THE YOUNG ACADEMY

de jonge akademie

BETWEEN RESEARCH AND SOCIETY

RECOMMENDATIONS FOR OPTIMAL SCIENCE COMUNICATION

ADVISORY REPORT

BETWEEN RESEARCH AND SOCIETY

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RECOMMENDATIONS FOR OPTIMAL SCIENCE COMUNICATION

The Young Academy
March 2012

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SUMMARY

Science has become an integral part of society. The wide-scale application of scientific knowledge and its role in politics and policy make it necessary for everyone to be aware of scientific results and to be able to arrive at a well-founded opinion regarding the impact of science on personal life and on society as a whole.

Communication regarding science is therefore very important. But it is no simple matter: scientific knowledge is often complex, it is never 'finished', and it is often the subject of internal debate. All of these elements are inherent to the scientific process, and contribute to achieving quality. In order to properly assess the various arguments, however, it is necessary to have some idea of the methods that have led to certain results. It is precisely that knowledge that is often lacking.

Scientists, science administrators, the media, and communication departments – but also teachers in primary/secondary education – all play a role in science communication. In this advisory report, The Young Academy sets out how these various parties can optimise their contribution to such communication.

One important point for all concerned is that greater attention needs to be paid to the scientific process rather than – as is currently the case – merely focusing on the results of research. Besides ensuring greater understanding among the general public, such an approach would also help in assessing the value of scientific knowledge in the context of political decision making. Where science policy is concerned, greater awareness of the scientific process could lead to such policy being better in tune with the practice of scientific research. In the education sector, acquaintance with scientific thinking and practice can encourage young people to adopt a critical and investigative attitude, and can also help them gain a more realistic idea of science as a profession.

Anyone who wishes to communicate about the effects and value of science must bear in mind its essential features: science develops by asking questions; it is varied and increasingly interdisciplinary, practised by teams, and driven by fascination; and it is not infallible but usually has the capacity for self-improvement. Finally, science is valuable in numerous ways – not merely economically – for individual citizens and for society as a whole.

The image that a broader audience has of science is created through both science communication and science education. We take 'science communication' to mean the transmission of scientific insights and enthusiasm for science to a wider public. 'Science education' – familiarising people with scientific thinking and practice – must take place throughout all sectors of education and in teacher training programmes. Both contribute 'science awareness', i.e. what science actually is, how scientists work, and what role science plays within society.

In this advisory report, The Young Academy outlines the role of various parties in science communication and science education, identifies problems, and makes recommendations for improvements.

Scientists must be open to interaction with the public. They should participate in training sessions regarding various types of science communication. They should deal critically and in a properly considered manner with media inquiries, and should not make any statements that go beyond their own level of expertise.
Further investigation of effective types of science communication and science education is indispensable, as is the pooling of best practices in this field.

Science administrators should recognise activities in the area of science communication and science education as being an important kind of knowledge valorisation, and should explicitly allow such activities to count in the context of external reviews of research and other types of evaluation. Efforts regarding science communication and science education should be an inseparable component of the assessment and promotion criteria for scientific staff. Students and PhD candidates can be involved in communication projects to a greater extent. The 'Science Hubs' for primary education must be based firmly within the university system.

When grants for scientific research are allocated, it should be mandatory for those receiving funding to contribute to science communication or science education.

The work and value of science should be dealt with in programmes for students of **journalism and communication**. Proper understanding is a precondition for being able to explain science effectively to the general public. Checking one's sources is a primary requirement for responsible reporting about science. The public will benefit from a clear and subtle presentation of research results.

If awareness and understanding of science are to be improved, it is necessary to begin the improvement process at **primary schools** and to continue it at **secondary school** level. Direct contact with enthusiastic scientists will encourage corresponding enthusiasm and understanding of science among school pupils. One basic requirement is for primary school teachers to already become familiar with 'how science works' during their studies at teacher training college. Universities can develop the relevant courses (or arrange for them to be developed). Improvements are also needed in teaching methods and refresher training for teachers with a view to facilitating 'investigative learning', including in core subjects such as language and mathematics.

