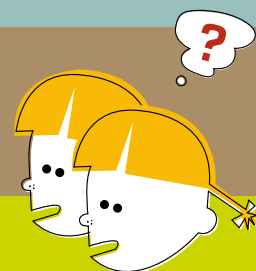




The Nysgjerrigper Method

A brief introduction to scientific working methods
in primary school

Teachers' Guide



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Teachers' Guide*

Original Norwegian version 1999, revised in 2003 and 2006.

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Knowledge is a driving force in today's society. Knowledge will ensure our future. It consists not merely of skills and facts, but also embraces the reasoning and reflection required for life-long learning. Curiosity is an important tool in this respect. In fact, the word Nysgjerrigper actually translates into 'Curious Peter', and the programme is designed to put research and science on the agenda inside and outside the classroom. This abridged English version of the original Norwegian teachers' guide offers a brief introduction to the Nysgjerrigper Method and other learning resources for teachers and pupils in primary school. The objective is not simply to tell the world about what is going on in Norwegian classrooms, but also to inspire educators and communicators outside Norway to put scientific working methods on their agendas.

The Nysgjerrigper Method is a tool designed for primary school teachers and pupils. Since the programme was launched in 1996, thousands of teachers all across Norway have attended courses and adopted the Nysgjerrigper Method. The teachers' guide is based on experience from meetings with teachers, as well as experience with entries in 'Nysgjerrigper of the Year', an annual research competition for young people in Norway.

Norwegian national curricula emphasise the importance of encouraging activity and creative enthusiasm at school. Teachers who have applied the Nysgjerrigper Method report that it helps make schoolwork meaningful and interesting for pupils, creating in turn a good platform for motivation and cooperation.

Each year, about 60 000 eager, hopeful first-graders embark on their academic careers in Norway. At school, they learn to recognise how one thing is related to another. They learn to read and write, and they learn how to gather and use scientific data and information. As they progress, they are required to deal with an ever wider range of sources of information. Their schoolwork should give them pleasure, and pupils need to be able to 'stretch' to reach new targets to keep up their motivation. Teachers should not simply teach, they should also pave the way for learning. Nysgjerrigper is intended to help contribute to this work through the Nysgjerrigper Method and other learning resources designed to benefit and inspire teachers and pupils inside and outside Norway.

Marianne Løken
Editor

The Nysgjerrigper Method

In a nutshell, *the Nysgjerrigper Method* is a presentation of the hypothetical-deductive method (HDM). This is a common research method based on a combination of the natural and social sciences, and it should work well in primary school. The method gives children a good point of departure for working with science on their own, and it teaches them about important aspects of science.

The Nysgjerrigper Method gives pupils a grasp of some of the basics of science. We want them to experience their own 'research' as a creative activity that challenges them to formulate questions and to think about potential explanations. It is also important that pupils learn to do this in cooperation with others.

This is what the Norwegian national curriculum says about science:

Science is presented in two ways in science classes: As a product that demonstrates the knowledge we currently have and as a process that applies scientific methods to acquire knowledge. Scientific processes encompass the formulation of hypotheses, experimentation, systematic observations, transparency, discussions, critical evaluations, argumentation, reasoning to arrive at conclusions and the communication of results.

The Nysgjerrigper Method can help pupils develop the following skills (defined by the Norwegian national curriculum as competence targets):

They will learn to

- ask questions, talk and philosophise about how they experience nature and the place of man in nature;
- use their senses to explore the world immediately around them and to describe their own observations from experiments and nature;
- apply natural science concepts to describe and present their own observations in different ways;
- collect and systematise data;
- present findings with and without digital equipment and using simple measuring instruments for their investigations;
- formulate questions about something they wonder about, make a plan for investigating a self-formulated hypothesis, conduct surveys and discuss the results, explain why it is important to make and test

hypotheses based on systematic observations and experiments, and why it is important to compare findings, use digital technical equipment and scientific equipment for experimental work and field work, excerpt scientific information from different media, and publish findings from their own investigations using digital tools.

By developing basic skills in different subjects, children can learn to make better use of what they read, write and calculate. Moreover, learning by experience allows pupils to acquire skills that will help them use language better in different social contexts, e.g. at school, home and recreation.

The term 'basic skills' implies being able to:

- express themselves verbally
- read
- write
- do maths
- use digital tools

Source (in Norwegian): Utdanningsdirektoratet.no (website for The Norwegian Directorate for Education and Training)

Pupils who successfully complete a Nysgjerrigper project will acquire skills in several different subjects.

ICT (Information and Communication(s) Technology) is a particular challenge at school. To deal with teachers' need for easily accessible tools for teaching ICT skills, Nysgjerrigper has developed an Internet resource. The Internet resource at nysgjerrigpermetoden.no is currently available in Norwegian only.

The project toolbox allows pupils and teachers to create a workspace and to post text and pictures for each step in the method. Supervisors will find hints about methods and how to make progress, as in the procedures described in this booklet. All this information is available in a toolbox on the Norwegian website. Once a project is completed, your class can publish its finished report so that it is accessible to everyone. It is also possible to publish the report and enter it in digital format into Norway's national research competition entitled 'Nysgjerrigper of the Year'.

Nysgjerrigper's six steps to research



I wonder why

1 I WONDER WHY

You can wonder about absolutely anything! In fact, a curious scientist questions pretty much everything. Write your question down. It is really important to your research that you learn how to ask good questions, so take your time at this stage. Maybe it would be a good idea to start by asking a question that can be answered right there in your own home town?



Why is it like this?

