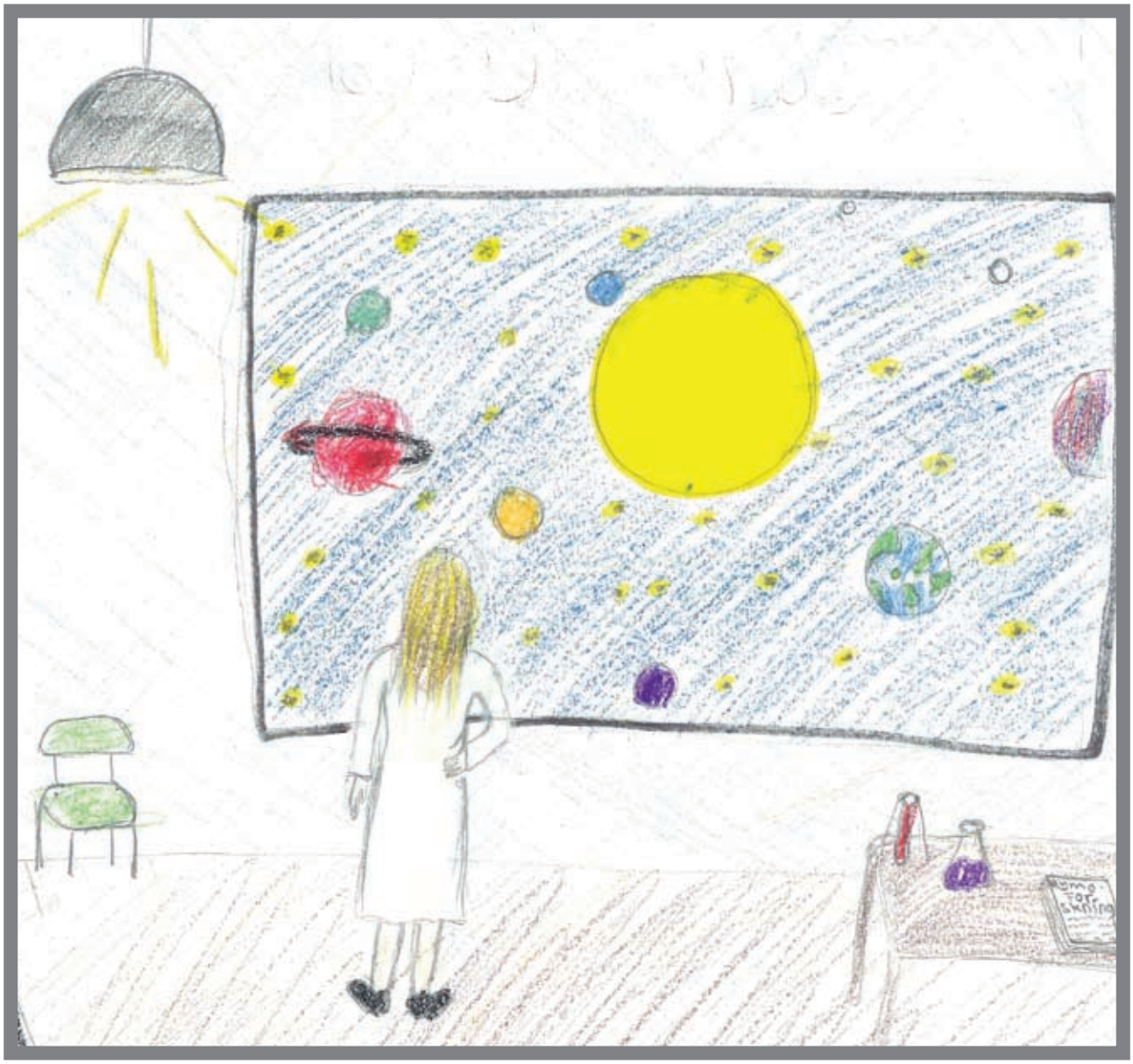
vetenskap & allmänhet

Myself as a researcher

– an analysis of children's images of scientists



VA Report 2008:3

PREFACE

Knowledge and learning are the foundations of our society. People are increasingly affected by science. Hence, it is important that people perceive science as meaningful and relevant, and view it in a comprehensible context. The Swedish association Vetenskap & Allmänhet, VA (Public & Science), aims at promoting dialogue and openness between the public – especially the young – and researchers.