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Chair of The Young Academy

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Board member of The Young Academy

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1. SCIENCE: EVERYWHERE AND FOR EVERYBODY

Science is an integral part of society. It provide the basis for such everyday items as synthetic clothing and smartphones, and contributes, for example, to the development of safe foodstuffs, improvements in healthcare, and the language development of young children. Science puts us in a better position to understand topics that are in the news every day: conflicts and terrorism, epidemics and economic crises, but also the arts and weather forecasts. Science is part of our culture and offers us new conceptual frameworks in the search for knowledge. Scientific data also provide the basis for political decision-making, for example on climate change, environmental pollution, the desired growth of the economy, and reducing traffic congestion.

The wide-scale application of scientific knowledge and its role in politics and policy make it important for everyone to be aware of the impact of science on personal life and on society as a whole, and to be able to arrive at a well-founded opinion regarding that impact. That is no simple matter, however, because scientific knowledge is often complex, incomplete, and sometimes disputed. Scientists do not always agree with one another and scientific theories are sometimes contradictory. Reciprocal criticism is a feature of scientific endeavour and frequently improves its quality. But without an understanding of the methods that lead to certain results or statements, it is difficult for the public to assess the true value of the various arguments.

For all these reasons, science communication is of vital importance. It involves scientists, science administrators, the media, and communication departments, but also primary and secondary schools – all of these play a role. In this advisory report, The Young Academy sets out how these various parties can optimise their contribution to science communication. We first show that there needs to be a change of focus. Rather than focusing on the end results of research, attention also needs to be paid to the process of scientific endeavour so that people understand how scientific knowledge is generated. We then consider what 'knowledge of science' actually means, and we deal with the relationship between science communication and science education, both focusing on 'science awareness'. Finally, we explain how the various different parties that we have mentioned can play a role in science communication and science education, and we set out recommendations for each of these parties.

2. SCIENCE COMMUNICATION

2.1 Greater focus on the process

For fruitful interaction between science and society, communication and mutual understanding are essential. Besides the results of science, it is therefore also necessary to clarify the process of scientific development, for one thing because that process results in verifiable new knowledge and insights and in new research questions. By not merely presenting results but also clarifying the underlying research, we create scope for involving the general public in a more engaged and critical manner in the challenges, possibilities, and limitations of scientific research. In the education sector, attention to the process of scientific endeavour – i.e. what scientists actually do – can help young people develop a more curious and more critical attitude to science. That attitude will be very useful in daily life and in dealing responsibly with scientific knowledge.

Involvement

Media reports currently focus primarily on the results of scientific research. If they report at all on the underlying process, then it is from the personal perspective of an individual researcher. A lack of understanding for the way in which scientific knowledge is generated makes it difficult for people to formulate an opinion on scientific controversies. Enabling them to understand how research works and giving them the opportunity to engage in discussion with researchers demand greater direct interaction. Science focuses on things that we do not yet know or that we wish to be more certain about. A quest of this kind definitely has 'media value'. The other side of the coin, however, is that that element of scientific uncertainty also determines how researchers talk about their work: they frequently insert commas and question marks rather than exclamation marks and full stops. It would be beneficial if it were made clear just when the scientific process is still at work – with major uncertainty regarding the outcome – and when it can be utilised with a greater degree of certainty.

Reliability

Clarifying the research process more effectively would also have positive effects in politics and policy, both as regards the role played by scientific knowledge in political decision-making ('science for policy') and in science policy itself ('policy for science').