2 WHY IS IT LIKE THIS?

Try to figure out the answer to your question by asking: What might the cause be? Can it be because...? This is called a hypothesis, which is like a 'possible' explanation. A hypothesis can also be a statement. You can then do further research to determine whether it is true or false. But don't be surprised if you come up with several explanations (hypotheses)!



Draw up a plan

3 DRAW UP A PLAN FOR THE INVESTIGATION

The time has now come to draw up a plan for your research. The purpose is to find out how correct your hypotheses are while you learn more about your subject. You might ask: Where can I get more information? How should I do my research? Who can I ask? You can take pictures, interview somebody who knows a lot about the subject, search the Internet, visit a museum, go on a field trip or do your own experiments and observations (to observe means to watch something and pay attention to what you see).



Collect data

4 COLLECT DATA

You have to gather information that is related to your hypotheses. You'll need information that might support your hypotheses, and information that can prove them wrong! You should observe, count and measure, call, read, write, ask and investigate. Maybe you even have some new ideas about how to get more information, or maybe you need to make new hypotheses. If so, you're working like a scientist!



What we found out

5 WHAT WE FOUND OUT

After doing your research, you have to summarise what you found out, and see if your hypotheses were correct. If you fail to get any further and all of your hypotheses seem wrong, go back to point 2. Try to come up with new hypotheses and conduct new experiments. Your results might lead to new questions that bring you closer to the answer you are looking for. Showing that one or more of your hypotheses are wrong, that is, disproving a hypothesis is just as important as confirming one. Research will always bring you further in one way or another!



Tell everyone else

6 TELL EVERYONE ELSE

Once you are done with your research, it is time to tell other people what you have found out and how you have worked. Write, draw or use other means to present your work. Your project can be presented by making a brochure, writing an article in a newspaper, or maybe making a proposal to your local authorities. Scientists have to present information that shows how they reached their conclusions, that is, they have to provide proof of their results.

Using the method in teaching

1 | I WONDER WHY

The question at hand should govern the way the class works. Your first major challenge as a teacher will therefore be to find out what the children wonder about and then to consider their questions.

Nysgjerriger's working method generally calls for a 'why' in the question being posed: *Why* are so many people moving away from a particular village? *Why* do cows get mastitis?

How to elicit good questions for investigation

Children are born with tremendous curiosity. Encouraging the class to ask questions – whether they are simple or comprehensive – is a valuable way of demonstrating that you take their wonder and curiosity seriously. It is often easy to get the youngest children to pose 'wonder why' questions. The best project questions are often the ones adults forget to ask: *Why are there fewer sparrows in our neighbourhood than other places? Why are wood-burning stoves black?*

What do the children in your class wonder about? Set aside an hour for discussion and write all their suggestions on the blackboard. This will allow you to start the project on the pupils' terms insofar as possible. The pupils should jot down their question and their homework assignment should be to find arguments in favour of their suggestion. Pupils who do not make suggestions can try to find arguments to support someone else's suggestion.

This will give you time to think about how appropriate each individual question would be for project work. Try setting up a hypothesis or two. If you can't manage, it is rather unlikely that the children will be able to do it. This kind of preparations will give you a chance to guide the class in the direction of the issue that lends itself best.

When the class assembles the next day, it is possible that they will have more questions/issues that might lend themselves to research. You may want to put the various alternatives up for a vote, for example.

Questions for investigation may also emerge as you work on special topics or during ordinary classroom work. You can also encourage pupils to ask questions about a given topic.

Good questions may pop up during an excursion in the local community (to the seaside, in the woods, at an ice cream factory, a power plant, etc.): *How do starfish move? Why are solar cells not more popular as a source of energy?*

Obviously, as the teacher, you can suggest or set the question to be investigated. If you would prefer to have a project that showcases a special topic, give the pupils two or three suggestions for projects and let them discuss the ideas, then take a vote to choose which one to study.

Projects can also be based on group work, where different groups explore different aspects of an issue. This approach will call for even closer supervision in the beginning, especially when formulating the problem for investigation and the hypotheses. It is a great advantage for both teacher and pupils to be familiar with this working method in advance.

An appropriate question for a scientific project?

It can take time to decide on a good project. Some questions lend themselves best for projects that focus on special topics. If you can find the answers to all the children's questions in reference works, you are not working on a research project. While outer space and exotic animals can engender a lot of curiosity, they are rarely good project questions: *Is there life on Mars? How do you tame an elephant?* Pupils can find many written sources and deliver a good report, but they can hardly be expected to contribute data, and it is not possible for them to arrive at any well-founded, independent conclusions on such questions.

Some types of questions cannot be answered scientifically. For example, questions about value choices lend themselves better to classroom discussion than to research.

2 WHY IS IT LIKE THIS?

Now the class should discuss possible reasons for the phenomenon they have decided to study. Their discussion should result in one or more hypotheses, i.e., possible explanations for the question at hand. It is important that you are well prepared and can help the pupils to be fairly specific, even though the children themselves will generally arrive at a hypothesis through discussion.

Pupils should usually acquire some background knowledge about the areas they will be researching *before* posing hypotheses.

Why do so many people say the new shopping centre is ugly?

Preliminary work: The teacher uses a question asked by one of the pupils. First, the children have to find out whether they think the centre is ugly and, if so, why. What do they perceive as ugly/attractive? Is the pupils' opinion the same as the generally accepted view? Who are the 'they' who have built the centre?

The discussion will lead to a hypothesis:

- The least expensive materials have been used
- The centre is a copy of another one
- The company did not care about the appearance of the building
- The centre is built in an attractive, but unaccustomed style
- The centre is attractive, but does not fit into its surroundings

Why do so few cabin owners use solar cells as a source of energy?

