biomedical Publication
http://www.icmje.org/

NATURE Editorial polices
http://www.nature.com/authors/editorial_policies/index.html

SCIENCE Information for Authors
http://www.sciencemag.org/about/authors/

Responsibility of Mentors and Doctoral Candidates
National Academy of Sciences, National Academy of Engineering, Institute of Medicine The National Academies Press1997. Adviser, Teacher, Role Model, Friend: On Being a Mentor to Students in Science and Engineering

Research on Humans, Clinical Studies

Information can be obtained from the ethics commissions of your own institutions and the ethics commissions of the local medical associations. In Germany, § 15 of the Medical Association's Code of Practice makes reference to this topic.

The German Ministry of Justice provides laws online free of charge
http://www.gesetze-im-internet.de/

In Germany, the data protection laws of the federal states can be obtained from the respective Data Protection Officers or from the responsible state ministries.

Bundesgesetzblatt Jahrgang 2004 Teil I Nr. 42, ausgegeben zu Bonn am 12. August 2004. Verordnung über die Anwendung der Guten Klinischen Praxis bei der Durchführung von klinischen Prüfungen mit Arzneimitteln zur Anwendung am Menschen. GCP-Verordnung 9. August 2004

Handbuch der Deklarationen: hier sind u.a. der Nürnberger Kodex und die Deklaration von Helsinki zu finden
http://www.bundesaerztekammer.de/downloads/handbuchwma.pdf

Informationen zu Investigator Initiated Trials (IIT): Arbeitsgemeinschaft der Wissenschaftlichen Medizinischen Fachgesellschaften (AWMF) und Deutsche Forschungsgemeinschaft DFG (2006). Empfehlungen für die Durchführung nicht-kommerzieller Studien an Universitätskliniken
http://www.uni-duesseldorf.de/awmf/awmfres.htm

United States Department of Health and Human Services. IRB Guidebook
http://www.hhs.gov/ohrp/irb/irb_guidebook.htm

Animal Research

Information can be obtained from the animal research centres at the universities

Deutsche Forschungsgemeinschaft, Hrsg. Senatskommission für tierexperimentelle Forschung (2004) Tierversuche in der Forschung. Lemmens Verlags- & Mediengesellschaft, Bonn
http://www.dfg.de/dfg_im_profil/struktur/gremien/senat/kommissionen_ausschuesse/senatskommission_tierexperimentelle_forschung/

European Science Foundation. ESF-EMRC Position on the Proposal for a Directive on the Protection of Animals used for Scientific Purposes. 2nd Edition March 2009

Tierschutzgesetz. Bundesministerium der Justiz
http://www.bundesrecht.juris.de/tierschg/

Conflicts of Interest, Scientific Cooperation

Information from the universities regarding inventions, copyright and research contracts can generally be found on the university administration websites.

Resolving Conflict

Montada L, Kals E (2001) Mediation. Beltz PVU, Weinheim

Office of Research Integrity (ORI) Handling Misconduct
http://ori.dhhs.gov/misconduct/

ORI Guidelines for Institutions and Whistle-blowers
http://ori.dhhs.gov/documents/guidelines_whistle.pdf

4. Evaluation, Feedback and the Further Development of the Curriculum

This curriculum is a “work in progress.” The experiences gained with the two parts of the training programme should be used to make content-related and didactic improvements to the curriculum. To this end, a direct exchange of information would be useful between the authors and the “users”, i.e. the teachers who conduct the classes on “good scientific practice” at universities and other institutions. Information that can flow into this exchange includes, for example, which forms of support and resources are needed, which ones still need to be developed, how the curriculum can be broadened to cover other fields.
Enquiries and feedback regarding the organisation should be addressed to:
DFG-Ombudsman@rrz.uni-hamburg.de
If you have questions, feedback or suggestions regarding the content please contact:
gerlinde.sponholz@t-online.de

5. Postscript

More than ten years have passed since members of the working group “Ethics in Medicine” at the University of Ulm started developing and testing the first courses on research ethics. The then spokesman of the working group, who was also the university ombudsman, Prof. Helmut Baitsch, rapidly realised the need to direct the focus of the courses toward training “good scientific practice”. Together with students of medicine, the sciences and engineering, the content and didactics of the course were continuously further developed and the basis for this curriculum laid through cooperation with doctoral students, university teaching staff and ombudspersons. I would like to thank them all for their commitment, criticism and support.

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