The European initiative Researchers' Night in Sweden is coordinated by VA. As part of the 2007 activities a drawing contest "Draw yourself as a researcher" was arranged. The contest was designed by the member of The Researchers' Night Advisory Board Professor Ilan Chabay, GC+, the Gothenburg Center of Public Learning and Understanding of Science at Chalmers University of Technology and the University of Gothenburg. The contest attracted about 3.000 contributions from 6–12 year-old school children. A sample of these drawings has been analysed by Lori Adams Chabay, Ph.D. Her analysis, conclusions and recommendations are presented in this report **Myself as a researcher – an analysis of children's images of scientists**, VA report 2008:3.

Readers are welcome to quote this report, provided they cite VA as the source. This and other VA studies can be downloaded from the VA website, www.v-a.se.

We do hope that these interesting results and reflections will stimulate further activities in this field.

Vetenskap & Allmänhet, VA, October 2008

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Contents

Myself as a researcher – an analysis of children's images of scientists

Lori Adams Chabay, Ph.D.

THE PROJECT

In 2007, as part of the European Commission's "Researchers in Europe" initiative, ForskarFredag[1] or Researchers' Friday, included a Draw a Scientist contest. Vetenskap & Allmänhet, VA, the organizer in Sweden, invited 6-12 year-old school children from across Sweden to participate in the drawing contest. Approximately three thousand children responded and submitted a drawing.

Rather than simply drawing a scientist, students were asked to imagine themselves in the future and draw themselves as a scientist/researcher (forskare) as well as write a few sentences explaining what they would do in that role. Vetenskap & Allmänhet, VA then chose three drawings and submitted them to the European Commission as Sweden's winners of the contest.

Drawings that had been collected were sent to me for my impressions and discussion of the imagery and ideas that were represented by the children. Not only did they share ideas about themselves doing research but also what interested them most in the field of science.

Across the age range of 6 to 12 year olds, I looked at nearly 1.500 drawings and narrowed them down to 800 to investigate. As might be expected, many of the drawings contained similar themes or ideas, like researching flowers, planets, or animals, subjects of interest to this age group or topics potentially being covered in their science coursework.

In making my selection, I looked for drawings that included, in order of priority:

1. An identifiable image of a person depicted either as a child or an adult. I assumed that the artist meant this person to represent him or her self.
2. Drawings with clear details, either drawn or written, about the child's focus of research.
3. A variety of environments or contexts in which the child placed him- or herself to do research.
4. The child's written thoughts on being a scientist/researcher or doing science.
5. Drawings that contained themes, imagery, or ideas that was unique to the majority of drawings or were very few in number – 10 or less.

My intention was to uncover the broad range of ideas that children wanted to share about science and research. Each drawing added another layer of children's theories, misunderstandings, fantasies, and desires around scientific research.

BACKGROUND

From the late 1970's through the 1990's, studies assessing students' images of scientists (Krause 1977; Chambers 1983; Schibeci & Sorenson 1983; Fort & Varney 1989; Huber & Burton 1995; Finson, Beaver & Cramond 1995; Newton & Newton 1998) have consistently revealed that primary school children held images of scientists and their work that fitted a stereotype of a white, balding male, wearing a lab coat and glasses, and working alone amongst a collection of test tubes, flasks, and machines, in a laboratory environment.

This stereotype was shown to have formed early, when children were six or seven years of age, and became more highly stereotypic as children progressed through the grades, until grade five, when the image appeared to have fully developed (Chambers 1983; Schibeci & Sorenson 1983, Newton & Newton 1992).

Researchers have suggested a variety of reasons for the persistence of these stereotypes including: classroom experiences of science learning, books and comics, and mass media portrayals of scientists and their work. All may have contributed significantly to this issue.