Preliminary work: The class is learning about energy sources and solar cells. The discussion leads to the following hypotheses:

- Solar cells are more expensive than other energy sources
- People tend to choose what they are already familiar with
- There are too few sunny days

When the topic for discussion is not completely consistent with reality

"Everyone says that" or "everyone knows that" it rains more in one city than in another one, that there used to be more birds, or that eating potatoes makes you fat. But such statements are not always true! Take nothing for granted – check the grounds for your question before you set up hypotheses.

3 DRAW UP A PLAN FOR THE INVESTIGATION

Now it is time to organise and plan your further work. If the pupils have posed numerous hypotheses, it is a good idea to choose the hypothesis or hypotheses that are most relevant. If the class has not worked with hypotheses before, the best idea is to work with one hypothesis at a time.

Your plan will probably involve collecting data. The class can search many different sources (see Section 4 below). They can decide to write letters, make interviews, conduct experiments, make observations or perform other types of surveys. The plan should include *who* will obtain information, *which* information you need to obtain, *from whom* you can obtain it, and *where and how often* you will need to collect data.

To carry out a good collection of data, pupils need to have certain basic knowledge. When they write letters, for example, they need to know how to set up a letter and which information it is prudent to include. If we plan to use faxes or e-mail, for example, a fax machine and computer with an Internet connection must be available to the pupils. You do not need to teach everyone how to use such technical tools; you can teach a smaller group and then put them in charge of teaching the other pupils.

The children need not be taught everything before they start collecting data. Take the example of calculating percentages and making graphs and diagrams. Pupils will be motivated for learning how to do this because they will be eager to calculate and collocate the figures from their surveys.

If the children know a great deal about their topic already, perhaps groups of them may want to investigate different hypotheses. This must be considered in the light of the age of the pupils and the complexity of the project. By the same token, you must take into account how confident the pupils are, both in terms of being able to count on each other and relative to the teacher.

4 COLLECT DATA

Who can the pupils contact to determine whether their hypotheses are correct? Information, help and/or equipment are usually available from the following places:

- Municipal offices
- Local newspapers, local radio stations, local TV stations
- Local historians, local history societies
- Family and friends
- Organisations and associations, including hobby clubs, can be of great help
- Enterprises in the local community
- Library
- The Internet
- Colleges, universities and research institutions
- Other schools, e.g. upper secondary schools

5 WHAT WE FOUND OUT

After collecting information, discuss the results, and consider them against the hypotheses you posed. Have the hypotheses been corroborated? If not, might it be sensible to go back to Section 2 and set up new hypotheses or is it better to continue to pursue the hypotheses already set up? Perhaps we will have to find a totally different approach to this hypothesis? The effect of working in a 'loop' is important to the pupils' understanding of the scientific working method. Results that indicate that the hypotheses are *not* completely consistent are, as mentioned, also valuable findings.

After thoroughly discussing this, the pupils can draw conclusions about what are the *most likely* reasons for what they wondered about.

6 TELL EVERYONE ELSE

Project work should lead to a product that we can present to others. The communication of results to others will help pupils understand how things are interrelated and the collective nature of science.

In any event, your product and its presentation are important for making a written report. In that report, pupils should show the correlation between the question they have raised, the data they have collected and the conclusions they have drawn. Drawings and illustrations are often very useful. The main thing is that the report collocates their data systematically and in a readily understood manner – whether it be handwritten and/or on computers. All the pupils need not be involved in writing the report.

Others products/types of presentations:

- Letters to the editor
- Websites/online newspapers
- Brochures, pamphlets
- Radio programmes
- Speeches to the Municipal Council
- Plays/musical theatre
- Songs
- Videos
- Photos/slides (take pictures as the project progresses!)
- An exhibition
- Storyline

A good example: The pupils in class 5B at Rjukan Primary School performed a project on local architecture in the spring of 1998. As one form of presentation, the pupils made a small folder in which they invited local residents to join them on an *architectural tour* of their own local area. The pupils guided those who were interested and pointed out special distinctive features of the local architecture. The project was a tremendous success as the pupils actually became the teachers, and grew in step with their new-found responsibilities.

PROJECT EVALUATIONS

Set aside some time to spend with the pupils at the end of the project for evaluation: What have we learned? Was the process satisfactory? Did we get interesting responses? Could anything have been done differently and, if so, how? What should we bear in mind for the next time? Is the project report a good description of what we have done?

Teachers should also spend time evaluating their role as supervisors and the way in which they organised their pupils.

TIME FRAME

If you set aside specific periods of time for a scientific project, some pupils may end up with idle time. Usually, we do not know in advance when a letter will be answered, when a professional will have time to visit the class, when a particular person's schedule can accommodate an interview or when the results of a test will come back from a laboratory.

Accordingly, it is probably best to allow time for such a project in between ordinary classroom work, using certain hours or parts of an hour. When your project so requires, clear the class schedule to work more intensively.

In other words, a scientific project can have duration of several weeks or even months, if the children keep making new discoveries or have to test new hypotheses. Naturally, the latter requires that the pupils stay interested – if not, it is better to round off the project. Otherwise, a project will stop itself when you find the answer to what you wondered about, and when you have evaluated the responses against the hypotheses you posed.

THE TEACHER'S ROLE

The teacher's role in a project is complicated, but the most important aspect involves being a supervisor.