Science can be brought into political decision-making in a more balanced manner if it is clear how the knowledge concerned was generated, i.e. in response to what particular questions, approach, and sources of funding. Someone who has achieved an understanding of how scientific knowledge is in fact generated will never again invoke 'science' as a simplistic facts-producing machine in order to justify policy. After all, science always involves a process of debate, criticism, and new developments. But this does not mean that science cannot play a valuable role in political decision-making. Quite the contrary: the quality of political debate can in fact improve if the facts and insights forming the basis for decisions are explicitly brought into the debate. This did not happen effectively in the commotion regarding the deadly EHEC bacterium in 2011, for example, when unfounded conclusions as to the reason for the outbreak caused great damage to the horticultural sector. It needs to be made clear – or clearer – to policymakers, and often also to the media, that there is a difference between speculation, hypotheses, and validated hypotheses. Deciding the specific level of certainty required as a basis for a decision then becomes a political question. In some cases, policy will be based solely on validated hypotheses (for example as regards the effect of imposing penalties); in other cases, however, a precautionary approach will require that account also be taken of unvalidated hypotheses (for example so as to prevent environmental disasters).

Awareness

Where science policy is concerned, greater awareness of the scientific process would lead to such policy being better in tune with the practice of scientific research. Personal contact between politicians, businesses and civil-society institutions and scientific practice can clarify how important it is to allow scope for developments in the scientific workplace, even if they do not appear to have any direct economic relevance in the short term. The innovativeness of the Netherlands is to a large extent determined by the quality of the education system across the board, and by the dynamism that new scientific insights and understanding bring about.

The image of science

Creating an image of science as a challenging field of work would benefit if the scientific process were made clearer. Careers in research and R&D would be more popular if school pupils had a realistic idea of what science actually involves and what researchers actually do. Secondary school pupils – at all levels – all too often have an image of the scientist as an elderly man with untidy white hair and clad in a lab coat, who causes explosions in a laboratory. This basically harmless caricature was created long ago in comic strips and cartoon films, but its stubborn survival is in fact significant. In feature films too, scientists are frequently depicted as somewhat vague, slightly disturbed, or even dangerous. At best, the scientist is presented as a pipe-smoking professor in a dusty study, surrounded by piles of books. At the very least, this image is open to improvement: science is in fact challenging work for normal people.

The necessary conditions

A number of requirements need to be met if the general public are to be made aware of the actual effect and value of science. Researchers and others involved in science communication and science education need to explain those elements in understandable language. In explaining their own work, researchers need to be aware that they are also contributing to the image of science as such. The task of science communication and science education must also be assigned a proper position in the work of scientists. There also needs to be cooperation with researchers as regards such communication and education: what methods actually work in order to get across the message?

2.2 Effect and value of science

Just what is science, and what do scientists actually do? Science is complex. The simple reason for this is that man and the world cannot be understood 'just like that'. There is good reason why the effect and value of science are themselves the object of research within such disciplines as the philosophy and sociology of science and technology. It is therefore not always easy to explain in ordinary language how science works. It is in any case important to assign a central position to the following four points in communication regarding science.

1. *Science develops by asking questions.*
   Scientists ask questions, construct hypotheses, investigate those hypotheses critically, and draw provisional conclusions. They question the concepts that they have devised and look for new concepts and connections. But there is no standard recipe for scientific endeavour. Furnishing proof and argumentation are essential, but creativity and a critical attitude play an equally important role. Science is not just a factory for turning out answers but above all a machine for producing questions: every scientific study generates new questions, and

scientific knowledge develops by posing valuable new questions. In answering those questions, researchers can make mistakes, but the built-in control mechanisms mean that those mistakes are generally corrected after a while. New conceptual frameworks may also be developed, meaning that earlier questions come to be viewed in a different light. The quantity of verifiable knowledge that we can trust thus grows, as appears from the success of the scientific description, interpretation, and prediction of numerous phenomena and the application of scientific knowledge in a whole range of different fields. Scientific disciplines also constantly renew themselves by critically examining their basis and amending the frameworks for interpretation. As a result, new disciplines arise and new connections are revealed.

2. *Science is varied*
   'Science' is a collective term for a large number of different disciplines, each of which studies a different aspect of the world. The image that people have of science is often dominated by the natural sciences; this does not do justice to the many researchers in the humanities and social sciences. All these differences have their own approaches, questions, and research domains. Moreover, science is increasingly becoming interdisciplinary: researchers – sometimes from entirely different disciplines – are working more and more closely together. Some types of research can no longer be seen as belonging to a particular discipline. This great variety of “science” needs to be made clearer than at present in science communication.

