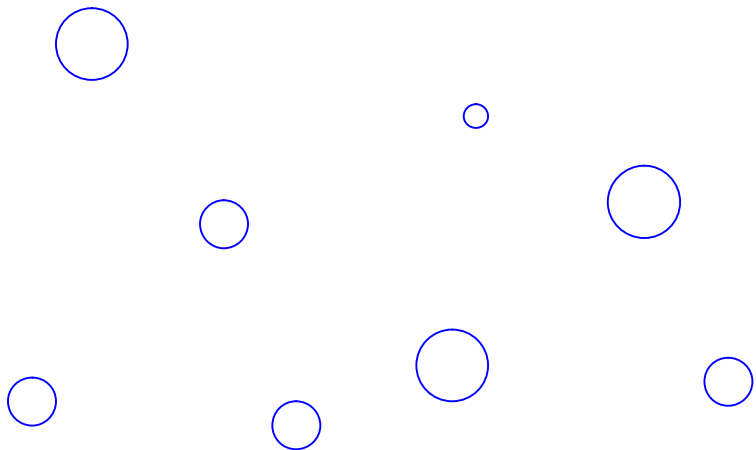




Grade 6



Reviewing Plant
and Animal Life
in a Wetland



Project part-financed by the European Union

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Preface

Being one of Sweden's largest wetlands used for wastewater treatment, the Alhagen Wetlands is an excellent place to study nature and biological processes. This instructor's guide demonstrates how field studies at Alhagen can be used to reach the goals stated in the national curriculum (Lpo 94) for biology for grade nine pupils.

Pupils are to:

- Know of some of our planets eco-systems.
- Be able to give examples of the cycles in which nature transports substances through air, soil and water.
- Know the requirements and importance of biological diversity.
- Be able to perform observations in the field.
- Be able to use natural sciences, aesthetics and ethics in order find standpoints in questions concerning the preservation of biotopes.

The visit at Alhagen for grade six pupils aims to present the area both as a biological municipal wastewater treatment facility and as a place of great beauty and diversity. Pupils will discover this through reviewing plant and animal life in the wetlands and the area surrounding it. For grade nine pupils, the main topic is nitrogen and in which ways this substance is transported through our environment. The grade nine field studies are to lead to a discussion on recycling, nitrification, denitrification and bio-indicators.

The field studies at Alhagen could also be used as part of an educational theme where ordinary school work and teaching material is included. By integrating different school subjects and backing up the field studies with relevant class-room lessons, pupils have the opportunity to put their knowledge in context and gain a deeper understanding of what they have learnt. The *Toilet Etiquette* material, for instance, provides ample connections to the national curriculum's (Lpo 94) goals for social sciences for grade nine pupils.

Pupils are to:

- Understand and apply ecological thinking and demonstrate the consequences of different courses of action in questions regarding environment, life and society.

If you have any questions regarding this material, copies, etc; please contact the Nature School of Nynäshamn on the phone number or address below.

We would like to thank the Water and Sewage Service Administration whose cooperation makes field studies at the Alhagen Wetlands possible.

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Robert Lättman & Mats Wejdmark

Programme

Assembly at the parking lots	8.30
Introduction	around 8.30
Morning snack	around 9.15
Review of plant and animal life	9.30-11.30
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The Alhagen Wetland, Instructors Guide, Grade 6

Eutrophication

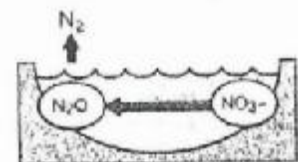
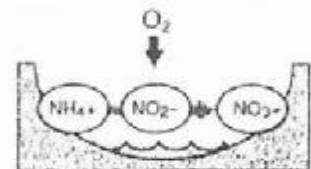
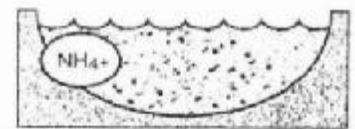
During the last decades, the eutrophication of the Baltic Sea has become a question taken more and more seriously. Depleted bladder wrack banks and sea beds void of oxygen are indirect indicators of an excessive input of nutrients. This in turn affects the reproduction of many species which use the bladder wrack as a “nursery”. The reproduction of the cod is also in danger since the roe, which needs salt levels only found at great sea depths, dies from lack of oxygen. This knowledge affected the parliament which in 1991 decided that the large coastal wastewater treatment facilities were to reduce their nitrogen discharge by 50%.