After more than three decades, concerted efforts by science educators and curriculum developers to present realistic images of scientists and how they go about "doing science" has "fallen on deaf ears," producing little if any real changes in the major aspects of the stereotypical image of scientists shared by school children in the USA, Europe, Canada, Australia, and New Zealand (Newton & Newton 1992, 1998).

Whatever the reasons or explanations for these stereotypes, they are alive and well today and may play a larger role than previously realized in students' attitudes towards entering a science profession.

IMAGES OF THE SELF

Gottfredson (1981) and O'Maoldomhnaigh & Mhaolain (1990) noted that students' occupational preferences and career aspirations were strongly linked to their images of particular occupations. A major goal of science education is that students regard a career in science as a desirable and viable option. This will only happen if the image of who does science and what it looks like to be "doing science" is dramatically changed. One place to begin this change would be with the children themselves. If children were asked to imagine themselves as a future scientist what might those images reveal?

To date, there have been no studies that we have found assessing children's images of themselves as scientists. Through this project, having changed the focus of the inquiry, children were asked to reflect on this potential future role and to reveal a more true-to-life image of themselves in the role of scientists.

What might these images look like? Given the opportunity, would children provide us with fresh insight into their ideas of scientists and the enterprise of science or depict themselves as the stereotypical scientist?

In this project my goal was to: a) identify the major characteristics that school age children use in depicting scientists and b) reflect on their ideas and theories of doing science.

Elements of the drawings were assessed based on three broad criteria:

1. Did the drawing include any aspect of the stereotypical image of scientists found in earlier research using the Draw-a-Scientist Checklist (DAST-C) developed by Finson, Beaver, and Cramond, (1995)?
2. Were the drawings realistic portrayals of scientists as adult people (male and female, neat appearance i.e. well-groomed clothing and hair) engaging in the positive pursuit of scientific inquiry, observation, experimentation, discovery, and invention within a positive working environment (working outdoors as well as indoors, positive symbols or messages, working cooperatively)?[2]
3. Were children's written descriptions of scientists' work reflective of a realistic and positive attitude about science and its use to benefit humanity, other living things or the environment?

CHILDREN'S PORTRAYALS OF THE SELF AS A SCIENTIST

Drawing abilities varied greatly amongst the youngest group, 6 and 7 year olds. Many were not able to clearly represent their thoughts and ideas with drawings alone. It was useful to have children's written thoughts to help identify their intentions (Figure 1).

Figure 1. "As a researcher I think to go out in space and check what there is over there. Maybe there are some planets like Saturn. I have on a space helmet." 7 year-old boy.

The majority of the youngest children in this age span attempted to draw some image of themselves. However, many of these attempts were not successful in providing a representation that could be thoughtfully assessed.

Figure 2. "He tries to make medicine to treat all the allergies in the world. Boy in grade level 4-6.

In drawings that included a person, the figure was often quite small, in comparison to other objects, or placed along the periphery of the drawing. This placement gave the impression of the figure as an afterthought or placed solely to illustrate someone engaged in an action. It was unclear whether or not the child actually meant the often times stick-like figure to represent them. Most drawings by children of this age were of their personal interests such as drawings of insects, pets, football, or outer space.

Seventy-five percent of the 10-12 year olds still held some aspect of the stereotypic image of a scientist. This was most evident when the child drew him- or herself as an adult figure in an indoor work environment.

Typically, the child-as-adult scientist had, if male, facial hair, wore eyeglasses and a white laboratory coat, and was surrounded by test tubes, flasks, Bunsen burners, books, microscopes, and chalkboards (Figure 2). The older students most frequently portrayed one or more of these characteristics in the drawings. This finding supports the research that the stereotypic image is set by 5th grade, when children are between 11 and 12 years of age.

Very few drawings, less than 2 percent, depicted the child as the stereotypical "mad or evil scientist" with wild hair, a maniacal expression, creating monsters or torturing people with images of explosions, blood, and body parts in the background.

CHILDREN'S RESEARCH FOCUS

Children focused their research in three main areas. The most frequent were topics possibly being studied in class or of interest to that particular child. The second was research that addressed health and social problems and the third were children's personal pursuits.

