

# The lifecycle of plants

Learning towards sustainable development focusing on biology



Seed sculpture from the Gardens of Fredriksdal

**40 exercises**  
for the pupils in primary  
school grades 1-9

**Nature School of Nynäshamn, Sweden**

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**Nynäshamns**  
Naturskola



CENTRAL BALTIC  
INTERREG IV A  
PROGRAMME  
2007-2013



EUROPEAN UNION  
EUROPEAN REGIONAL DEVELOPMENT FUND  
INVESTING IN YOUR FUTURE

Project part financed by the European Union



<http://blogg.sydsvenskan.se/mylla/2009/10/>

Pumpkins

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# Chapter 1 Introduction

## Preface

With a continuing urbanisation, people's life environment changes and causes more and more pupils having less contact with the countryside and other natural areas, which makes them losing contact with nature.

Working actively is today necessary for pupils to develop contact with the nature, and especially in urban areas. Since the sense of nature is an important aspect concerning sustainable development, it is necessary that everybody participates and takes responsibility. Striving towards sustainable development and with a desire to really do something, are the reasons for this folder being published for the teachers in Nynäshamn.

The folder layout consists of an introduction in chapter 1 containing the steering documents, central terms, the pedagogical idea and how to use the folder. It describes the steering documents, which are the curriculum and the environmental quality goals, as well as the central terms, which are sustainable development and learning towards sustainable development. The purpose is for the reader to get an understanding of the underlying commitment of the plants' lifecycle.

The educational/didactical idea consists of five steps, where the first four steps are the basic ideas and future beliefs of the Nature School Organisation. The steps are included in the concept "to find the path", which consists of Experiencing with all senses, Discovering diversity, Understanding the connections in the nature and Insights of knowledge about the lifecycle of nature. A fifth step has been added to this folder, i.e. Activity, which means achieving skills and insights to act.

For example, the section "How to use the folder" illustrates how to make groupings.

Chapter 2 contains discoveries, experiences and understanding of the plants' lifecycle. The different sections follow the years of the plants or the sequence of cultivation, i.e. **Seeds, Plants, Trees, Pollination, Soil, Seed Dispersal**. The chapter summarises with examples of outdoor lessons all the year around for the grades 1-3, 4-6 and 6-9.

Chapter 3 discusses and suggests how teachers can move on with their teaching about insights and activity. Achieving understanding from experiences and discoveries is part of the learning for sustainable development. The understanding must also be put in a bigger context, which requires discussions about ideas and values about the surrounding or global environment. Insights mean becoming aware that understanding interacts with outer conditions, and that can prepare the pupils for their own individual action. Three important discussions about the lifecycle of plants in a broader perspective are part of the chapter. The first is about food **and**

**the farmer's role in the landscape** with questions such as: What defines organic farming? How is the agriculture affected by the food production? The other discussion is about **ecological footprints** with questions such as: What is an ecological footprint? How is the footprint connected with biodiversity?

A third discussion visualises **biodiversity** and the **ecosystem services**. The questions here are about: What are ecosystem services?

Which ecosystem services are directly involved in the food production? A short summary is illustrated for each question, with reference to websites for the teacher to find more information. Examples of some activities connected to the discussion are also given.

Hopefully the pupils will feel lust and inspiration to start with the studies about “the lifecycle of plants”, which is of great relevance to the big important future issues.

## Steering Documents

### The National School System

A declared value-system forms the basis of the national school system (Lpo94) where the democratic education is emphasised. The task of the school is to encourage respect for the intrinsic value of each person as well as for the environment we all share. The task of the school, besides the democracy aspect, is to promote learning, i.e. the following (Lpo94:5)

*In a deeper sense education and upbringing involve developing and passing on our cultural heritage – values, traditions, language, knowledge – from one generation to the next*

Knowledge can be expressed in a variety of forms - as **facts, understanding, skills and accumulated experience**. The school should provide the pupils a scope where different perspectives are emphasised. This folder emphasises the importance of the environmental perspective. The curriculum expresses it as follows (Lpo 94:6)

*An environmental perspective provides them (the pupils) with opportunities not only to take responsibility for the environment in areas where they themselves can have a direct influence, but also to form a personal position with respect to global environmental issues.*

The curriculum of Biology, Lpo94, contains the following goals to be attained, which the different exercises are related to.

By the end of the fifth grade, the pupils should

- Recognise and be able to name common plants, animals and other organisms in the local environment, as well as be familiar with their environmental requirements
- Be able to give examples of the life cycle of some plants and animals and their different growth processes
- Be able to take part in discussions on the preservation of different types of nature and diversity of species

By the end of the ninth grade, the pupils should

- have a familiarity with some of the world's ecosystems and how interrelationships between organisms can be described in ecological terms
- have an insight into photosynthesis and combustion, as well as the importance of water for life on earth
- be able to give examples of lifecycles and accumulation in an ecosystem
- be familiar with the basic features of the development of life, as well as the conditions for and importance of biological diversity

## **The Environmental Quality Objective – Biodiversity**

The environmental objective “a rich diversity of plant and animal life” is to be attained through a number of criteria stipulated by the government. Some of these touch the contents of the exercises.

*The society and its citizens have wide knowledge of and understanding about the importance of biodiversity. Traditional and local knowledge about biodiversity and its use are preserved and used when appropriate.*

*The biological culture heritage is conducted so that important nature and culture values will last.*

## Sustainable Development

A sustainable development shall be secured. The wealth of the nature shall be used in a way that we can hand over a world in balance to our children and grand children (Government Offices 2010).

The concept sustainable development was first mentioned 1987 when the Bruntland commission presented their report "Our common future". The report not only discussed the conservation of nature resources and environmental problems, but also considered social and economic development. People were to take part in and be able to influence their future.

The UN conference about environment and development 1992 in Rio de Janeiro formed an agenda to secure a sustainable development for the 21st century. The document, Agenda 21, was a commitment signed by the world's leaders. The programme was implemented in many countries on several levels, resulting in a wide local work with local action plans (UNECE 2010). The action programme Agenda 21 was in Sweden followed by a national strategy for sustainable development, 2002. A further development succeeded 2006, with four challenges in focus: Build a sustainable society; Stimulate good health on equal conditions; Meet the demographical challenge; Promote a sustainable growth.

Twelve main indicators have developed during this work, in order to give an overall picture of sustainable development in Sweden. The Agenda 21 programmes are established and stipulated in the municipalities of Sweden. The programme with its goals and interim goals within the municipalities' work areas is run during a certain time period and then being revised and renewed (the Government 2010).

## Learning Towards Sustainable Development

In 2005 the UN decided that within ten years new perspectives about learning towards sustainable development were to be produced. This means that the world's governments should work to integrate the sustainability perspective in all of the school education. All education levels and institutions will need to contribute increasing the competence about the big future issues. The Swedish National Agency for Education states that sustainable development should influence all the work in the schools. Learning for sustainable development is characterised by democratic work methods and process intended approaches. The learning includes participation, interdisciplinary subjects and diverse educational methods.

The public investigation SOU 2004:104 formulated that learning towards sustainable development includes several starting-points, i.e. to:

- *highlight economical, social and ecological conditions as well as processes*
- *look at past time up to present time, and from the global to the local*
- *work democratically*



- *be reality-based in nature and society*
- *be problem solving, stimulate critical thinking and preparedness to act*
- *to consider both the process and the final product as important*

In learning towards sustainable development the democratic perspective is emphasised. The democracy goal affects the outdoor education. The outdoor education generates a contact with nature for the pupils that can result in engagement for sustainability issues. The democratic aspect could be the opportunity for all pupils to participate in outdoor education (The public investigations 2010)