Alhagen – An Artificial Wetland

Nynäshamn’s wastewater treatment facilities lacked the necessary nitrogen reduction stage. Thus it was ordered to expand its facilities to meet the new demands before 1999. The municipality of Nynäshamn decided to construct a wetland to trap nitrogen. Alhagen is situated in a valley that stretches 2.5 kilometres in a south-west / north-east direction. Before the wetland was constructed, there was a natural swamp in the north part of the valley, closest to the Baltic Sea. The south part of the valley consisted of overgrown fields, and it was here that, in 1997, a number of shallow dams were built.

Trapping Nitrogen in a Wetland

At Alhagen, biological processes convert nitrogen in the water into ordinary air nitrogen. The ambition is that half the nitrogen arriving in the cleaned sewage water is to be converted this way. From the clarifying basins at the south part of the wetland, the nitrogen rich water is emptied into two inlet dams. These two dams are filled and emptied continuously to increase the level of oxygen in the water. The oxygen is needed by the bacteria that convert ammonium (NH_4^+) to nitrate (NO_3^-) in a process called nitrification. From the oxygen rich dams, the water is emptied into the lower parts of the wetland. Here bacteria that are able to use the oxygen in the nitrate are favoured. Thereby the nitrate is converted to harmless air nitrogen (N_2) through a process called denitrification.



The Wetland as Source of Biological Diversity

Stockholm’s county is one of the poorest in wetlands in Sweden. This is partly due to the extensive trenching activities during the 19th and 20th century. Trenching as a means to make land area useful for farming culminated during the hard times of the 1930ies. 90% of the non-peat-producing wetlands in the south of Sweden were, however, trenched out before the practice was forbidden in 1994. This also meant that the plant and animal life dependent on this habitat decreased to the same extent.

Producing an artificial wetland opens up completely new possibilities for the wild life in the area. It is often in coastal areas, and other places where land and water meet, that the largest number of plants and animals are to be found. This is why it is interesting to see how the diversity of plants and animals can increase in an area such as Alhagen. Continuously reviewing the wetland is thus of great interest.

Preparations

- Divide the class into five groups depending on interest (plants, birds, animal plankton, water living bugs and land living bugs).
- Make copies of the group assignments (see pages 6-10). The groups are to read their respective assignments before the field study.
- Give the pupils some time to think about what they would like to learn concerning wetlands and wastewater treatment. Send the questions to the Nature School on First Class at least a week in advance.
- Work with the theme *Toilet Etiquette* (can also be used after the field study). This instructor's guide was distributed to all teachers in March 2003 and is also available on the Nature School's First Class homepage.
- Let the pupils read the Water Book. The book is available in class sets at all schools (see page 12).
- Do a home investigation (see pages 13 and 14).



Toilet Etiquette

The campaign *Toilet Etiquette* was initiated in spring 2003 as a way to increase public knowledge on what can and cannot be flushed down the toilet. The long-term aim of the campaign is that the sludge produced at the wastewater treatment facility is to become so pure it can be used as an agricultural fertilizer, thereby sparing seas and lakes from environmentally harmful substances. The parties involved in producing the campaign were:

- The Nature School
- The Water and Sewage Service Administration
- The Agenda 21 coordinator

Sewage and Sludge

Today, households dispose of more chemicals than the industrial sector. Many heavy metals that are harmful to humans are flushed down the drain. A few examples are cadmium, found in paints and tobacco (don't empty ashtrays into the toilet), and quicksilver, e.g. from tooth fillings. Some substances impair wastewater treatment since they affect micro organisms. Examples of these are petrol, oils, degreasing agents, drugs and cleaning agents. Objects such as tops, tampons, pads, etc. can cause blockages in pipes and pump stations. All of the above mentioned contaminate the sludge produced at the wastewater treatment facility and render it unusable.

The large content of nutrients is what makes the sludge suitable as a fertilizer. It is especially important to take care of phosphor that is a non-renewable natural resource that according to the Swedish Environmental Protection Agency's estimates will be depleted in 100 to 400 years.

To avoid that environmentally harmful substances end up in the wastewater, consumers must have the possibility to choose environmentally friendly products in shops and stores. The *Store Watchers* activity for grade five pupils helps see to it that such products are available. *Store Watchers* is done in cooperation with the municipality's environmental department and the results of the pupils' store investigations are sent there. This work is important since every year the quality of the sludge is re-examined, i.e. the sludge must continuously be of high quality to continue being used. The pupils' yearly review is good way to put pressure on store keepers to reduce their range of environmentally harmful products that end up in the sludge, reducing its quality.