One important task is to distinguish between the various phases of a scientific project. Pause and let the pupils reflect on the work they are doing. *What have we learned thus far? What might it be prudent to do before moving on?* You must also present potential choices: *Can we conduct an experiment to test our hypothesis? Perhaps the pupils know someone who knows a lot about architecture in the local area?*

You must also help pupils filter information. There is a wealth of information on the Internet and it is not always easy to sift through it. Do your best to help the children figure out which sources are trustworthy, and which are not. If you receive letters written in difficult language, you will need to show the children how to extract keywords and then use them as a roadmap to understanding the content.

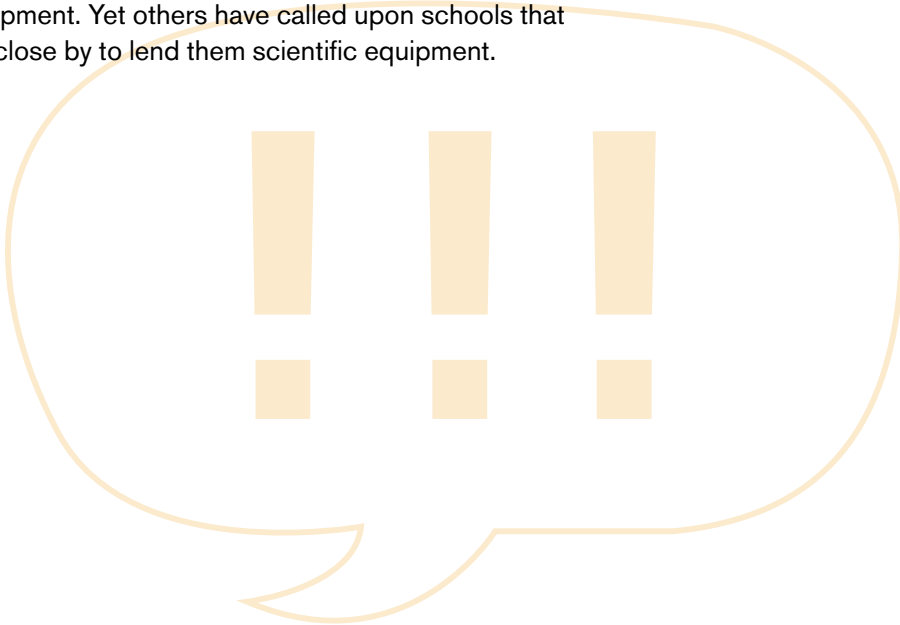
As mentioned, many projects are of an interdisciplinary nature. It may therefore be a good idea to brief the specialist teaching staff on your project plans. Some of them may want to follow up the project in other subjects.

As a teacher, you can provide as much or as little guidance as needed. If you know the pupils well and the group works well together, you may not need to provide much guidance. If the pupils are young, you will no doubt have to provide more supervision. The same applies if the pupils are unaccustomed to this way of working, regardless of their age.



PARTNERS

Upper secondary schools have served as partners for several of the classes that have participated in the research competition 'Nysgjerriger of the Year'. Some have run projects parallel to those of the older pupils, although obviously based on simpler questions for investigation and hypotheses. Others have used the schools as 'resource centres', where they have been shown how to use microscopes or other scientific equipment. Yet others have called upon schools that are close by to lend them scientific equipment.



Examples of projects

When you smash two eggs together, why does only one of them break?

A scientific study of this question brought pupils at Vevelstadåsen School the Nysgjerriger Prize for 2002, which they received from the hands of HRH Crown Prince Haakon in person.

The road to victory began one day when Karoline was going to bake a chocolate cake. She started off with two eggs, smashed them together and found that only one of them broke. "Well, I wonder why that happened?", she thought. So she took another couple of eggs, and then two more, and the same thing happened every time: only one of the eggs broke.

Karoline told some of her class-mates about what had happened, and soon 11 of the pupils in the Primary 7A class at Vevelstadåsen School in Akershus County were busy finding out why every time you knock two eggs together, only one of them breaks.

WHY IS IT LIKE THIS?

After studying the details of how an egg is constructed, and having thought and considered the matter a bit more, they drew up a set of the most likely hypotheses or theories to be tested to answer the question: why does only one of the eggs break?

- If one of the eggs is moving faster than the other, then that is the one that will break.
- They cannot both break because the egg that gets broken is no longer strong enough to break the other one: the broken egg has become weaker.
- Perhaps it has something to do with the weight and size of the egg?
- One of the eggs may have a thicker shell than the other.
- All eggs are different, since they come from different hens.
- It depends on which parts of the eggshells that are knocked against each other (e.g. narrow end against narrow end).

DRAW UP A PLAN FOR THE INVESTIGATION

In order to test their hypotheses, the pupils drew up a plan. They wanted to know as much as possible about eggs, carry out a series of experiments and talk to someone who knew a lot about hens and eggs. Karoline and her associates got down to work: they bought 20 eggs from one shop and 20 from another, so as to be quite sure that they came from different farms. Then they numbered the eggs at random

and weighed them on a very accurate laboratory balance. To measure the length and width of the eggs they used something called a calliper gauge. And to measure the thickness of the shell they got hold of a micrometer (an instrument for measuring very small distances). All their data were put into a table.

COLLECT DATA

Forty eggs to be sacrificed! To test the first hypothesis (If one of the eggs is moving faster than the other, that is the one that will break) the young scientists chose eggs at random and smashed them together in various ways; narrow end against narrow end, blunt end against blunt end, side against side, narrow end against blunt end, blunt end against side and narrow end against side. So as not to miss anything, they videotaped the experiment. Every single time, the egg that was not in motion was the one that broke. So much for that theory!