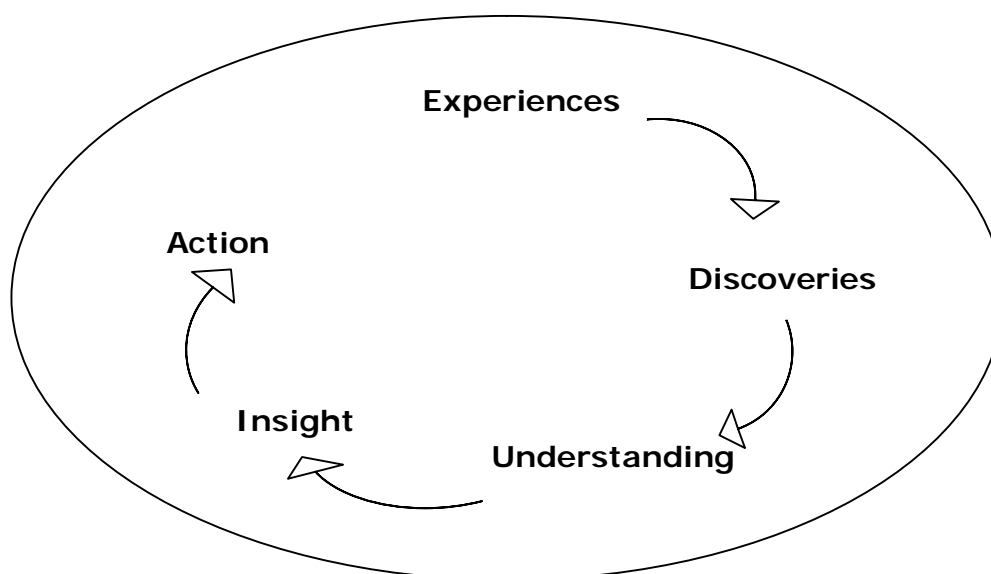
## The Pedagogical/Didactical Idea

Curiosity together with experiences and discoveries around nature phenomena are the basis for learning. In a social and cultural environment the individual sensual experiences will be shared with others through discussions. Communication is the prerequisite for learning towards sustainable development.

To achieve understanding for the diversity in the nature and to see the connections, such as the plants' lifecycle, are important values. When understanding is knowledge, and when it can also be expressed as skills and familiarity, the nature experience may develop to insights about our role in the larger context.

To create a contact with nature, i.e. to give/find a feeling for the nature, is a very important part of the education. With insights and feelings, the humans (the teacher, the pupils) can, through their own actions, be able to change the society.

### Sociocultural environment with communication



## How to Use This Folder in the Education

In this folder the term lifecycle is used as the process running *from generation to generation*. However, the daily metabolism and the evolutionary aspect, i.e. the beginning of life until today, are disregarded in this context.

Teachers can ask didactical questions about their education concerning the plants' lifecycle. Particular questions may be

- What defines sustainable development?
- What does the concept "lifecycle" contain?
- What is the importance of lifecycles to the plants?
- What are the pupils' starting points?
- Which goals can be used?
- How can the goals be achieved and which methods are required to achieve the goals?

Many of the exercises in this folder will benefit if they are supplemented with creativity. When the theme "soil" is studied, the pupils can dig up their own mud from a ditch or clay from a beach. It is an exciting experience to make sculptures or build landscapes on wooden plates using the clay.

Other ways to approach the life of the plants are to use **fiction**. There are both short stories and novels, telling about cultivation or plants. One book is for example "Tistou of the Green Fingers" by Maurice Druon. Tistou is 8 years old and he falls asleep during the lessons in school. Finally the school sends him home and his parents must care for his education. The pages 34-42 are perfect as an introduction to cultivation.



### Groupings

While the class is divided into groups the teacher can use the content of the exercise for naming the group or the individual group members. Following are some advices:

- **Seeds.** The teacher uses the seeds from the seeds bag. If the teacher wants six groups, then six different types of seed should be chosen (e.g. broad beans, chickpeas, sunflower seeds, beetroots, burdocks, thistles) and as the same number of pupils. The pupils should pick the seed they like from a bowl that is carried around, and then they should try to find the other pupils having the same seeds.

- **Plants.** The teacher can use playing cards of plants, which can be bought via internet at the children's book store ([barnbokhandeln.com](http://barnbokhandeln.com)), a cost of about 100 Swedish kronor. It contains two packs of cards, thus containing more than hundred different plants.

Suggestion is to use the plant cards for groupings, by handing out one card to each pupil. The teacher must decide beforehand how many groups to divide in order to make four-five species of each plant family. This means that each group of pupils belongs to one family, but of different species. For example umbelliferous plants – cow-parsley, yarrow, goldenrod...

The teacher lets everybody finding their family and then the group should think about what characterises their plant family. It is recommended to go through the pupils' different plant families and species so that everybody has heard the names at least one time.
  - **Trees.** The teacher can use postcards with Swedish trees, which can be bought at [www.hjelm.se](http://www.hjelm.se)

There are about fifteen different species and it is recommended to laminate the postcards.

The pupils should draw a card and then try to make a group using the trees with one or several common features. The teacher must decide beforehand how many groups to be created. If the class is big, then the teacher can use two cards of the same tree species and let the pair find each other. The teacher goes through the trees that are represented in the class. It is suitable for the teacher to continue with the exercise *Play with tree cards*.
  - **Leaves.** The teacher can use the pictures in the appendix, leaf memory made of leaves from different trees. Selection with or without text. The leaf memory should be cut and laminated.

Half of the class gets leaf cards and the other half gets tree cards. They should try to find each other to become pairs. The teacher gives a briefing of which trees are represented.
  - **Butterflies.** The teacher can use a pack of cards with butterflies, which can be bought at [barnbokhandeln.com](http://barnbokhandeln.com) for about 100 Swedish kronor.

The same method as for plants can be used here.
  - **Bumblebees.** The teacher can use the posters in the appendix, copy them, cut them as cards and then laminate them.

The teacher divides the pupils into groups and lets each group draw a card. It could be common carder-bees, tree bumblebees, large red-tailed bumblebees or buff-tailed bumblebees.
  - **Soil.** The teacher can use the cards of different soils and rock types in the appendix. They should be cut and laminated. The pupils should draw a card and then try to make a group using the soil words with one or several common features. The teacher must decide beforehand how many groups to be created.
- Apples.** The teacher can use a pack of cards with apples, which can be bought at [barnbokhandeln.com](http://barnbokhandeln.com) for about 100 Swedish kronor.
- The same method as for plants can be used here.

# Chapter 2 Experiences, Discoveries and Understanding

## Seeds

### Exercise 1: Sunflower Drama (Grades 1-3)

The purpose is to understand the growth and to listen to selected parts from our Old Scandinavian culture heritage



[www.bjorn-carlen.se/teknik\\_1g.htm](http://www.bjorn-carlen.se/teknik_1g.htm)



[www.odla.nu/artiklar/solros\\_helianthus\\_annuus.shtml](http://www.odla.nu/artiklar/solros_helianthus_annuus.shtml)

The teacher tells the group about the old farms, the cultivation and how important it was with an abundant harvest. It was vital for a family to harvest enough food before a long winter.

The pupils may lie down on the grass. The teacher continues by telling the pupils about the time before Christianity got known in Sweden, when people used to pray to Old Nordic gods with special knowledge. One of them was the God of fertility and love, Freyr, meaning “the seed”. His sister, Freya, was the Goddess of growth.

The teacher asks the pupils to close their eyes and then starts telling about the drama. The pupils are encouraged to make movements to the words. It is nice with some relaxing music playing in the background.

Freyr was the God of fertility and love. He was also called Ing. He mastered rain and sunshine – thus the harvest in the fields, i.e. he was ruling the welfare of the people. His attributes were the boar Goldenbrush and the ship Skidbladnir. Therefore pigs were a common sacrificial animal to Freyr.

Freyr’s love for Gerd, the goddess of plants, reflected a cult of fertility, a holy marriage between heaven and earth. Freyr was the god of harvests. In Uppsala and Trondheim, large cult feasts for the worship of Freyr, the God of fertility, used to be held.

Freyr’s sister Freya could be prayed to concerning love affairs. She was also Goddess of fertility and bread.

- You are a small sunflowerseed resting in the ground. The winter is heading north and the ground around you feels warm and humid. Slowly you start to “unfold”. Your roots are stretching down in the soil and your stem pulls you upwards. A few days later your small leaves start to burst out. They pop out from the dark ground and in to the light warm sun. You grow higher and higher. You can feel the sap running in your veins. Your green leaves stretch longer and higher up towards the sun.
- When the spring turns into summer a bud is formed on your head and finally it opens up becoming a beautiful flower. Feel the long hot summerdays. Imagine rain on your leaves and petals. It pours slowly and is the steam of the humus and scents of the summer. A chilly morning puts dew on your leaves and flowers. A bit later a bee passes by. She is covered with pollen from other flowers. She, the bee, sucks nectar from you and at the same time gets pollen from your flowers. She also leaves pollen from others so that your ovules can grow.