3. *Science is a human enterprise*
   Science is carried out by people, and their curiosity, creativity, and critical approach impose a personal stamp on their work. Science is also a social process: although individual 'heroes' definitely play an important role, scientific knowledge is developed by a research community. Within such a community and between scientific groupings, communication is essential. It takes place constantly and on a massive scale via academic publications, conferences, lectures, etc.
   In all of this, scientists do not merely exchange information but build on one another’s work, correct one another, and inspire one another to come up with new ideas. But because science is people work, it is not infallible. It does, however, have a built-in control mechanism whereby researchers continually assess and correct one another’s work. This takes the form of peer review prior to the publication of results, but also long after publication through debate, replication of the results, and correction.

4. *Science is valuable in many different ways.*
   As a powerful source of knowledge and understanding, science is an inseparable component of society. It has economic value: many connections are possible with the commercial sector, meaning that research can play an important role in innovation. Science forms the basis of science education, not only because new knowledge is generated but also because of the critical and independent thinking that it involves. Science helps us to conduct political discussion more effectively. It also helps us tackle such problems as disease, the impact of climate change, or the issues raised by multiculturalism. Everybody therefore needs to be able to become aware of the scientific and technological developments that affect our daily life, so as to understand them better and to form an opinion.

2.3 Science communication – who does what?

Generally speaking, the image of science is created in a variety of different ways, which are often summarised as 'science education' or "science communication". These disciplines are still developing, but much of the knowledge and understanding that have already been developed is still unknown to researchers and others involved in science education and communication.

Science education – familiarising people with scientific thinking and practice – ought to take place throughout all sectors of education, including at primary and secondary schools and in teacher training programmes. Outside the formal educational context, science education also takes the form of educational media, games, science centres, etc. We speak of science communication when we are concerned with 'the transmission of scientific insights and enthusiasm for science and the world of science to a wider public'. Science education and science communication are extensions of one another. They contribute jointly to what are referred to as 'science awareness' or 'awareness of research and design'. This involves, on the one hand, awareness of what science actually is and how it works and, on the other, of the role science plays within society and how the public perceive that role. Within that public perception of science, emotions play a role, for example fascination or concern, but also understanding of the material, recognition within one's own conceptual framework, and the feeling of being able to exercise control of or even utilise science oneself.

Various different parties are involved where science awareness is concerned: primary and secondary school teachers, journalists, communication professionals, researchers themselves, and – indirectly – science administrators. These parties not only all have different kinds of expertise but also differing interests. How all these different parties benefit from science and how much they do so determine to a large extent what form science communication takes and how much time is devoted to it. Improving public awareness of the effect and value of science demands changes in the attitudes and policies of all the parties concerned and the pooling of expertise. We will set out the changes that we consider necessary in the form of specific recommendations below.

3. OPTIMISING SCIENCE COMMUNICATION

3.1 Recommendations – scientists

Most researchers are not experts at explaining the content of their work or the nature of their discipline for the general public. Nevertheless, public awareness of their work can lead to greater appreciation for it, and can help in marketing the knowledge they have generated. University departments also have a direct interest in public awareness of their 'brand', for one thing when it comes to attracting students. These interests have a major influence on the current form taken by science communication, with its emphasis on publicising mediagenic discoveries and research that keys in to current concerns – in other words, an approach that is in line with the wishes and interests of the media. In the educational context, the target group for scientific information is often the upper classes of senior general secondary schools because it is from these that universities must recruit their students. The approach where the lower classes are concerned focuses on encouraging more pupils to specialise in the exact sciences. Many universities do not consider primary schools at all where communication is concerned, although the advent of the 'Science Nodes' has meant an encouraging start to collaboration.
All in all, this is not a very good basis for the creation of a balanced image of what science involves. A large number of researchers potentially have a talent for explaining their subject to lay persons; what they lack, however, is experience of science education and communication so as to make an effective contribution to science awareness.