Ideas for Discussion

- How do you think that people are affected by eating food that has been grown on fields fertilized with wastewater sludge?
- What environmentally harmful products in your home could you do without and what alternatives are available?
- What may and may not be washed down the drain?
- Why do we wash so many things down the drain although we know that it is wrong to do so?

The Field Study at Alhagen

The five groups review:

1. Plants in the water and on land (herbs, bushes, trees) as well as mosses and lichens (see page 6).
2. Insects and other small creatures in the water (see page 7).
3. Birds (see page 8).
4. Insects and other small creatures on land (see page 9).
5. Animal plankton (see page 10).

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Programme

Equipment

- Boots and clothes appropriate to the weather (dress warmly since there is no where to go inside and warm up).
- Lunch and snack.
- Paper, pencil and something to sit on.



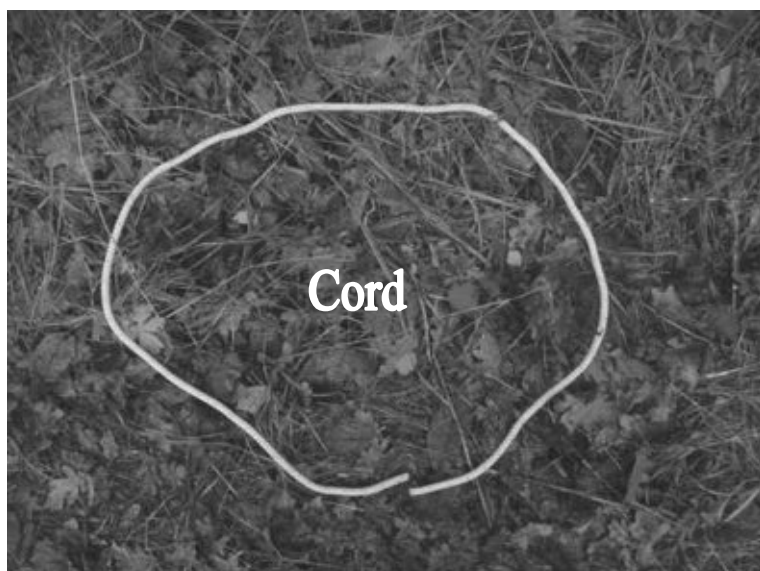
Exercises to do after the Field Study

- Work with *Toilet Etiquette*, if this hasn't already been done as a preparation.
- Summarize the field study at Alhagen in form of a display, a magazine, an oral presentation, etc.
- Make cattail dolls (instructions can be found in the appendix or on the First Class homepage). The cattail's leaves must turn brown before it can be used.
- If you've chosen to work as "nature reporters", putting together the magazine will be your exercise.

Plants at Alhagen

Alhagen receives wastewater from 16,000 residents in Nynäshamn's municipality. Before it arrives at the Alhagen wetlands, the sewage has passed through the wastewater treatment facility. However, the water still contains large amounts of nitrogen (a nutrient) that will harm the Baltic Sea if not removed. This is why there are several dams in which natural processes transfer the nitrogen to the air, thereby sparing the sea. The water in the dams closest to the inlet contains much oxygen and the water in the dams closest to the sea contains less oxygen. Some animals have problems breathing when there is too little oxygen while others will do just fine.

- Your group bag contains a number of cords. Take one cord each and place it, making a circle, somewhere in the surrounding area. Who can find the largest number of different plants? Pick a sample of each species and place it in a plastic bag.
- Try placing the cords at different places; down by the water, up in the wood, on the hill and on the field. Where do you find the largest number of plant species?
- Back at the pavilion; find out the name of each plant, coat them in plastic and write down the name of each plant next to it.
- If you or your group prepared your own questions; please feel free to seek answers in nature, in books, or by asking the teachers from the Nature School.



Bugs in the Water

Alhagen receives wastewater from 16,000 residents in Nynäshamn's municipality. Before it arrives at the Alhagen wetlands, the sewage has passed through the wastewater treatment facility. However, the water still contains large amounts of nitrogen (a nutrient) that will harm the Baltic Sea if not removed. This is why there are several dams in which natural processes transfer the nitrogen to the air, thereby sparing the sea. The water in the dams closest to the inlet contains much oxygen and the water in the dams closest to the sea contains less oxygen. Some animals have problems breathing when there is too little oxygen while others will do just fine.