The days become shorter and shorter. Autumn is here. One morning you discover that frost has frozen your leaves and that you have shrunken completely. But now you have seeds – seeds filled with nutrition – seeds you did not have during the summer. Some bluetits find them and picks them with their fine bills. You feel proud – someone likes you. But there is not much left of you. The days are very short now. You are now dead. A dried brown stalk when the first snow falls. But in the ground next to your dry roots, the seeds are resting so that they can create new life when the long warm days arrive with some rain during the springtime.

After reading, the teacher lets the pupils lie down some more minutes in silence. Afterwards they all discuss how they felt being a seed or a plant for a whole year.

## Exercise 2 Gymnospermous and Angiospermous Plants (Grades 1-6)

The purpose of this exercise is to provide an initial introduction/insight of how plants roughly are categorised and how the location of the seeds illustrates that.



<http://linnaeus.nrm.se/flora>

Pinetree cone – gymnospermous  
(see the textbox)



[www.kekarlsson.nu/host\\_plommon.htm](http://www.kekarlsson.nu/host_plommon.htm)

Plums – angiospermous (see the textbox)

Everybody should gather in a circle. The teacher has prepared the exercise so that all pupils get one cone or fruit each. The pupils hold their hands behind their backs and the teacher puts a cone or a fruit in their hands. The pupils should now touch and feel them without watching. The teacher introduces shortly about how to describe a thing and which words can be used, and maybe needs to give examples such as scratchy, slippery, hard, cold, angular, oblong... One pupil is told to describe the item, guess what it is and finally look if it the guess was right. The teacher says: Those of you who think you carry the same nature item may have a look. Half of the group remains and someone starts describing. The exercise is repeated. When everybody has discovered that nature items are two different kinds, the teacher asks: What is the difference between the cone and the fruit? The discussion then continues with: Where are the seeds placed? Can we pick them out? Which animals/birds eat the seeds? How do their teeth/bills look like? The exercise ends by investigating the seeds that the pupils picked out using magnifying glasses. It is possible to continue the exercise by planting the seeds or discussing about seed dispersal.

**Gymnospermous plants** are mainly the conifers and they represent an earlier development level than the angiospermous blossoms. The bracken plants with their spores are considered to be their predecessors. The seed is located under the ovuliferous scale. It differs from the angiospermous plants by not having blossoms and the ovule is naked, exposed. They comprise around 700 species.

**Angiospermous plants** produce seeds in the ovule and are protected in there. The ovule matures into fruits. These plants developed 130 million years ago and comprise about 250 000 trees, bushes, herbs and grasses. The angiospermous plants are divided in two groups: flowering plants *phanerogams* and spore plants such as mossen, lichen, brackens *cryptogams*.

Seeds are eaten since they are good nutrition source. Cones (pinetree, firtree, larchtree) are eaten by squirrels, field mice, woodpecker and crossbills. The mammals are rodents, thus having two big front teeth. Woodpeckers have one big and sharp bill. The crossbill use the tips of the crossed bill to open the cones. Bigger crossbills are specialized in opening pinetree cones which have harder scales. The firtree cone normally contains between 36 and 70 seeds while a pinetree cone contains between 9 and 24 seeds.

### Modification of the exercise: adding spore plants

For the older pupils the teacher may add a third nature item, i.e. a bracken leaf. The grouping of plants then reaches a higher level, i.e. the splitting-up between spore plants and seed plants.



[www.bfig.se/Goteborg.html](http://www.bfig.se/Goteborg.html)  
Common polypody

## Exercise 3: Seeds Exercises – Five Different Examples (Grades 1-9)

The purpose is to discover the seeds through observations and creativity



[http://flutetankar.blogspot.com/2009\\_11\\_01\\_archive.html](http://flutetankar.blogspot.com/2009_11_01_archive.html)



[www.nta.kva.se/index.php?categoryid=26](http://www.nta.kva.se/index.php?categoryid=26)

The teacher should divide the pupils into groups with the use of beans, e.g. large white beans, which have been painted with a coloured spot. The beans should be put in a bowl for the pupils to take one each. The pupils are now grouped according to the colour of the beans. Each group gets a bowl with different seeds. The seeds could be foodstuff taken from the kitchen cabinet, e.g. lentils, chickpeas, kidney beans, black beans, alpha seeds, alfalfa sprouts, grain stones. It is also possible to fetch sunflower seeds and hempseeds from the bags of birdseeds. If the teacher wants to collect seeds, then flowerbeds, winter seedheads, flowers on the meadows, etc. are filled with all different kinds of seeds. Last but not the least; readymade seed bags can be bought.

Examples of activities the group can do - the list can be handed out:

1. Make a list of three general observations of the seeds. One observation is that some seeds have shell. Discuss the observations based on "Why does it look like that?"
2. Use a white sheet of paper to sort the seeds according to size, colour, shape, pattern and edibility.
3. Write down as many open questions as possible. Always start with one question word: What happens if I blow a seed? How does the dandelion seed look like when it is magnified?
4. Guess which species the seeds come from.
5. Create a pattern, animals, flowers, buildings, sculptures, etc, using different types of seeds, on a piece of black paperboard. (Use glue if the pupils want to keep the card).



## Exercise 4: Sow the Seeds and Watch them Growing (Grades 1-6)

The purpose is to discover and investigate what happens with the seeds when they grow



<http://rubensrabatter.blogspot.com/2009/01/ett-fro-med-takter-i.html>

This exercise requires the following material: a bag of soil, seed bags, plastic pots and soft PET bottles. It is recommended do this exercise after other seed exercises.

The teacher puts all the material outdoors on a big table, demonstrates the material and shows how to sow. An eye-opener: Small seeds should not be planted as deep as larger seeds.

The PET bottles can be used in two different ways. One way is to split the bottle alongside to get a sow-box, with two rows. The pupils can draw a plant scheme if they will sow different types of seeds. Another way is to cut the bottle, in a standing position, straight just above the middle. Small holes should be made on the lid, and the bottleneck part turned upside down and filled partly by soil and then planted with seeds. The lower part of the bottle gets water (maybe together with some water plants, e.g. food for ducks).

The bottleneck's upper part with the lid is placed down towards the lower part that is filled with water. This experiment illustrates how fine roots grow through the holes in the lid and how they reach the water.



Ammi Wohlin. [www.hallbarframtid.se](http://www.hallbarframtid.se)

The pupils may keep a log book about what happens during the next 6-8 weeks. Seeds that grow easily are sunflowers, pumpkins, squash and peas.

See attachment: Extra\_2005\_Juni frön och xBlagan\_2008\_vinterns\_fron



## Exercise 5: What do Seeds Require for Growing? (Grades 4-6)

The purpose is using experiments to observe what seeds require for growing.



[www.alltombostad.se/Tradgard/Artiklar/Tradgard/Fa\\_frona\\_att\\_gro](http://www.alltombostad.se/Tradgard/Artiklar/Tradgard/Fa_frona_att_gro)



[www.fruktogrond.se/modules/produkter/produkt.php?pageId=256](http://www.fruktogrond.se/modules/produkter/produkt.php?pageId=256)

Alfalfa sprouts

The teacher groups the pupils and gets the following to each group: 6 containers, soil, water, aluminum foil, pencils, paper, masking tape and about 30 seeds of sunflowers, peas or oats. Use the exclusion method to discover the most important elements for seeds to grow. Each group should mark the containers with the numbers 1-6 and then write the following words on pieces of the masking tape: light, moisture, oxygen, soil and heat – and add them on all the containers.

The teacher discusses with the pupils what they think are the most important elements for a seed to grow. The teacher and the pupils write a hypothesis together or each group can write their own. The hypothesis might be: We believe that the seed requires... to be able to grow.

The following instructions can be handed out to the groups:

Container 1: cross out the word “Light”. Then fill half the container with soil, add 5 seeds, water it to make it moist and then cover the container with foil.

Container 2: cross out the word “Moisture”. Fill the container with dry soil and add 5 seeds.

Container 3: Cross out the word “Oxygen”. Put five seeds at the bottom, add some soil on top and carefully pour some water a bit over the soil surface. No seeds should be floating.

Container 4: Cross out the word “Soil”. Put a piece of paper at the bottom, put 5 seeds on top and water it to make it moist.

Container 5: Cross out the word “Heat”. Fill half the container with soil, add 5 seeds, make it moist with water, and put the container at a temperature of 0 - +4 C degrees.

Container 6: This is the control container, all elements should be added. Fill half the container with soil, add five seeds, and make it moist with water.

Put all the containers except number 5 in the window for about 2-3 weeks. Check what happens. Normally the seeds will not grow in three of the containers - which are those, do you think? Make a try.