Topics included researching:

- animals- land and sea, wild and domesticated
- dinosaurs, fossils
- outer space, planets
- insects
- life on other planets; "beings" from outer space
- plants/flowers, rocks, diamonds
- stars, sun, clouds
- human body, skeletons
- bacteria
- chemicals

Problems engaged them such as:

- how to improve the quality of water in the seas
- how to help people stop smoking
- research on foods that would prevent obesity
- developing medicines for allergies and a cure for cancer and other diseases
- developing alternative fuels
- improving car engines to prevent air pollution

Children chose to research their personal pursuits or fascinations:

- football
- better tasting candy and toothpaste
- cosmetics in rainbow colors
- guns, bows & arrows and antique weapons
- clothing
- cars
- computers and computer games

DISTINGUISHING BETWEEN SCIENCE AND TECHNOLOGY

About 3 percent of children equated technology with doing scientific research and invented robots, time machines, cars, and machines to alter their size, personality, or appearance (Figure 3). Other imaginary machines in some drawings appeared to be a part of the laboratory equipment.

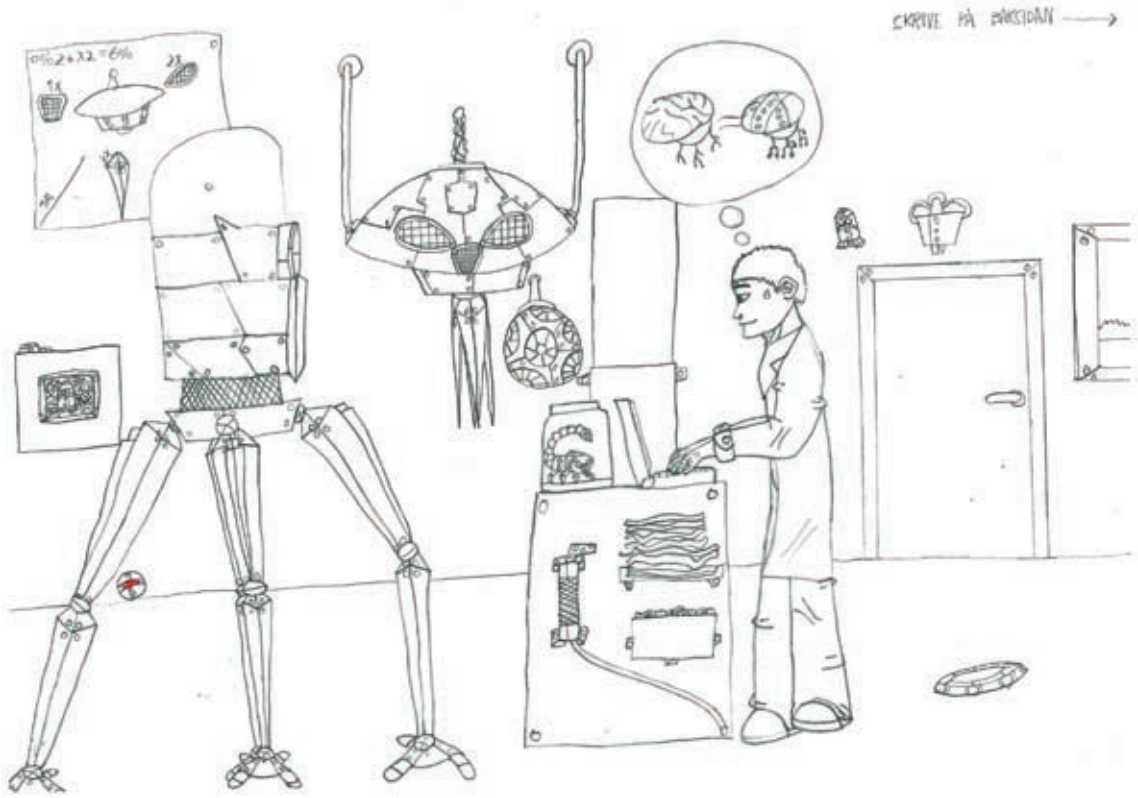

Figure 3. "I am a researcher and I am researching how one can copy a brain and make it out of metal." 10 year-old boy.