Can a broken egg destroy another egg? This time they used a vice from the carpentry workshop to squeeze the eggs together. From their report: "When one of the eggs breaks, the other egg continues to force its way into the broken egg. The egg that is still whole continues to break up the other egg by making its way right through it, just like a snowplough that pushes ahead and shoves everything ahead of it to the side".

Can the size or weight of the eggs have any influence on which egg gets broken? No, say the pupils, basing their answer on yet another experiment. However, the thickness of the eggshell may tell us something about which egg breaks first, since the tests showed that the egg with the thinnest shell is usually the first to give up.

A farmer whom the research team talks to tells them that even a tiny irregularity can cause an egg to break. He thought that the blunt end is usually the strongest part of an egg. Another farmer agreed that most get broken at the narrow end.

WHAT WE FOUND OUT

In their conclusions, the class wrote: "Every time you smash two eggs together only one egg will break because there is always a tiny little difference between the thickness of the two shells. The broken egg will not damage the unbroken egg because it has no strength left. This shows that hypotheses 2, 4 and 5 are the most correct".

A NEW PROBLEM!

The pupils discovered that at the blunt end of each egg there is an air-pocket, a sort of “airbag”, which leads them to suggest that it is the blunt end of the egg that comes out of the hen first. They take their new problem to other experts on hens: does the “airbag” act as a sort of protective cushion for the egg as it hits the ground? They are given a lot of different answers, but the Agricultural University in Ås confirms that yes, it is the blunt end that emerges first. Whether the airbag acts as a cushion is not something the scientists had thought of. So perhaps Vevelstadåsen School’s Nysgjerriger gang have given the poultry scientists something to think about!

Why does dust form dust-balls?

Everyone has been bothered by dust-balls from time to time, but few of us have spent several days observing their exciting lives, unlike the pupils of primary 6b at Ulsmåg School in Bergen. They won the Nysgjerriger Prize in 2003.

No matter how much we wash and vacuum-clean the house, the dust-balls always seem to come back. A mother wonders where they come from. The primary 6 pupils decide to do a bit of detective work to find the answer to the question: “Why does dust form dust-balls?”

WHY IS IT LIKE THIS?

The pupils based their work on four likely hypotheses (a hypothesis is a suggested explanation that can be tested experimentally):

- Static electricity makes the dust gather into “balls”.
- Dust-balls form according to the same principles as snowballs.
- Dust-balls are whirled up by draughts and settle down in “calm” areas of the room.
- Heating cables attract dust.

DRAW UP A PLAN FOR THE INVESTIGATION

Obviously, the project needed to concentrate on dust. The young scientists wanted to question experts and have the dust analysed in order to find out how a dust-ball is built up. And they wanted to carry out advanced “space research” by looking at how the dust-balls develop and move around the room.

COLLECT DATA

Four lucky (?) pupils were allowed NOT to clean or vacuum their rooms for six weeks so that they could study the lives of the dust-balls. They followed their movements by marking existing dust-balls with tiny brightly-coloured feathers. The dust-balls were given names like “Goldie” and “Greenie”, and the pupils drew accurate plans of their rooms so that they could document the dust-balls’ travels for the six weeks of the experiment.

Each pupil kept a logbook, one of which contains the following entry: “February 20th: Today I have noted the first movements of my dust-balls. Greenie has found a cosy corner beside the radio. Bluey has pirouetted to the wall. Lilac has done the same and is only about 15 cm from Bluey”. Three days later: “February 23rd: Bluey and Lilac have fallen in love”. And again: “February 26th: I have noticed that the dust-balls settle down in shady places. Perhaps light is not good for them? So I close the curtains a bit, in order to see whether dust-balls will form in other places, if I let as little draught and light as possible into the room”.

Tristan, one of the boys in the class, has an uncle in Oslo who knows a lot about dust and dust-balls, so Tristan travelled to Oslo to look at dust (which he collected from his grandmother’s house in Oslo) in an electron microscope. The pictures gave him a shock: dust consists of a mixture of hair, dandruff, bits of insects, pollen, sawdust, crystals of ceramic tiles, insect faeces and red blood cells, algae and bacteria. A typical dust sample, says the laboratory.

WHAT WE FOUND OUT

Of course, the pupils managed to find out all there is to know about dust, and they drew the following conclusions:

HYPOTHESIS 1:

Static electricity attracts textile fibres to each other and these “suck up” the dust. There must have been movement in the room for static electricity to occur. This hypothesis is true, but we don’t know how much credit static electricity should be given for the birth of dust-balls. We know that different types of textile fibres can have different electric charges and that this is what attracts them to each other. At the same time, they have to be very close to each other before they will join up.

HYPOTHESIS 2:

This hypothesis is almost completely false. Our space research showed that the dust-balls grew even when they lay almost completely at rest. This means that dust and textile fibres are most attracted to the dust-balls, rather than the other way round. We know that they do move now and again, and we cannot reject the possibility that dust “hooks up” to the body of the dust-ball if it moves.

HYPOTHESIS 3:

This is the most important reason of all. Draughts are stronger than static electricity forces. Our “space research” showed us where the dust-balls grew in size. All of them ended up in “backwaters” of the room, without any possibility of getting out of them. The feather draught project that we carried out in the classroom showed that it was incredibly difficult to persuade dust-balls to leave such draught-free areas. We really tried! Draughts often pass through the whole room.

HYPOTHESIS 4:

Heating cables in the floor may create air-currents that encourage the formation of dust-balls. This is the hypothesis that we have least faith in. Heating cables have no electromagnetic field worth mentioning in comparison with the electromagnetic field from a computer screen.