	<b>Exclude one of the following elements</b>
--	--

Container	Light	Moisture	Oxygen	Water	Heat	Nothing/Control
1						
2						
3						
4						
5						
6						

## Exercise 6: What Does a Seed Look Like Inside? (Grades 4-6)

The purpose is to discover what a seed looks like inside.



[www.fruktogrond.se/modules/produkter/produkt.php?pageId=430](http://www.fruktogrond.se/modules/produkter/produkt.php?pageId=430)

[www.fruktogrond.se/modules/produkter/produkt.php?pageId=423](http://www.fruktogrond.se/modules/produkter/produkt.php?pageId=423)

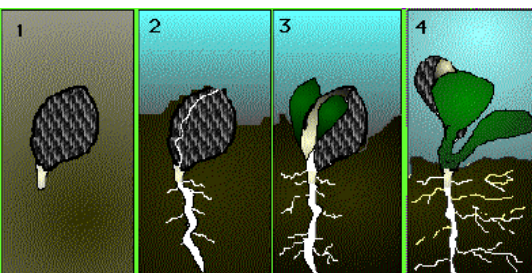
The teacher divides the pupils in groups of three. They get an A4-size paper with a drawn shape of a bean. Each pupil should draw how they think the bean looks like inside. After five minutes they discuss and show each other what they think and what they have drawn. The teacher goes through what endosperm, seedlings, etc., look like.

Each group gets a number of big white beans, which they should split with a knife. The teacher shows how to handle the knife. The pupils should use the magnifier to find out if the scientific books are telling the truth.

**How do you think the bean looks like inside? Draw.**

### The seed/The bean

Ett frö i genomskärning



<http://home.swipnet.se/~w-30993/saddtva.htm>

## Exercise 7: What to Make of Potatoes, Sunflowers or Oats? (L,M,H)

The purpose is to show the use of different crops. The nature resources include several values. The production of the crops will provide support and welfare such as food, medicine and energy - an economical value. At the same time they generate ecosystem services.

### Ecosystem services

The microorganisms' issuing of nutrition and their decomposing of the pollution in the air, ground and waters;  
The pollination of insects;  
The effect of the vegetation's water regulation



<http://emmestar.se/2009/03/30/koket-kallar>



[www.bakkemi.se/mjol.htm](http://www.bakkemi.se/mjol.htm)



<http://iminvackravarld.blogspot.com/2007/01/jag-behver-hjlp-med-rabattplaneringar.html>

The pupils are divided into groups of four or five. As introduction the teacher tells about the plants being producers and nature resources in the ecosystems and at the same time they perform ecosystem services. The groups get a plate with potato, sunflower or oats (other crops can be used as well). For about ten minutes the pupils should draw a mindmap and reflect about how to use the crop they got. The groups should then demonstrate to each other. Many creative ideas are usually suggested by the groups.

## Exercise 8: When did Different Types of Species First Begin to be Planted in Sweden? (Grades 4-9)

The purpose is to achieve knowledge about the import of crops to Sweden and that they are connected to historical events.



<http://vetenskap-forskning.blogspot.com/2007/09/>  
Millet



[http://liberhortus.blogspot.com/2007\\_08\\_01\\_archive.html](http://liberhortus.blogspot.com/2007_08_01_archive.html)  
Jerusalem artichoke (sunroot)

The teacher starts by hanging and stretching a rope between two trees and then marks *The Time* on the rope, e.g. 4000 years, 3000 years, 2000 years, 1000 years, 0, 500 years A.D. 1000 A.D., 1500 A.D., 1600 A.D., 1700 A.D., 1800 A.D., 1900 A.D., 2000 A.D. Fifteen different types of crops have been written on each card and the same number of clothes pegs have been obtained.

Now the pupils are grouped in pairs and the teacher lets them draw a card and gives them a clothes peg. They should now discuss from which area in the world they think the crop comes from and when it first came to Sweden. They should hang the card on the rope at the right time period.

When the pupils have finished, they should all stand up, showing the timeline. The teacher leads the discussion about the import of crops to Sweden and which historical events that are connected to them. Good examples are the Farming Stone age, the Great Migration Era, the Viking voyages, the Hanse, the spreading of Christianity and its monastery gardens, the discovery of the New World, the East India time period, etc. Many new ideas will usually be brought up.



Ammi Wohlin. hållbarframtid.se

### Different types of vegetables and grains

- Barley 4 000. B.C.
- Wheat 4 000. B.C. einkorn wheat, emmer wheat
- Millet 4 000 f. Kr odlats på 1700-talet, dålig avkastning
- Oat 0 C., South European wild species, related to wild oat
- Rye 1000 A.D. pushed away unfermented barley bread, late middle age/upswing 1500 A.D.
- Tomato 1540's from Peru
- Potato 1700's from South America
- Rapeseed crossbreed of cabbage and turnip, the third oil plant following the soybean and oil palm, middle age 1300 A.D., Turnip rape
- Swedish turnip very old cultivated plant (supposition 4000 B.C.)
- Turnip 4000 B.C. since the stone age
- Cucumber 1600's, common as its present shape in the 1900's
- Salad 1500's at the royal court, 1700's served warm
- Carrots 12- 1300's via the monastery gardens
- Parsnip mentioned during the 1500's, probably the middle age
- Jerusalem artichoke 1500's from North America
- Cabbage 3000 - 4000 B.C., prehistorical time, cabbage gardens
- Brussels sprouts 1800's sprouts
- Paprika, pepper 1500's from South America
- Sweet corn 1500's from Mexico, cultivation for the ensilage
- Sunflower 1600's decorative plant, 1800's oil plant America
- Onion 200 A.D.the Romans brought it
- Pumpkin 1500's America, replaced the calabash



## Exercise 9: Seed Poem (Grades 4-9)

The purpose is, by using a collection of seeds and associations, to write a seed poem

Read some poems about seeds:

COME COME LITTLE  
seed don't be frightened  
come come!  
The sun is shining  
The sun is longing  
so much to shine on you  
Come come little seed

Johanna 8 years, Bladet (The Leaf) 1998

You are the seed and I am your soil  
You lay inside me and are growing  
You are the child I am waiting for  
For I am your mother

Earth, give us your warmth!  
Blood, give us your sap!  
An unknown power needs today  
All the life I've had

The streaming warm wave  
Does not know any pond,  
Still wishes to create,  
And is breaking forward.

Therefore it hurts so vividly  
Inside me now:  
Something grows and explodes me --  
Dear you!

Karin Boye, 1935

Groups of three or four get a collection of seeds in their hands or in a bowl. The teacher has distributed seven bowls with some contents, e.g. soil, water, sand, sticks, mosses. Each bowl is covered with a sheet of cloth. Each pupil walks around and touches the contents in the bowls under the fabric sheets.

The group should use the words of feelings, the content in the bowls and the seeds to write a poem together. The structure of the poem is free of choice. The simplest one is to create a rhythm of words, e.g. wet, warm earth...

About fifteen minutes later the groups should read their poems loud to each other. Thereafter the teacher removes the sheets of cloth and the pupils can now see the content of the bowls. It usually feels a bit strange to now see the things you have earlier only touched.

# Plants

## Exercise 1: Flower Bouquets (Grades 1-6)

The purpose is, based on the aesthetical value of the plants, to create.....



<http://blogg.expressen.se/tradgard/category.jsp?catid=4006>

The teacher tells about the florist profession, for example that there are both men and women who compete in making flower arrangements, such as bouquets, wreaths, table decorations or chandeliers. The teacher continues by saying like this: “You should try to make as nice bouquets as possible. You are now training for the Swedish Championship”. The teacher tells how big the bouquet should be, how long stems and which flowers and grass they can use. The bouquet can be based on colours and/or forms, such as big and small or rough and fine. The exercise requires bast fibre to tie the bouquet, and a vase.

Groups of 3-4 pupils should be divided. The plant cards can be used. The pupils in each group should pick beautiful flowers and grasses and arrange them by tying the stems with bast fibre and putting the bouquet in a glass of water. Finally they may sketch or depict the bouquets.