Six children invented machines of destruction that killed or maimed people or created monsters. Futuristic looking airplanes and flying motorcycles could shoot bullets and lasers and drop atom bombs and missiles.

SCIENTISTS' WORK ENVIRONMENTS

Drawings were chosen for their wide variety of rich and imaginative contexts. Interestingly, the younger children tended to place themselves in outdoor, natural environments while 10-12 year olds depicted more indoor work environs. This may just be due to older children's greater knowledge of laboratories and its association with scientific research (Figure 4, 5).

Figure 4. 7 year-old girl.

Figure 5. "When I become big I will research explosions!" 10 year-old boy.

Children did not seem to perceive their research interests as limited to one kind of an environment. For example, they researched the planets and stars, and searched for alien life by looking through a telescope as well as placing themselves in a rocket ship or walking on the surface of a planet. Animals, insects and dinosaurs were most frequently studied outdoors in their natural habitats but a fair number of children also imagined doing research in laboratories, zoos, oceans, archaeological sites, aquariums, and museums (Figure 6, 7).

Figure 6. "I work at NASA and research space." 11 year-old boy.

Figure 7. "I will research fish and coral reefs." 12 year-old girl.

THE PHYSICAL ACTIVITY OF RESEARCH

What was most striking, but not surprising, was children's images of themselves in action. For the majority of children of all ages, science research meant doing something physical. In drawings, they were actively engaged – observing with telescopes, magnifying glasses, and microscopes, climbing/crawling/swimming, mixing liquids, measuring, manipulating levers and buttons on machines, digging up fossils and bones, using mechanics' tools, walking in space, driving cars, and flying airplanes (Figure 8, 9, 10).

Figure 8. "Here I am as an archaeologist." 8 year-old girl.

Figure 9. Boy in grade level 1-3.

Figure 10. "I will research dinosaurs. I will try to bring them back." 10 year-old boy.

Children characterized the activity of research in their drawings by illustrating the "processes of science." Here, process refers to the idea that how children learn science resembles what real scientists do – the processes they carry out in their scientific activities – observing, classifying, inferring, carrying out experiments, and communicating their findings (Figure 11, 12).

A little more than half of the drawings were of a figure sitting or standing at a desk or laboratory table. Vials and flasks of chemicals and solutions, science and research equipment, and invented machines and gadgets most often surrounded them. Clearly, children saw themselves as the "actor" in these drawings even if they did not portray themselves as actively moving.

Figure 11. 11 year-old girl.

Figure 12. "I will research animals under the threat of extermination (extinction). My goal is for the animals to live free. I am in the forest and trying to come up with one solution." 6 grade level girl.

WORKING COOPERATIVELY WITH OTHERS

Seven drawings depicted two or more children engaged in research and/or working cooperatively with others. These were drawings that focused on uncovering dinosaur bones, developing medicines, and improving the environment (Figure 13).

Figure 13. "Here I am and my friend Linnea. We are tree researchers. Just now we take samples in the Amazon and send (them) to the lab in Sweden. There we produce trees that can improve greenhouse effects. Our dog Suzai helps us to find the right tree. Linnea takes samples and I check them." 11 year-old girls.

This small number may be attributed to what children were initially asked to do which was to draw themselves, not for example themselves working with a friend. Possibly, rewording the request and having children consider different kinds of social and collaborative environments conducive to scientific research may further illuminate this issue. It could be argued that some of the greatest scientific achievements came from researchers working together rather than in isolation to solve a problem.

SUMMARY

These richly detailed drawings by Swedish school children illustrate cases in which the child clearly represented a current or future construction of him- or herself, working in realistic environments, both indoors and outdoors, engaged in science research. I interpret these imaginings as a positive and critical step towards the development of an early role identification as a future scientist.

Asking a child to write, in addition to draw, was essential in getting a clearer picture of what she or he wanted to communicate. For anyone wishing to pursue similar types of drawing activities with children, I would highly recommend using this strategy.