Landing Net

- Use a landing net to catch bugs in four different dams and place the bugs in the jars you will find in your group bag. Write the name of the dam on each jar to remember where the bugs came from.
- Back at the pavilion; pour the contents of the four jars into four plastic trays. Write the name of the dam on each tray.
- Sort the insects into an ice tray. Examine them using one and two-way loupes.



- Draw the insects and write down what you know about each bug. First write down facts you have discovered through examining the bug, then look for additional facts using books.
- Count how many species you found in each dam and how many times each species occurred, e.g. how many backswimmers did you find the main dam?

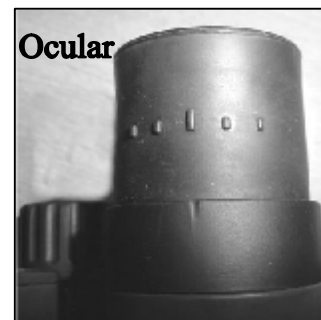
Daywater Dam		Crooked Stream		Sedge Marsh		Main Dam	
Species	Quantity	Species	Quantity	Species	Quantity	Species	Quantity

- If you or your group prepared your own questions; please feel free to seek answers in nature, in books, or by asking the teachers from the Nature School.

Birds at Alhagen

Alhagen receives wastewater from 16,000 residents in Nynäshamn's municipality. Before it arrives at the Alhagen wetlands, the sewage has passed through the wastewater treatment facility. However, the water still contains large amounts of nitrogen (a nutrient) that will harm the Baltic Sea if not removed. This is why there are several dams in which natural processes transfer the nitrogen to the air, thereby sparing the sea. The water in the dams closest to the inlet contains much oxygen and the water in the dams closest to the sea contains less oxygen. Some animals have problems breathing when there is too little oxygen while others will do just fine.

- Use the binoculars to look for birds. You may go to the bird tower, the wood and to the far side of the hill. Check that the markings on the oculars of your equipment are facing each other before you go off. Don't forget the single tube telescope!
- Write down what birds you see and hear. If you don't know the name of a bird you can try to describe its sound or how it looked when you return to the pavilion.
- Back at the pavilion; write down what you have learnt about the birds by watching them and then use books to search for additional information.



The Bird Tower		The Woods		The Far Side of the Hill	
Species	Quantity	Species	Quantity	Species	Quantity

- If you or your group prepared your own questions; please feel free to seek answers in nature, in books, or by asking the teachers from the Nature School.

Land Living Bugs

Alhagen receives wastewater from 16,000 residents in Nynäshamn's municipality. Before it arrives at the Alhagen wetlands, the sewage has passed through the wastewater treatment facility. However, the water still contains large amounts of nitrogen (a nutrient) that will harm the Baltic Sea if not removed. This is why there are several dams in which natural processes transfer the nitrogen to the air, thereby sparing the sea. The water in the dams closest to the inlet contains much oxygen and the water in the dams closest to the sea contains less oxygen. Some animals have problems breathing when there is too little oxygen while others will do just fine.

You are to look for bugs using 4 different tools.
You can collect the bugs using the insect sucker.



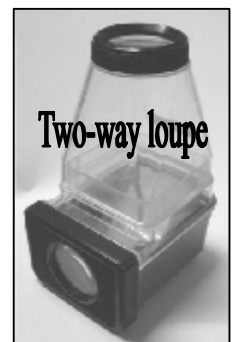
1. Landing net; run the landing net roughly through the grass and use the insect sucker on any bugs you catch.
2. Fern sieve; gather fern in the woods and place it in the fern sieve. Shake, untie the knot, and pour the bugs onto a white cloth. Use the insect sucker on any bugs you catch.
3. Umbrella; turn the umbrella upside down and place it under a tree or a bush. Shake a branch to make bugs fall down. Use the insect sucker.



4. Knife; remove the bark of a fallen, dead tree and see what you find underneath. Use the insect sucker or place bugs directly into canisters.

The insect suckers are labelled with the tool used to catch the bug (landing net, fern sieve, etc). Be careful to use the correct insect sucker, e.g. if the insect sucker is labelled fern sieve, only use it on insects caught with the fern sieve.

- Back at the pavilion; use two-way loupes to examine your bugs.
- Draw your bugs and write down what you know about them. Search for additional facts in books.
- Give examples of species belonging to the groups found in the table below.