## Exercise 2: Playing with Flowers (Grades 1-6)

The purpose is to see and hear various names of flowers/plants/herbs



Foto: Peter Asmberg  
<http://linnaeus.nrm.se/flora/di/gerania/geran/gerasy12.html>

Buttercup



<http://vartilllarodahus.blogspot.com/2010/04/nyvacktpassion.html> [www.stenvallen.se/blomster/blomster.html](http://www.stenvallen.se/blomster/blomster.html)

Yarrow



Wood cranebill

The teacher picks different species of recognised flowers. The pupils get one flower each. To be able to recognise the flowers, the teacher first says all the names of the flowers and then lets the pupils repeat them. They should all be standing in a circle with one person in the middle; a center person without a flower but with a rolled newspaper. The teacher points at someone in the circle and that pupil should say a flower name (but not their own), e.g. marguerite. Now it is up to the pupil in the center to be fast and to find the pupil with the marguerite, and with the newspaper patting that pupil's shoulder before the name of another flower is spoken. This means that the person with the marguerite should be fast to say the name of another flower in the circle, e.g. a bluebell. If the pupil in the center misses to pat the pupil with the marguerite, then he/she should try to pat the pupil who has the bluebell instead. The pupil that is patted on the shoulder changes places with the pupil in the middle and will stand in the middle with the pupil's flower in one hand. The game continues until the pupils get tired. This game usually makes the pupils move around at full speed for about ten minutes and at the same time many new names of flowers will be learnt.

### Exercise 3: Sorting Plants (Grades 4-6)

The purpose is to see the diversity of plants and to learn about some species



[www.barnbokhandeln.com](http://www.barnbokhandeln.com)

The teacher prepares by going to the exercise place to make a quick inventory, which may result in twenty ordinary species. In the beginning of June plants to be found could be e.g. tufted vetch, marguerite, red clover, northern bedstraw, etc. The teacher writes down the twenty species on a flip chart.

The pupils are grouped using the plant cards. Each group chooses five plants they do not recognise from the list. They can choose either to find out how they look like via the flora or via the plant cards, which have been put out in a long row. Then it is up to the groups to search the vegetation, pick one sample of each species, return and sort them on the correct plant card. The teacher limits the time to speed up the exercise a bit.

Gather everybody to watch all the picked flowers. It is recommended to continue with the exercise Flower bouquets (Plants, exercise 1) or Playing with flowers (Plants, exercise 2).

## Exercise 4: Chasing for Plants (Grades 4-9)

The purpose is to discover the diversity of species on pasture land or meadow.



Ammi Wohlin [www.hållbarframtid.se](http://www.hållbarframtid.se)

**Kidney vetch**



Ammi Wohlin [www.hållbarframtid.se](http://www.hållbarframtid.se)

**Poppy**

The teacher has prepared by taking digital photos of 20-30 plants on the ground/meadow that the education is performed at. The pictures are printed and laminated. Behind each photo one or two questions should be written, which require the pupils to investigate the flowers. Add points to each question.

<b>Lady's mantle</b> <b>3 POINTS</b>	<b>Look at the leaf:</b> <b>Describe the shape and the edges</b> <b>5 POINTS</b>
---	--

<b>Bitter vetch</b> <b>5 POINTS</b>	<b>Open a flower and count the stamens!</b> <b>5 POINTS</b>
--	--

<b>Blueberry</b> <b>5 POINTS</b>	<b>How does the flower taste?</b> <b>5 POINTS</b>
-------------------------------------	--

<b>Sorrel</b> <b>5 POINTS</b>	<b>Does it have any friends or does it grow alone?</b> <b>4 POINTS</b>
----------------------------------	---

Make groups using the plant cards. Each one gets a magnifier.

Introduce the exercise by telling about the chasing of plants, which will last for about 30 minutes. The group can run and just get points without actually seeing anything or stroll around and discover the plants/flowers. The teacher puts out the photos on a sheet of cloth. Each group gets a scheme/table to fill in (see below).

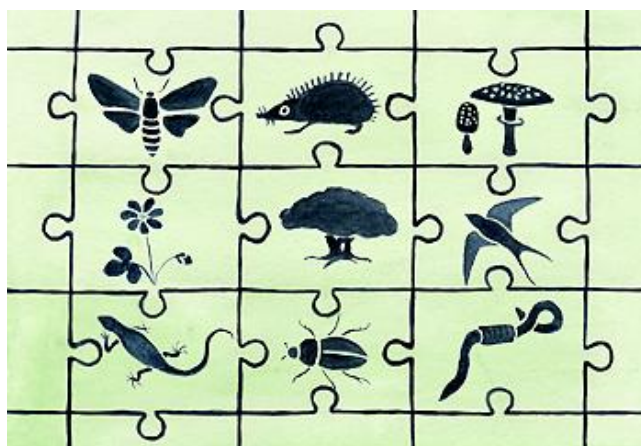
When time is up, everybody should gather and the groups should count their points. The teacher asks who has got more than... The discussion continues about which plants were difficult to find and where they grow. The teacher continues with some of the biological questions, on the backside of the photos.



<b>Plant Chasing</b>			
<b>Species</b>	<b>Found the plant - points</b>	<b>The assignment - points</b>	<b>Total</b>
<b>Total</b>			

### **Exercise 5: Plant Inventory (Grades 6-9) / The Plant Detectives (Grades 4-6)**

The purpose is to discover the diversity of species in pasture or meadow



The teacher divides into groups and lets each group measure a square which is 1 x 1 meter. The teacher has already drawn a table where the pupils can write down the species and the number of individuals of the species. The groups should try to find as many species as possible, by looking at leaves and flowers. At the same time they should count or estimate how many individuals there are of each species.

Then they write down the figures in the table and make a bar diagram of nature material. They

choose six species for the x-axis and a maximum value for the y-axis. Twigs can be the coordinate axis and cones or stones can indicate the number. The bars of the diagram can consist of big branches or ropes. Then they demonstrate to each other.

Geographical area		
Species	Number	Is there a flower?



Ammi Wohlin [www.hallbarframtid.se](http://www.hallbarframtid.se)

If the inventory is done during a longer time, the square might be larger, for example 100 x 100 meters. The groups can complement the inventory by making a nature film about the place, either with a film camera or a mobile phone.

The teacher tells about biodiversity in the culture landscape.

#### Biodiversity – Sweden's 16th environmental objective

- Diversity at ecosystem level (dynamic complexity of plants, animals and microorganisms and the physical environment – land, water, air, minerals, currents, wind)
- Diversity of species
- Diversity of genetical variation

#### Four motives to biodiversity

- **Ekonomical values**  
Sustainment/support and welfare – nature resource exploiting food, medicine
- **Aesthetical values**  
Inspiration resource, mindfulness
- **Ethical and existential values**  
The diversity/evolution of life, understanding our own role in nature
- **Ecosystem services**  
Microorganisms' emission of nutrition, their decomposition of pollution in the air, land and water, the pollination of insects, the vegetation's water regulating effect

#### The Plant Detectives

The younger pupils are playing plant detectives. The teacher goes through the detective course (see infobox from Anders Rapp, Vântande spännande natur 1992) so that the pupils get basic knowledge about the flora terms. The teacher arranges about forty white empty cards.

The pupils now get the assignment of finding plants. By themselves or in pairs they should search a meadow, pasture or forest, looking for one or several plants that they should describe

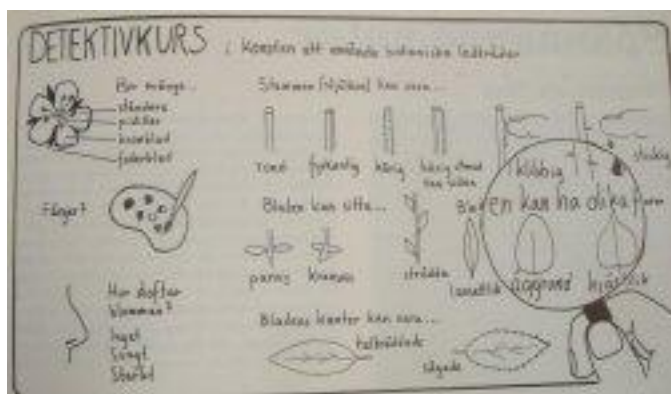
with the help of the detective course. They should write down on a white empty card, a *clue note*, and are allowed also to use more words of their own.

After about fifteen minutes everybody gathers together with their written clue notes, which should be put in a box. Each pupil should draw a clue note from the box and start chasing the plant.

When coming back, the plant and clue note should be put together and the teacher checks if the plants are the right ones. This can be done with the whole class or in smaller groups.

#### Clues

Purple flowers  
Five petals  
10 stamens  
Lobated leaves  
Many flowers on the same stalk  
70 cm high



## Exercise 6: Create an Ecosystem (Grades 4-9)

The purpose is to make the pupils understand the contexts and connections in the nature and on our earth by creating their own little planet.