The default option should be for science communication to form an integral part of scientific work. Although one cannot expect every individual researcher to deal with the general public, this objective does need to be formulated at the level of research groups, departments, or institutes. In a general sense, researchers need to feel responsible for making their work accessible to the public. After all, it is that same public that has made their research possible and that is affected by the consequences.

Scientists have a responsibility as regards explaining their work to the general public and must be open to contact with that public.

We recommend that the following specific action be taken:

- Scientists should be given courses in promoting science awareness (see also point 3.2 in our recommendations for science administrators).

- Important elements in such courses would be how to get across the work and value of science (see 2.2) and training not only in dealing with the media but also in the use of other channels, for example "science cafés", social media such as Twitter, and websites or blogs. This approach would give more people a direct feeling for actual scientific practice.

- Scientists need to deal critically and in a properly considered manner with media inquiries. They should not make any statements as scientists that require expertise that they do not actually have.

- Encourage scientific research on effective types of science communication and science education and share the knowledge thus generated. Share best practices with other researchers.

3.2 Recommendations – science administrators

Optimum science communication will require a tightening up of the policy pursued by universities, both as regards priorities in marketing and communication and the assessment and appreciation of the activities of researchers as regards science awareness. For many years now, increasing financial pressures have meant that universities have focused their communication efforts on the recruitment of students and on mediagenic publicity. This approach does not always make a positive contribution to public awareness of the role of science. Moreover, there is little appreciation and no compensation for research groups and individual researchers who explain their work in the media, let alone for less obvious contributions such as giving public lectures, guest lessons at schools, or presentations at teacher training colleges. These efforts take up researchers' time but they have major benefits. Personal contact with an enthusiastic researcher can clarify and inspire. Furthermore understanding of scientific practice helps people adopt a more responsible and critical attitude. Particular attention needs to be paid to science education at primary schools and in the lower classes of secondary schools. It is at this stage that children begin to develop their perspective as regards the future, sometimes excluding careers that do not appear attractive enough. Interaction between researchers and receptive, curious pupils contributes to the latter gaining a more realistic idea of what scientific work actually involves. It gives them a better understanding of the fascination that researchers have for the process of questioning and answering, but also of the possibilities and limitations of science, its benefits, and its threats. It was in this way that many researchers originally became interested in a career in science. At primary schools in particular, activities of this kind also extend to others close to the pupil, specifically the parents. Helping increase knowledge of science and investigative learning at teacher training colleges ultimately has a positive effect on large numbers of pupils. Given the importance of science education at primary and secondary schools, science administrators should facilitate and encourage activities in this field.

We recommend that the following specific action be taken:

- Activities in the area of science communication and science education should explicitly count in the context of external reviews of research and in assessments by the bodies that fund research, for example the Netherlands Organisation for Scientific Research (NWO). These activities need to be recognised as an important kind of knowledge valorisation. In line with this, the assessment and promotion criteria for scientific staff need to be extended to include activities involving science education and communication. These activities can partly replace other activities such as management or teaching.

- The 'Science Hubs' which provide science education programmes for primary and secondary schools should be given a firm place within the university. Funding should be ensured so that expert staff can be recruited with good prospects.

- At the behest of the universities, experts should develop training courses for researchers on science awareness. The communication departments of the universities and research institutes can serve as the organisational basis for this.

- The possibilities for/effects of deploying students and PhD candidates for science education and communication should be investigated and if possible expanded. Communicating with the general public is an essential but undervalued academic skill that should be rewarded with course credits. It is important to involve students and PhD candidates in projects in which experienced researchers act as role models.

- Participation in science communication should be a mandatory requirement for the allocation of research grants.

- Scientists need to be challenged to participate actively in science communication. This might involve linking up with a number of existing best practices, for example the programmes of the various 'science cafés' that the Netherlands already have, constructing and maintaining a website or blog, and contributing to public discussion via the opinion pages of newspapers, radio, and television.