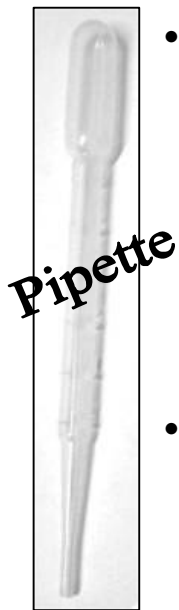


	Insects	Spiders	Crustaceans	Centipedes	Molluscs	Frogs & Newts
Landing net						
Fern Sieve						
Umbrella						
Knife						

- If you or your group prepared your own questions; please feel free to seek answers in nature, in books, or by asking the teachers from the Nature School.

Animal Plankton

Alhagen receives wastewater from 16,000 residents in Nynäshamn's municipality. Before it arrives at the Alhagen wetlands, the sewage has passed through the wastewater treatment facility. However, the water still contains large amounts of nitrogen (a nutrient) that will harm the Baltic Sea if not removed. This is why there are several dams in which natural processes transfer the nitrogen to the air, thereby sparing the sea. The water in the dams closest to the inlet contains much oxygen and the water in the dams closest to the sea contains less oxygen. Some animals have problems breathing when there is too little oxygen while others will do just fine.



Pipette

- You will study four different dams:
 1. Measure the temperature using a thermometer.
 2. Measure the pH-value using a pH-stick (write the result directly on the stick).
 3. Use the sieve to catch animal plankton. Many animal plankton are so small you won't be able to see them until you look at them in the stereo-loupes back at the pavilion.
- Back at the pavilion; examine your animal plankton using stereo-loupes that will enlarge the animals with a factor 20-40. Use a pipette to place the animals in the petri dishes. One drop of water is enough to see the animal properly in the stereo-loupe.
- Draw the animals and write down what you know about them. First write things you discovered by examining the animals, then search for additional information in books.



Plankton Sieve



Petri Dish

	Daywater Dam	Crooked Stream	Sedge Marsh	Main Dam
Temperature				
pH-value				
Animal Plankton				



Stereo Loupe

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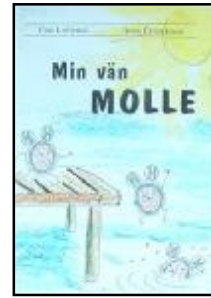
The Waterbook should be available at your school in class sets.



The Waterbook (for pupils in grade 6, can be borrowed from the Nature School)



The Waterbook, Teachers Manual (for all grade 6 teachers)



My Friend Molly (for all grade 1 teachers)



Environmentally Friendly Cleaning Tips (for pupils in grades 1-9)



Sticker (for pupils in grades 1-9)



Things That Shouldn't Be Flushed (for pupils in grades 1-9)



As Long as There's Life – There's Water and Sewage (video, 26 minutes, can be borrowed from the Nature School, for grades 4-9)



Sludge – No Dirty Business (video, 12 minutes, can be borrowed from the Nature School, grades 1-3)



The Nature School and the Alhagen Wetland Area, Year 2000 (video, 30 minutes, available at schools and libraries)



www.scienceacross.org Exchange knowledge and ideas globally on this homepage devoted to environmental issues



The Swedish Chemical Inspectorate's Observation List. One copy distributed to each school's environmental group representative.






Drugs and the Environment (for all grade 4-9 teachers).



Choosing Environmentally Friendly Washing Powder and Detergents (one copy distributed to each school's environmental group representative).

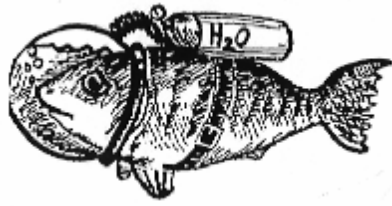
Home Investigation

How many eco-labelled products can you find in your cleaning cabinet and bathroom?
Write the name of the product below the corresponding symbol.

Good Environmental Choice	The Swan	The EU-Flower
		

Examine the products you found in your cleaning cabinet and bathroom. Which of the following chemical substances can you find on the declaration of contents?
Write the name of the product next to the corresponding chemical substance.

Chemical Substance	Products
Sodium hypochlorite	
Sodium metasilicate	
Optical whiteners	
Triclosan	
Ammonium	
Anionic Tensides	
Cationic Tensides	
Phosphoric or other acid	



What Goes Down The Drain?

	Toilet	Kitchen / Laundry	Washbasin	Drain in garage, etc.	Common drains in streets, etc
Monday					
Tuesday					
Wednesday					
Thursday					
Friday					