[www.forskolanalgen.com/Pedagogik.php](http://www.forskolanalgen.com/Pedagogik.php)



[www.buf.kristianstad.se/fjalkestad/redovisn01/slutredov.htm](http://www.buf.kristianstad.se/fjalkestad/redovisn01/slutredov.htm)

**Nothing disappears!  
Everything is spreading!**

Firstly, it is necessary to have the insight that organisms, such as herbs and plants **transform** when they grow and decompose. This means that new substance is neither produced nor disappeared. The substance has just been spread so that it gradually will be built into some new organisms, such as herbs. This is the physical law named the Thermodynamics' first and second theorem.

A plastic globe catches the pupils' attention. The teacher holds it and says that our planet/earth is hanging in an infinite large space with a sun shining on the earth/which sunrays reach the earth. The teacher then ties a transparent plastic bag around the globe and asks questions like

- if all organisms, such as plants, animals and humans, are able to leave the plastic bag
- if water is able to pour in from the space or out to the space
- if the pollutions are able to leave the plastic bag

The pupils usually understand that nothing disappears from the bag containing the globe, i.e. from our planet.

The discussion is continued by the pupils considering what comes into the bag. Most pupils understand that the light and warmth from the sun penetrate the plastic bag. It is important that the teacher shows the connection between the plastic bag and the atmosphere and informs that everything going into the air will be staying about one kilometre from the ground surface, and that the atmosphere is the space in between the plastic bag's surface and the globe.

The exercise continues with the pupils building their own little earth/planet. This exercise can sometimes be used for processes in the water ecosystem. Materials required are: Soil, pots, seeds, plants (e.g. basket plant), PET bottles, labels and pencil, possibly also some flower sticks.

Do like this:

- 1 Use a PET bottle. This will be your ecosystem, a small biosphere, a small earth.  
Add 1 cm of gravel in the bottom
- 2 Add soil, about 1/5 of the bottle's volume, i.e. about 3 cm of soil
- 3 Add water to cover the gravel, about 1/3 dl
- 4 Carefully put a plant inside, poke it down with a flower stick
- 5 Put some seeds inside
- 6 Put a stone inside
- 7 Cover the bottle with the lid
- 8 Stick a label on the bottle, marked with the startdate of the ecosystem/biosphere

#### **Ecosystem services**

The microorganisms' emission of nutrition, their decomposition of pollution in the air, land and water, the pollination of insects, the vegetation's water regulating effect

It is recommended to read this explanation of the ecosystem in the lifecycle container

[www.buf.kristianstad.se/kick/not/kretsloppsburken/mojligheter/mojligheter.htm](http://www.buf.kristianstad.se/kick/not/kretsloppsburken/mojligheter/mojligheter.htm)

Also find out how water ecosystems can be created

[www.buf.kristianstad.se/kick/not/kretsloppsburken/recept/recept\\_vatten.htm](http://www.buf.kristianstad.se/kick/not/kretsloppsburken/recept/recept_vatten.htm)

## Exercise 7: Plants in a Different Way: Edible Plants (Grades 1-9) and Carnivorous Plants (Grades 6-9)

The purpose is to understand the use of plants for food and medicine.



[www.fornaker.org/stenalder.htm](http://www.fornaker.org/stenalder.htm)



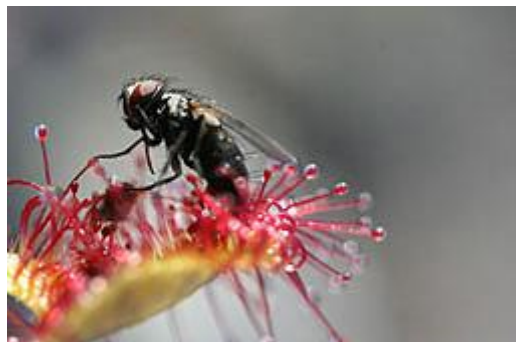
Depending on the season, the teacher prepares which plants can be picked and prepared. It is advisable to have ready-made or bought cards with the plants that should be collected for the younger children. Examples of plants during spring may be elm seeds, birch leaves, small dandelion leaves or fat-hen. Groups can be divided using the plant cards. The teacher hands out a plant list and the respective plant cards as well as a bowl to each group. After the collection all the plants should be put in the bowl. For the salad, croutons can be added. The teacher informs how the Trangia stove works and each group should get their own. The bread should be divided into small squares and fried in oil with little herbal salt.

When everything is ready, the salad is served with lemonade or juice from berries and plants. An alternative is to make tea of e.g. pine-needles or blueberry, in case warm drinks are desired.

See the attachment: xBilagan\_2008\_nodmat

## Carnivorous Plants (Grades 6-9)

The purpose is to discover that some plants in Sweden feed on small animals.



[www.artportalen.se](http://www.artportalen.se)

A fly in a sundew



Great sundew with a butterfly

In connection to studies of the ecosystems of wetlands, bogs and mires, this exercise is very suitable. The teacher prepares by showing the different species of sundew. The pupils should reflect about questions such as: How does the sundew plant catch insects? How does it digest/eats them? And, what happens with the remainders afterwards? The teacher divides into groups and let the groups write their own hypothesis. The groups should search for sundews and study if different kinds of sundew individuals are in different stages of their digestion. The teacher lets the groups have time to observe if any plant has caught an insect.

The teacher sums up with a discussion about the hypothesis of the groups and the result of the observations.

### Sundew

- Three species of sundew – oblong-leaved sundew, great sundew and round-leaved sundew.
- Grows on nutrient-poor clumps of bog moss.
- The edges and the upper part of the rosette leaves are full of beautifully purple glandular tentacles with sensitivity and ability to move.
- The sensitivity of the glandular tentacles notices when small prey touches the leaf. While the leaf bends around the prey, it also secretes various fluids, e.g. enzymes to digest the proteins of the animal.



## Exercise 8: Chasing for Grasses (Grades 6-9)

The purpose is to introduce different species of grass and their importance in the vegetation



<http://linnaeus.nrm.se/flora/mono/> alla bilder

Common sedge  
- Sedges



Hairy wood-rush  
- Luzula (Wood-rush family)



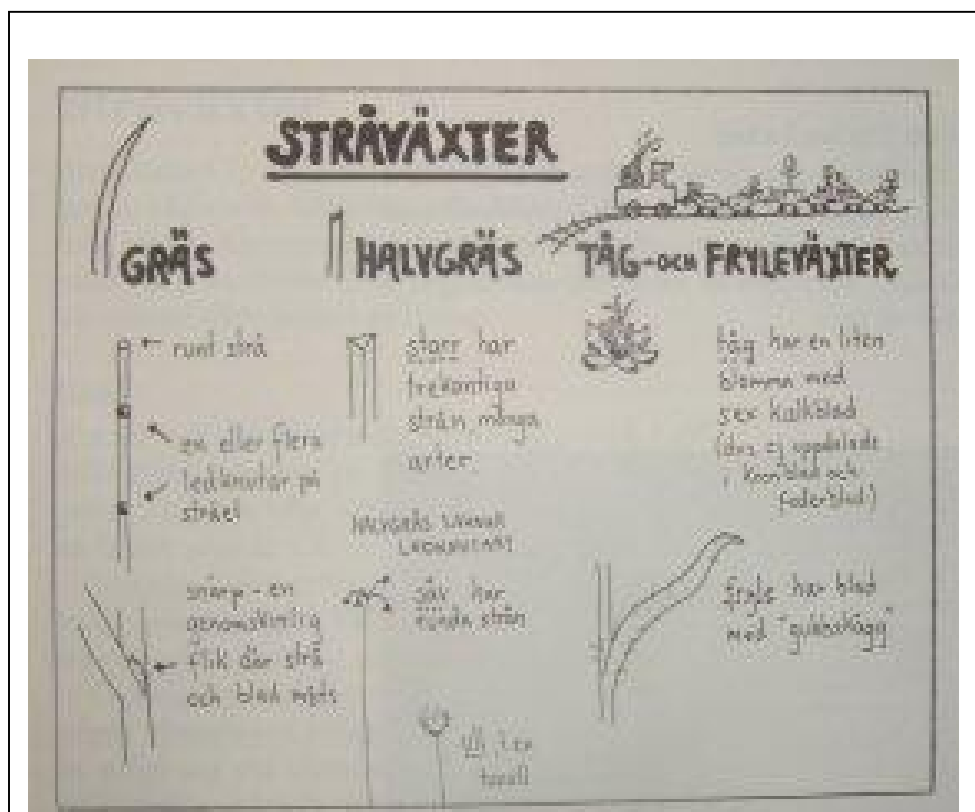
Orchard grass – Grass



Soft (common) rush  
– Rush Family

Grasses (Graminoids/Poaceae) are the common name for grasses, sedges, rush plants and luzula plants (Anders Rapp, Vântande, spännande natur 1992) and they cover large parts of the open areas on the earth. They consist of manifold of species and are food for many herbivores.