- Scientists should reserve 1% of their grants for science education or science communication. They can if necessary contract out these activities to colleagues or other persons who are more expert at them.

3.3 Recommendations – journalists and communication professionals

Science journalists and communication professionals are experts in arousing interest, in quickly and clearly explaining complex material, and in encouraging critical discussion.

Science communication professionals at universities generally focus more on the mediagenic results of research than on the scientific process itself. If attention is in fact paid to that process, it generally focuses – in line with what the mass media expect – on the researcher as an individual rather than on the research team, the value of the work of scientific predecessors, the methods used, the funding, the role of peer review, and other aspects of scientific endeavour. This can create an incomplete picture of what science actually involves.

For their part, science journalists do not always have the space or time to go into a topic in depth or to listen to both sides of an argument. Ordinary reporters are under even greater time pressure, but often have to report on complex matters with which they are unfamiliar. This leads to errors being made. It would be an important step in the right direction if training programmes in journalism and communication focused explicitly on how scientific endeavour actually operates and what functions science plays within society.

We recommend that the following specific action be taken:

- The work and value of science should be dealt with in programmes for students of journalism and communication. The universities could provide the relevant guest lecturers. 'Work shadowing' could be arranged as a means of giving students an insight into scientific practice. Networking sessions could also be organised for researchers and science journalists.

- One important aspect of responsible journalism is checking one's sources. This is comparable with the peer review process and the replication of results within the scientific world. Determining whether a press release on a scientific topic is based on a peer-reviewed publication is a basic requirement for checking whether the press release is in fact reliable. If a particular assertion or finding raises questions, for example, then a responsible journalist will make inquiries with other researchers in the relevant field. Above all, the public will benefit from a clear and subtle presentation of research results, avoiding sensationalism.

3.4 Recommendations – primary and secondary education

There are two important arguments for familiarising children with scientific thinking and action from an early age. Talented children need to be identified and given the necessary scope to develop their talents. Whether we want it or not, the fruits of scientific research are taking an increasingly prominent place in the lives of us all. Basic and applied scientific research need to be able to count on both 'players' and 'fans': appreciation and support are important and will remain so.

If awareness and understanding of science are to be improved, the improvement process will need to commence as early as possible, namely at primary school. If efforts at that level are to be successful, primary school teachers and their colleagues in the lower classes of secondary schools need to become familiar – or more familiar – with scientific research and scientific thinking.

Teachers are experts at helping children build up knowledge and understanding of large quantities of material at an appropriate level. Secondary school teachers have often been trained in one particular discipline and can keep up their subject-specific knowledge by means of in-service training. The training of primary school teachers is more general, with a great deal of attention being paid to didactic skills; they only come into contact with science and technology to a very limited extent. In addition, many primary school teachers tend to display a certain wariness where science is concerned, perceiving it as 'difficult' and consequently hard to get across to their pupils.

The primary school curriculum offers hardly any scope for science awareness or for investigative learning. One reason for this is that schools are judged on the basis of quantifiable performance, as expressed by pupils' results in the 'CITO' tests (the equivalent of the SATs tests in other countries). 'World orientation' – a school subject in which science and technology play an important role – is tested but the result is not counted towards a pupil's total score.

Teaching methods and the key objectives and learning pathways laid down by law mean that teachers are primarily engaged in dealing with the mandatory curriculum and must necessarily follow the methodology of the educational publishers. Improvements are possible both in these teaching methods and in the in-service training provided for teachers. Efforts should be made, for example, to prevent the emphasis being merely on factual details and on technical matters. Rather, for example, than requiring simple experiments to be performed in which the result has already been established – meaning that the pupil's answer is 'correct' or 'incorrect' – it would be better to link up with the investigative attitude that children already develop at an early age. This kind of 'investigative and designing learning' can also be applied to language and mathematics. As in the world of 'real science', the key element here is that of questioning – by both the teacher and the pupil.

When projects are being developed for primary school pupils, it is important to create a bridge between formal in-school learning and informal extramural learning, for example with the Scouts, or through sport, TV, or games. There should ideally be a natural line running from primary school to secondary school.