The pupils thus felt that hypothesis 3 was the most important cause of dust-ball formation. As the Ulsmåg School pupils pointed out “...draughts often pass through the whole room. Static electricity only works if two objects carrying different electrical charges are brought close together. Static electricity may help in the final stage of accumulation, but by that time the draught has already done the job, perhaps at a distance of several metres...”.

TELL EVERYONE ELSE

The pupils produced a very readable report and their tireless research and creative problem-solving was celebrated for all of three days, with visits to Tusenfyrd Amusement Park, the Research Factory, the Kontiki Museum and the Teknotek science experience centre. Finally, representatives of the 27 pupils who had carried out the project received the Nysgjerrigper Prize on national TV.

Their victory meant several TV appearances, (e.g. on the “Newton” popular science programme and news broadcasts), talks given to school heads and teachers in Bergen, etc.

Why are there so many rusty old vehicles in Sandland?

The six pupils in Primary 1 – 4 in Sandland School in Finnmark in northern Norway wondered why so many old cars and other vehicles are rusting away where they live. Their project took them to the very top of the Nysgjerrigper 2004 competition for young scientists.

In autumn 2003 a journalist was writing about how people were leaving the Loppa district in northern Norway. While he was working on his article he noticed a green bus that had been abandoned in a field. The journalist went to Sandland School to ask whether any of the school's research-oriented pupils could find out why it was there. The pupils gladly accepted the challenge, because everyone had seen the bus and had wondered why it stood there.

On their way to inspect the bus, the pupils noticed a lot of other vehicles and old lumps of scrap near the road-side. Suddenly they had a research project: Why do we have so many old, rusting cars in Sandland?

WHY IS IT LIKE THIS?

Could it be because:

- Some people just like rusty cars?
- Some people keep rusty cars in order to use their spare parts to repair other old cars?
- Some people cannot be bothered to take their old cars to the nearest town's rubbish dump?
- Because it is expensive to take cars that don't work to the scrap heap?

DRAW UP A PLAN FOR THE INVESTIGATION

The first thing that they decide to do is to carry out a study among everyone at school, at home and everyone else who lives in Sandland. They decide to register and measure all the rusting vehicles. They want to take photos of them and measure them in order to find how far they would stretch if they laid them end to end.

Vehicle wrecks usually end up at the city rubbish dump in Alta. The pupils would like to visit the dump in order to interview the people who work there. But it is a long, expensive trip, so they apply to the Nysgjerrigper Fund for money to travel to Alta. Nysgjerrigper agrees to support them, and they prepare for the trip. Among other things, the pupils

want to find out who is responsible for making sure that rusting vehicles are taken to the scrap heap. Does it cost a lot? And what happens to cars once they are brought to the dump?

COLLECT DATA

The young researchers carry out their questionnaire study and begin to register the wrecks. They find more and more rusty abandoned vehicles; cars, tractors and caravans. They note down a total of 49 vehicles which have been more or less abandoned out in the wild. Every vehicle is given a number, and they take photographs and write up what sort of condition the vehicle is in. They note broken windows, punctured tyres, rust and dents in bumpers. By the time they have measured 35 of the 49 vehicles, they have already used 155 metres of string.

It turns out that the rubbish dump is a long way off. It takes a two-hour ferry trip and a drive of 140 kilometres to get to Alta, where they find out that old vehicles can be taken to a dump that is closer to Sandland than Alta, and that owners are paid NOK 1500 even for cars that have not been licensed for many years. The problem is that the owners themselves have to organise transport for their old cars.

Once a year, a machine comes to crush old cars into small blocks of metal. These are sent to Germany, where they are recycled into nails and other useful metal objects. The most interesting information that the pupils get to hear is that the previous year, there had been a big vehicle collection campaign, which was paid for by local councils. Four hundred tonnes of old cars were brought in from West Finnmark. But few of them came from Loppa, because the local council was short of money.

The trip to Alta gives the pupils plenty to discuss. Not least, they need to find out whether the council took part in last year's vehicle collection campaign.

WHAT WE FOUND OUT

The answers to the questionnaire strengthen the hypothesis that rusting vehicles are not removed because people cannot be bothered to take them to the dump, and that it is too expensive and too far to send them to the dump.

In Loppa, the mayor confirms that the council is short of money, but that the owners of abandoned vehicles are responsible for removing them. If the pupils will help to find out who owns the cars, the council will put pressure on the owners to remove them. The waste collection company, on the other hand, says the local council is responsible for

removing vehicle wrecks whose owners are unknown. This costs NOK 500 per wreck. The company promises in turn to put pressure on the council to have the vehicles removed. With promises like these, the prospects are good for a "rust-free" town.

TELL EVERYONE ELSE

This project has thus led the pupils into another project: how to make sure that these rusting vehicles are taken away from Sandland. They are already looking forward to get on with their next project.

The young researchers have written an easy-to-read report with drawings, photos, tables and text, and have produced a work of art with the string they used to measure the vehicles. What was the work of art? A rusty car, of course!

The pupils have won the Nysgjerrigper Prize 2004 for their impressive and socially useful piece of research.

Why do we get wrinkled skin when we are in water?

Class 5b from Eiksmarka primary school came first past the post in the Nysgjerrigper 2005 competition with research performed both above and under water.