In this exercise the pupils will get the opportunity to discover the differences of the various types of grasses, of their flowers and of their seeds. The teacher goes through basic knowledge (see infobox Anders Rapp, Vântande, spännande natur 1992).



Examples of activities the group can do. The list can be handed out.

1. Make a list of three common observations of different types of grasses. One observation could be that all have different flowers. Discuss the observations based on the question “Why do they look like that?”
2. Search for grasses from each one of the four grass families. What differs more than the stalk?  
Search if some grasses have seeds. How do the seeds look like? Watch through a magnifier. It is favourable to pick them and then sort into different groups.
3. Tie a crown made of grasses (Refer to the book from Hemslöjden: Grönt är skönt eller Krona och krans).



## Exercise 9: The Colours of the Nature/Plants (Grades 6-9)

The purpose is to discover the colours of the nature and their use during the millenniums.

The colours of the nature give an insight of the solubility of water and fat respectively, as well as the light resistance. This is well connected to the subject Chemistry. The teacher informs how peoples have been manufacturing colours for textiles and everyday tools.

Materials are required for the three different proposals on how to explore the colours of the plants. Use the plant cards for groupings; this facilitates the knowledge about the species when collecting plants. For activity 2 it is good if plants have been picked and dried already before the exercise, because the result will become better using dry pigment.

Examples of activities the group can do. The list may be handed out.

1. Dye yarn using leaves, lichen or roots on a Trangia stove. Make a collection for a few different recipes, for example three, which could give three different colours. Three Trangia stoves are then required.





[www.naturjobbelvhyttan.se/12012971](http://www.naturjobbelvhyttan.se/12012971)



<http://www.fingerfardig.nu/kurs/tema.html>

Materials to use could be leaves from trees and plants, onion skin, bark, spruce twigs, heathers, lichens, etc. Try either three different plant materials or use a book with formulas of plant dyeing. Pigments to be bought are woad, madder and cochineal. For mushroom-dyeing, another technique is used – however it will not be mentioned here. The plant material should be put in water and extracted/soaked in high temperature for at least one hour. Some plant materials may require much longer time. When the dye solution is ready according to the formula, the parts should be filtered and the remaining is a coloured water mass, i.e. the dye solution.

The yarn requires to be bated if it is to be used for textiles. Bating will make the dye to attach to the yarn. The basic formula is

100 g of yarn  
5 liter of water  
15-25 g of alum  
10 g of tartar

It is also possible to bate using bearberry. However, too much bearberries (maximum 90-100 g / 100 g of yarn) may yield a yellow colour, according to the website <http://medeltiden.ifokus.se>

When the prebated yarn is to be dyed it is important that it is wet and has the same temperature as the dye solution. The basic formula is

100 g of yarn  
5 liter of water  
Colorant

The dye solution should not exceed 90 degrees C so that it starts boiling. This is very important; otherwise the wool will be spoiled.

If the teacher only wants to show the different kinds of colours in the nature, then put the yarn directly into the water as well as the plant material and let it soak in high temperature for about one hour.

2. Make water-color ink for painting on paper. Pick plants or use dried plants that have been pounded and grinded down to pigment. The pigment should be mixed with a binding agent, such as wallpaper paste or sour milk. Add water and sugar.

### **Make your own water-color inks/aquarelle paint**

(Swedish Centre for School Biology and Biotechnology • x-Bi-lagan August 2008)

1 teaspoon colorant (dry)

2 ml measuring spoon (Gummi arabicum or wallpaper paste made of starch)

2 drops of water vatten

1 ml measuring spoon of sugar or honey

(makes the surface more shiny)

Grind the pigment. Mix the ingredients and then add more water to get desired density.



[www.husohem.se/Fixa/Renovera/Mala-m-fargpigment](http://www.husohem.se/Fixa/Renovera/Mala-m-fargpigment)

### **Soil pigments**

#### **Paint with sour milk**

Mix one part of sour milk with 4-5 parts of water.

Use a palette, e.g. a paper plate. Pour some of the liquid on the palette and add some pigment with a brush.

Use one brush to each colour and rinse often.

#### **Soil as pigment/Colorant**

Soil or mud can be used as colorant. Put CLEAN soil into a bucket with a lot of water, stir and pour the mixture through a sieve. Keep the mixture without touching it for about 24 hours. Then most of the soil will sink to the bottom. Then very carefully remove the water. What remains in the bucket can now be used to paint with.

You can also dry the soil. Pour out the wet soil on a piece of cloth, on top of some newspapers on the floor. Let it dry and become hard. Take a piece and grind it in a mortar.

3. Make a colour palette of the colours from the nature. By picking leaves, flowers, fruits berries, parts of plants, sticks, lichen, mosses, etc., and then rubbing and grinding them against sandpaper, a colour will appear. The colour scale looks different during spring and autumn respectively.



Ammi Wohlin. [www.hallbarframtid.se](http://www.hallbarframtid.se)

See attachment: xBilagan\_2008\_akvarellfarger

# Trees

## Exercise 1: Playing with Tree Cards (Grades 1-3)

The purpose is to introduce some Swedish tree species and tree activities



The teacher buys postcards of the Swedish trees ([www.hjelms.se](http://www.hjelms.se)) and then laminates them.

Each card contains the tree, the bud, the leaf, the female and male flowers and the fruit.

Everybody should stand in a circle and the teacher distributes one card each.

The teacher makes statements about trees (see the textbox). For example: I have needles or I have red fruits/berries. When a statement has been spoken, the pupils should observe their tree card and wave their arms in the air if they think the statement is true. The teacher does not go through whether it is reasonable or not, but continues with 10-12 statements. Afterwards the teacher discusses what the pupils thought and what seemed difficult to judge. It is usually the male and female flowers or the leaf edges that might cause difficulties.

Thereafter the pupils should make pairs or group themselves.

For the younger pupils, it is good if each tree card has a duplicate so that they can find their partner with the same tree card.

The older pupils can be divided into groups of three or four by walking around trying to find a common feature, such as: everybody who has red berries; everybody who has catkins (regardless of seeds or flowers).

When they are ready, the teacher lets all the groups tell each other about their common features.

Thereafter it is just to move on with the tree activities.

### Suggestions of statements

- I have red berries
- I have needles
- I have white flowers
- I have black berries
- I have light-brown
- I have cones
- I have simple leaves
- I have nuts or acorns
- I have black and white trunk
- I have saw-toothed leaf edges
- I have seeds that can fly
- I am the one children like to play on
- I have compound leaves
- I have palmately compound leaves
- I have pinnately compound leaves
- I am a climbing tree
- I have crenated leaf edges
- I have a trunk that adults like to lean against

## Exercise 2: Leaf Shapes (Grades 1-6)

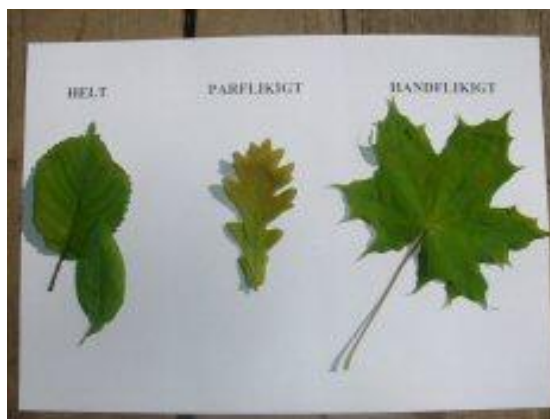
The purpose is to discover the diversity of leafs and to learn some botanical terms



Ammi Wohlin. [www.hallbarframtid.se](http://www.hallbarframtid.se)

The teacher groups the pupils and lets them search for many different types of leaves from trees and bushes for about five – ten minutes. The teacher has prepared a cardboard paper with the text: Simple leaves – Compound leaves. When they return they should sort, roughly, the leaves into different piles. A finer sorting is done on another paper for simple leaves, with the text – entire, lobated, palmately lobed and for compound leaves – pinnately and palmately. The groups should take the piles and try to make a correct preliminary sorting and with help from the teacher they should continue to the finer sorting, which includes determining the shape of the leaf. When all the leaves have been put in piles, the teacher tells about the third level of the species determination, i.e. the leaf edge. How does it look like? Is it toothed, crenated, sinuated or serrated?