Children saw themselves as doers engaged in the activity of research. Unfortunately, most older school age children report that while doing activities is their preferred way of learning science, their actual experience had very little to do with doing anything. When 5th grade children were asked to draw a picture of themselves doing science at school more than half drew themselves reading a science textbook or taking notes (Barman, Ostlund, Gatto, and Haferty, 1996).

Students considered a broad range of topics, interests, and problems. For the youngest children, many of their ideas of doing science were based in fantasy and dreams, like inventing a flying carpet or a teleportation machine or meeting a being from another planet.

While more realistic in their theories of science research, older children also practiced some fanciful thinking, inventing robots to do homework and household chores and a machine to make you improve your soccer playing performance. However, they also were willing to tackle some very current health and environmental issues showing that they were aware of what is happening in the world around them and seeing science as a tool for solving some of these problems.

As a whole, the majority of children showed positive images of scientists and science research, considered it a strategy to learn more about their personal interests, and a tool for addressing health and environmental problems.

The findings in this report provide insights into children's imagery of scientists and science research. We believe they are both important and hopeful for those interested in strengthening these positive images and encouraging school age children to pursue science as a career.

RECOMMENDATIONS

The following are some recommendations for educators- formal and informal, parents, pedagogics and researchers interested in further supporting children's interest in science and science research.

1. Children have a natural curiosity about the world around them. This is most evident in their questions and theories about how things work. This natural curiosity requires nurturance as well as stimulation.

   Adults can tap into children's energy by following their lead as the children ask questions and attempt to find their own ways to answer them. Provide a child with positive feedback, material resources, social support for learning, and time to process her or his observations and ideas. This sends the message that having ideas and pursuing them is a worthwhile endeavor.

2. Inquiry into authentic questions generated from students' experiences is the central strategy for teaching science. Educators can encourage a student to pursue his or her separate ideas, theories or interests from those presented in the class or assist a child in following through with an investigation sparked by a group discussion. The teacher's role in this is as a facilitator focusing and supporting inquiries while interacting with students.

3. Make efforts to ensure, whenever possible, that children may find their inspiration, explore ideas, investigate questions, and develop theories outdoors and from the natural world.

4. Encourage students to investigate possible solutions to real-life problems.

5. Provide opportunities, through hands-on activities, for teachers to model and students to regularly engage in the skills of scientific inquiry; observing, recording, developing theories on, for example, the stages of plant growth or rainfall effects on water levels or electrical energy needed to power a vehicle.

6. Have students work together, in self-selected pairs or teams, to research a mutual area of interest, experiment, or investigate natural phenomena. Structure time so they are able to engage in extended investigations.

7. Broaden children's image of scientists by inviting scientists and scientists-in-training to become a part of the classroom through bi-weekly or monthly visits. During this time, the scientist should be a part of the science learning experience, working side by side with the students, rather than lecturing or presenting information.

8. Last but not least, adults who are enthusiastic, interested, and who speak of the power and beauty of scientific understanding, instill in children some of these same attitudes.

FOOTNOTES

[1] Researchers' Night was held for the first time in 2005. Across Sweden and all over Europe, hundreds of activities showed how exciting, fun and relevant research actually is. Activities included experiments, workshops, hands-on activities, science shows, exhibitions, science cafés and many other opportunities to meet researchers face-to-face. The Swedish activities, ForskarFredag (www.forskarfredag.se), were coordinated by the association Vetenskap & Allmänhet, VA (Public and Science).

[2] Researchers of the Maxima Project at San Diego State University, California, developed these positive attributes of scientists for a Draw a Scientist Test, as part of a longitudinal study of girls' conceptions of scientists.