Currently, there is a confused jungle of websites, programmes, and educational resources focusing on science and technology. Assessing the true value of all this material is difficult. It often also focuses on scientific facts and hardly at all on how science actually operates. If pupils are in fact encouraged to undertake their own research, then it is often in an inflexible and prescriptive manner. A major improvement could be achieved in the longer term by bringing more academics into schools and creating scope for science education at teacher training colleges and programmes. From a short-term perspective, it would be feasible to offer teachers in-service training and professional development programmes and to introduce pupils to researchers. One point of concern here is that only a small number of researchers could contribute in this way at primary and secondary schools, whereas the number of pupils and schools is very large.

We recommend that the following specific action be taken:

- The universities should develop courses on scientific attitude and training for the teacher training colleges; these could be coordinated at national level, for example by the Royal Academy. 'Work shadowing' could also be arranged to give students an insight into scientific practice. Meetings and networking sessions could also be organised for researchers and teachers.

- The regional 'Science Hubs' and similar initiatives should be developed further and should be enabled to provide subject-specific programmes for schools in the region. This demands the development of an overall approach to science awareness among both pupils (and indirectly their parents) and teachers at primary and secondary schools.

- Teacher training colleges should make investigative and designing learning part of their curriculum. The aim of this would be for the staff and students of these colleges – and through them ultimately primary school pupils – to become familiar with learning that involves posing questions and searching for answers, in line with the research cycle that applies in the world of science. Reinforcing an investigative attitude will give future teachers a better idea of what science involves and equip them with the necessary skills to adopt such an approach together with their pupils. Investigative learning will not replace but will be incorporated into the mandatory subjects, including language and mathematics. The Young Academy will initiate a pilot project to develop knowledge and expertise regarding investigative learning and science education and to provide that knowledge and expertise to (university level) teacher training colleges, thus contributing to the professional development of primary school teachers in this field.

APPENDIX 1
THE YOUNG ACADEMY

The Royal Netherlands Academy of Arts and Sciences (KNAW) decided to set up The Young Academy in 2005 as an independent platform made up of young researchers who are at the top internationally within their discipline. Members are between 25 and 45 years of age and received their doctorates less than ten years before their appointment to the Academy. They represent a broad spectrum of scientific and scholarly disciplines and work at Dutch universities and a wide range of research institutes. They are appointed for a five-year period. In the spring of 2010, when The Young Academy celebrated its fifth anniversary, it said farewell to the first 'class' of members. The Young Academy now has fifty members. Each year, ten members are added and ten depart.

Membership

In order to qualify for membership of The Young Academy, young researchers must have already made their mark in science. They must also have a broad interest in science and scholarship, in the role that science plays in society, and in science policy. A special committee made up of members of The Young Academy and the Royal Academy selects ten new members every year from nominations submitted by university vice-chancellors, research school directors, non-university research institute directors, chairpersons of the Areas covered by the Netherlands Organisation for Scientific Research, chairpersons of the Royal Academy sections, the members of The Young Academy itself, and the chairperson of the National Network of Female Professors.

Objectives

The Young Academy operates independently within the Royal Academy. It has its own working plan, organises its own events, and is responsible for its own viewpoints. The areas in which it is active are interdisciplinarity within science and scholarship, science policy, and science and society.

The Young Academy

- actively brings researchers into contact with disciplines outside their own area of specialisation and in doing so encourages interdisciplinary research;
- asks its members to make an active contribution to the future of their own and ancillary disciplines and to formulate their views on science policy;
- consults with scientific organisations and ministries and advises them on science policy;
- conveys its fascination with science and scientific insights to the public and pupils and students, and considers the matter of valorisation in the broadest sense of the word.

The Young Academy and the Royal Academy cooperate mainly on projects and advisory matters. The Young Academy is an independent division of the Royal Netherlands Academy of Arts and Sciences.

Royal Netherlands Academy of Arts and Sciences

The Young Academy operates independently within
the Royal Netherlands Academy of Arts and Sciences.

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