The primary school pupils have a mail box in their classroom where they can put all the questions they might have. After a while the mail box is full, and at this point, they go through the questions. The teacher helps them to choose the questions that they can do research on. Three questions grab their interest: How can we make fresh bread stay fresh? Why do we have hair? Why do we get wrinkled skin when we are in water? The last question "wins" – the pupils imagine that they can do many fun activities when researching this question.

WHY IS IT LIKE THIS?

The pupils set up three hypotheses:

- The skin pulls itself together or is extended when it is in water
- Something under the skin pulls itself together so that the skin wrinkles
- The skin absorbs water

They limit the task by researching the skin on the hands alone.

DRAW UP A PLAN FOR THE INVESTIGATION

Soon the list of activities grows big. The pupils want to do many experiments – both on land and in water. They plan a research session in the swimming pool, and they want to test how their skin reacts to water with different kinds of additives, for example Fairy liquid and food colouring. They also want to rub their skin with Vaseline and butter in parts of the experiments.

Before the swimming pool experiments are carried out, the pupils have done much planning. Amongst other things, they write an application for 800 kr (about €100) from the class' money box to cover the swimming pool fee. The application is directed to the leader of the parents' group, and, luckily, the money is granted. The pupils also write letters to their parents to get transport to and from the swimming pool. They make detailed plans to coordinate the transport in the best way possible.

They want to contact experts on the field, either by e-mail or personal interviews.

The pupils are divided into several groups and have different areas of responsibility. To make sure that the research is appropriately documented, two of the pupils are in charge of photographing.

COLLECT DATA

In the swimming pool, they test what happens to their skin after they have been in water for five minutes, fifteen minutes, half an hour, and one hour. The results are carefully logged in tables with wrinkle-degrees from "not wrinkled at all" to "extremely wrinkled." Most of the pupils have a stable and fairly similar wrinkle-development, with the exception of one of the girls - after 23 minutes she starts to feel her palate wrinkle!

They also do some experiments in a sauna, and register that the wrinkles quickly disappear here. With a measuring tape they measure around a finger to see whether it has grown larger or smaller. To have something to measure by, they mark their fingers with a waterproof pen. This experiment is not so successful – the waterproof pen turns out not to be completely waterproof after all.

Back in the classroom, the pupils test how their skin reacts to water at different temperatures and with different additives. They also prick themselves with needles to see if water trickles out of the wrinkles.

One of the skin doctors they contact invites them to Rikshospitalet, a university hospital in Oslo. They prepare

fourteen questions, for example: Does the skin get damaged by chlorinated water? Why do we not get wrinkles on our stomachs? Why does the skin pinch when it is in 50°C?

Four other skin doctors answer their questions by e-mail. One group also interviews the proprietor of the Askepott-salongen, a local skincare salon.

WHAT WE FOUND OUT

Through their own experiments and answers from the experts (even though the answers differed somewhat!), the pupils conclude that we get wrinkles when we are in water because the layer of fat on the skin is rinsed off. The skin absorbs water and expands, and the fat on the so-called horned skin disappears. The horned skin is thickest on the fingers (and feet), this is why we get the most wrinkles there – or a swelling in the skin, as one of the skin doctors points out. Thus one of the hypotheses is falsified, while the hypotheses that the skin expands when it is in water and that the skin absorbs water are strengthened.

TELL EVERYONE ELSE

The pupils document the process thoroughly and with great neatness in a huge report. The report is spiced up with pictures, drawings, and comprehensible tables from the research.

The fifth grade pupils win the Nysgjerriger Prize 2005 for their research work. The jury stresses that they have completed research of high quality in real Nysgjerriger spirit. The experiments are highlighted as creative and good, and when the results turn out to be different than expected, the pupils show their ability to reflect over what went wrong.

Is it necessary to have different types of flavour additives in Non Stop?

A total of 4323 Non Stops, heaps of taste tests of colours, and large numbers of bar charts. This was the recipe used by the winner of the 'Nysgjerriger of the Year' 2006.

The question to be studied turned up by coincidence while the 7th graders were working with statistics in their maths class. What are the odds of picking a yellow Non Stop among a large number of Non Stops of all colours?

The discussion then moved on to whether black and

brown Non Stops taste better than the others, and whether the various colours differ in taste at all. Half of the class believed that all the colours taste the same, while the other half were of the opinion that different Non Stop colours have different flavours. This called for some detective work!

The next step was to write a letter to Freia, and then wait for a response. The reply gave them some ideas about how to proceed. The letter from Freia revealed that red Non Stops taste raspberry, green taste pineapple/apple, and yellow taste lemon, while the orange ones taste orange and both the brown and the black Non Stops are vanilla-flavoured.

The seventh graders performed a taste test in the classroom to see if they could tell the difference. They found that when they saw the colour, they could tell the flavour. But when blindfolded, very few managed to determine which Non Stop they were tasting: only 5 of 22 identified the flavours correctly. As a result, the class began to wonder whether it was really necessary to use so many different flavourings.

WHY IS IT LIKE THIS?

They formulated the following hypothesis: We do not think there is a need for so many flavour additives in Non Stop. They based this on their own experience with the problem as presented.

DRAW UP A PLAN FOR THE INVESTIGATION

The pupils made a plan for a large-scale survey, including taste tests among their fellow students. A total of 150 individuals took part in the surveys and experiments. The young scientists believe this constituted an adequate sample for their research.

COLLECT DATA

Using questionnaires, the class wanted to determine how many of their fellow pupils felt the same way about the taste as the class did before contacting Freia. They also wanted to count the Non Stops to find out whether the colours were evenly distributed, so they made a registration form for the different flavour additives. They decided to divide the surveys by age level. Obviously, the project also required a visit to the Non Stop factory.