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VA Reports

2002:1 **Vad tycker folk i andra länder?**
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2002:3 **Forskares syn på samtal med allmänheten**
2002:4 **Ungas syn på vetenskap**

2003:1 **Vetenskapen i Samhället**
– resultat från SOM-undersökningen 2002
2003:2 **VA-studier under luppen:**
Synen på vetenskap 2002
– en analys
2003:3 **Allmänhetens syn på Vetenskap 2003**
2003:4 **Forskares syn på Vetenskap och Allmänhet**
– intervjuundersökning 2003
2003:5 **Forskares syn på samtal med Allmänheten**
– en fokusgruppsstudie
Delrapport

2004:1 **Vetenskapen i Samhället**
– resultat från SOM-undersökningen 2003
2004:2 **Lärares inställning till vetenskap och forskningsbaserad kunskap**
– en översikt av några svenska forskningsrapporter
– några goda exempel på mötesplatser
2004:3 **Allmänhetens syn på Vetenskap 2004**
2004:4 **Lärares syn på Vetenskap**
– intervjuundersökning 2004
2004:5 **Forskares syn på samtal med Allmänheten**
– en fokusgruppsstudie
Slutrapport
2004:6 **Vad tycker folk i andra länder 2004?**
– analys 2004 av några utländska opinionsundersökningar

2005:1 **Vetenskapen i Samhället**
– resultat från SOM-undersökningen 2004
2005:2 **Lärare om företagsamhet**
2005:3 **Eurobarometrar om Vetenskap 2005**
2005:4 **Allmänhetens syn på Vetenskap 2005**
2005:5 **Vetenskap i Press**
– en innehållsanalys
2005:6 **Journalisters syn på Vetenskap**

2006:1 **Vetenskapen i Samhället**
– resultat från SOM-undersökningen 2005
2006:2 **Politikers syn på Vetenskap**
2006:3 **Vetenskap i Politisk Press**
– en innehållsanalys
2006:4 **Kunskapsbiten, 18 röster om relationen forskare – politiker**
2006:5 **Politik och Vetenskap**
– VAs politikerstudie i korthet
2006:6 **Allmänhetens syn på Vetenskap 2006**
2006:7 **Stockholmspolitikers syn på Vetenskap**
2006:8 **Politik och Vetenskap**
– en litteraturstudie
2006:9 **Allmänheten om Carl von Linné 2006**

2007:1 **Journalister om Forskning**
2007:2 **Vetenskapen i Samhället**
– resultat från SOM-undersökningen 2006
2007:3 **Allmänhetens syn på Vetenskap 2007**
2007:4 **Ungdomars syn på Vetenskap**
– analys av VA-data 2002–2007
2007:5 **Unga om kunskap**
– en djupintervjustudie
2007:6 **Galna, virriga och ondsinta?**
– bilder av forskare i medier för unga
2007:7 **Projekt utan effekt?**
– utvärderingar av N&T-initiativ under luppen
2007:8 **Kunskap äger**
– VAs ungdomsstudie i korthet

2008:1 **Efter Linnéjubileet**
– Allmänheten om Carl von Linné 2007
2008:2 **Vetenskapen i Samhället**
– resultat från SOM-undersökningen 2007
2008:3 **Myself as a researcher**
– an analysis of children's images of scientists
2008:4 **Kunskapssynen i Näringslivet**
2008:5 **Kunskap i omsättning**
– VAs näringslivsstudie i korthet
2008:6 **VA-barometern 2008**

Vetenskap & Allmänhet, **VA (Public and Science),** is a Swedish association aimed at promoting dialogue and openness between the public – especially the young – and researchers. It endeavours to stimulate greater dialogue around issues that concern people, and to connect these issues to science.

VA's goals

- Promoting contact and the exchange of ideas between the public and scientific researchers
- Increasing public knowledge of research methods and findings
- Improving sensitivity and understanding among researchers about the public's questions and concerns about research
- Building networks for encounters, interactions and exchanges of experience

VA uses three main approaches:

- **Dialogue** – we organise and encourage meetings in new and unconventional arenas where researchers and members of the public can hold dialogues based on what the participants are interested in.
- **Knowledge** – we conduct surveys and studies on how the public views research, how researchers view dialogue and what specific groups of society think about science.
- **Experience** – we disseminate experiences of various and diverse activities, organised both by ourselves and others, via our network and our website.

VA is based on the broad involvement of some 60 organisations, public authorities and institutions, universities, labour confederations, companies and private associations from across Swedish society. The main financing sources are membership fees and project grants. VA is also supported by the Swedish Ministry of Education and Research.

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