WHAT WE FOUND OUT

Fifty-five per cent thought the different colours tasted the same and most stated that they tasted chocolate. A few thought they tasted strawberry, orange, apple and raspberry. Red ones taste best, according to the opinion poll, as opposed to the opinion of the class doing the research, who favoured brown and black.

A total of 4323 Non Stops were used in the survey, and there was an average of 288 in every bag. When the contents of all the bags were counted, the pupils found that there were almost twice as many red Non Stops as other colours (except yellow), while yellow was nearly three times as common as all the other colours except red. However, the conclusion states that they did not use quite enough bags to draw a definite conclusion.

As far as the taste tests were concerned, 31 per cent of the pupils tested recognised which flavour the Non Stops had when they saw the colours. Even more actually recognised the tastes when blindfolded. The seventh graders admit that they conducted this test immediately after the other test, meaning the subjects of the experiment had just been familiarised with the flavours. The red ones tasted best, while the black (vanilla-flavoured) had the most distinct taste. 73 per cent of the sample was in favour of flavour additives in Non Stop.

All the same, the main conclusion drawn by the 7th grade class at Hillestad School was that their surveys indicate that it is not necessary to use so many flavour additives. They propose one 'common flavour' and suggest that the apple and lemon flavours be discontinued.

TELL EVERYONE ELSE

The pupils made a detailed report and won the Nysgjerrigper Prize 2006. They also sent the report to Freia, set up a website on the project, and made newspaper headlines during the local taste test days.

Nysgjerrigper's resources for primary school

Nysgjerrigper offers a variety of resources to stimulate children's curiosity, interest and imagination. The experiments, articles and multimedia are designed to improve knowledge and enhance awareness of research activities. The Nysgjerrigper resources enable primary school children and teachers to work together on science projects, teaching children research skills and thus promoting research recruitment in the long term.

The Nysgjerrigper Science Knowledge Project incorporates:

An annual science competition in which school children carry out small-scale research projects, and compete for the national Nysgjerrigper Science Award. A special jury consisting of researchers and educators evaluates and selects the best projects.

A teachers' guide to the Nysgjerrigper Method and an interactive web resource at nysgjerrigpermetoden.no provide simple instruction in research methodology. Teachers will find help and inspiration there.

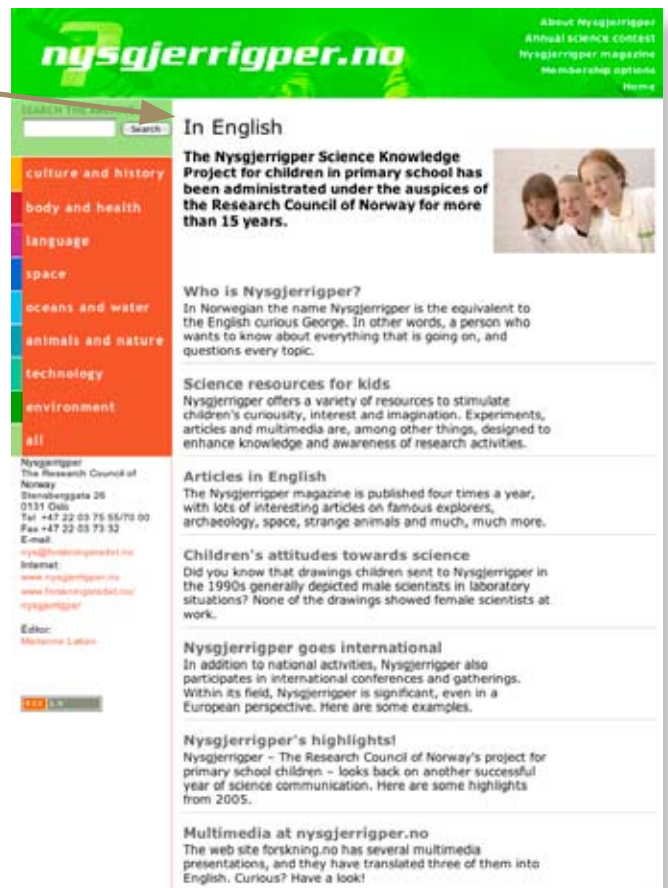
Methodology courses and presentations provide guidance and inspiration to teachers, school administrators and science communicators. The courses are often held by one of the teachers from Nysgjerrigper's network of science teachers.

The Nysgjerrigper Magazine is published in Norwegian at least four times a year, presenting science and research from all disciplines; science, technology and the humanities. Nysgjerrigper's exciting magazine is distributed to all members.

Participation in a wide variety of activities throughout the year, including National Science week, the annual Astronomy festival, etc.

A website, www.nysgjerrigper.no, featuring science news, multimedia presentations, examples of science projects, articles and more.

For more information, see the website at www.nysgjerrigper.no: "In English"



Ever since the early 1990s, pupils in Norwegian primary schools and their teachers have entered their scientific projects in the children's research competition 'Nysgjerriger of the Year'. The teachers' guide to scientific methods has therefore been a central effort to further improve Nysgjerriger, the Research Council of Norway's programme for primary school pupils and teachers.

Nysgjerriger can pave the way for children to learn about scientific working methods, Internet resources and tools for basic education. The Research Council offers this programme in an attempt to put research and science on the agenda in primary school.

In this abridged English version of the original Norwegian teachers' guide, we offer a brief introduction to the Nysgjerriger Method and Nysgjerriger's other learning resources for teachers and pupils in primary school.

Visit Nysgjerriger at www.nysgjerriger.no ("In English")