Afterwards the groups should use the leaves to create an insect on a white sheet of paper and finally they display them like a “vernissage”. The group should either tell something about their insect or let the other groups guess which animal it resembles. They can use a digital camera to take photos.



Ammi Wohlin. [www.hallbarframtid.se](http://www.hallbarframtid.se)

See groupings with leaves and the attachment: [Extra\\_2005\\_Bladmemory](#)



### Exercise 3: Forest Oldies (Grades 4-6)

The purpose is to arouse interest for tree stumps, dry pine trees or spruces and fallen trees as well as to discover their importance in the forest ecosystem



[www.myra.nu/stubbrotvalt.html](http://www.myra.nu/stubbrotvalt.html) - alla bilder

High stump



Stump and fallen tree



Dry spruce

The teacher starts telling about the lifecycle of the forest trees and lets the pupils reflect about what happens with tree stumps. Forest oldies are introduced (see textbox). The pupils should be grouped using tree cards.

Examples of activities the groups can do. The list may be handed out.

1. Find the four forest oldies in the local area and memorise where they are located. When returned, a map of the area is drawn using nature materials and the forest oldies are placed on the "right" spot.
2. Write questions to a forest oldie, search for it in the forest and interview it. The answers from for example a tree stump or a dry pine tree can be imaginary or real information. Use books that you have brought and write down relevant facts. Let the groups demonstrate their interviews beside the respective forest oldie.
3. Investigate a forest oldie and its surroundings, such as mushrooms, plants, insects, etc. It is suitable to use magnifiers and petri dishes (small plastic bowls).
4. Sketch some forest oldies.

## Exercise 4: The Tree Path (Grades 4-9)

The purpose is to learn to recognise the trees using poems and at the same time have some time for quiet reflection



[www.gashagapirar5.se/gashagapirar5/extern/forening\\_och\\_naromrade.htm](http://www.gashagapirar5.se/gashagapirar5/extern/forening_och_naromrade.htm)

### Harry Martinsson

... **white-legged in the day**  
wanders its avenue steps to a manor  
house  
Others gathered and created a grove  
and two very small forests.  
The leaves were still fresh.  
It was still spring  
in the trees yearly infancy  
with the landscape playing.

(birches)

### Viktor Rydberg

So light and bright in spring-blue air  
in rows ... standing crowns  
with flowers in yellow fringes,  
flickering light from trunk to trunk  
along joyful sunny roads  
a singing southern wind is dancing

(maples)

### Esias Tegner

Dodonas (old oaks)... spoke in ancient  
days  
out of sacred shadows stammered the  
judgement of fate  
Yet today in the sage's ear  
a voice is whispering in your crowns  
(oaks)

The teacher hangs five-six poems along a path. A suitable path can be a track so that all the pupils will return to the starting-point. The teacher can choose to hang signs along the path or not. Each poem contains the name of the tree. The teacher has crossed out the name with a big black felt pen.

There are two ways how to do this exercise. One is the pupils leaving in pairs and trying to solve which trees are "hidden" in the poems. The other one is, at the beginning of the track, to discuss the importance of silence. Questions such as: When are you quiet? Are you with your own thoughts then? What are you afraid of?

One by one, the pupils are then sent away. Important is the way the teacher sends them away, so that they can get a feeling for reflection and being able to read the poems in their own pace. They are not allowed to catch up with anyone else, but it is nice to be able to see someone in front of them to feel safe (someone who is courageous should walk first and someone who is secure should walk last, while the "insecure" ones should walk in the middle).

When everybody have returned the teacher reads the poems but excludes the name of the tree. The teacher emphasises that it is more important to believe in something than not knowing. Because if there is a belief, it means there is an idea, and all ideas are important for development. The pupils/the pairs may suggest which trees they think the poems are about. The teacher may tell the characteristics of the poem for that specific species. The terms in the poems have been highlighted with bold text.

### Harry Martinsson

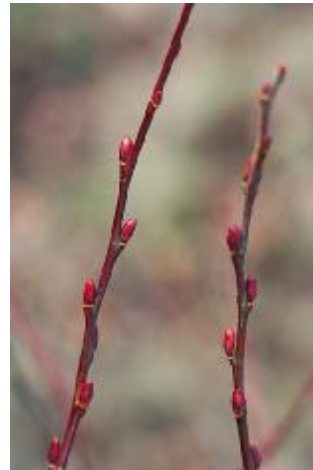
... standing **closely** alongside ...  
they merge together  
holding a **needle-umbrella** over  
the bells of **the twinflowers**.  
The moths of the grass are flying  
low, ahead  
with unheard wing-beats.  
Here the forest is whispering in  
the countries up North,  
its smallest ballad.

## Exercise 5: Buds (Grades 4-9)

The purpose is to see the different buds of the tree species



Unknown



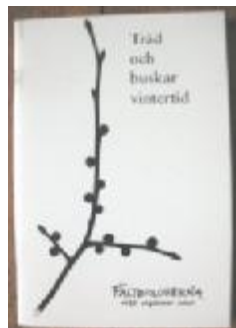
<http://thort.se/blog/tag/knopp/>

During wintertime it is possible for the pupils to discover the buds of the trees. The pupils start by looking around, using magnifiers, at the different tree buds. What do they look like? Are they rounded, pointed, hairy, black, brown, alone or several together? It is favourable if the teacher informs about the different adjectives that can be used.

After the first discovery, the teacher hands out a pamphlet of bud attributes to the pupils, such as the field biologists' *Trees and bushes during wintertime*. They should try to determine the species and finally choosing three types of trees with brushwood. They should cut off the brushwood branches and then label them, writing the name of the tree that they think it is. When indoors, the branches should be put into water and when they develop it will be possible to see if the typing of species was correct.

For the younger pupils a bud game can be played. Find out more at the publisher of Naturpedagogen:

[www.naturpedagogen.com/läromedel%20förskolan.htm](http://www.naturpedagogen.com/läromedel%20förskolan.htm)





## Exercise 6: The Trees of Spring (Grades 4-9)

The purpose is to discover the differences between tree species



<http://rubensrabatter.blogspot.com/2009/07/lindblomsgront.html>  
Linden blossoms



[www.vattenriket.kristianstad.se/vykort08/080129.htm](http://www.vattenriket.kristianstad.se/vykort08/080129.htm)  
Hazel female flower



[www.naturskyddsforeningen.se/kretsar/lan/bohuslan/molndal/gunnebo/var-i-gunnebo/](http://www.naturskyddsforeningen.se/kretsar/lan/bohuslan/molndal/gunnebo/var-i-gunnebo/)  
Hazel male flower

Both flowers and leaves of Swedish deciduous trees develop during spring. The teacher tells about: What do the flowers of the trees look like? When can we see the flowers? How are the flowers pollinated? How do the seeds spread?

Each pupil should search for their own three specific trees, which they should study during spring. The trees should be of different species. Since the trees should be selected during wintertime, the species can be determined by studying the buds (see Plants, exercise 5). Another possibility is to study the trees carefully and at the same time put a branch in the warmth indoors. The branch will then develop leaves and it will be easier to determine the species of the trees. The pupils should draw their own observation scheme, about what they think will happen, i.e. their hypothesis.

### Deciduous trees

- **Vegetative propagation**– shooting new buds from old root systems
- **Reproductive propagation** – **The flowers** may contain female organs/pistil and male organs/stamens. It may sometimes be different types of flowers on the same tree (hazel, birch). In some cases there are female trees and male trees respectively (sallow).
- **Pollination** comes through the wind (birch, hazel) or through insects (linden, willow).
- **Seed dispersal** comes through the wind (birch), water (alder) or animals (oak, beech).

	<b>Month</b>				
<b>Tree species</b>	February	March	April	May	June
?					
?					
Hazel					
?					
?					

## Exercise 6: The Trees of Autumn (Grades 4-9)

The purpose is to discover the abscission of different tree species



[www.svenskaturistforeningen.se/  
PageFiles/9066/h%C3%B6stl%C3%B6v.jpg](http://www.svenskaturistforeningen.se/PageFiles/9066/h%C3%B6stl%C3%B6v.jpg)



[http://farm4.static.flickr.com/3045/2933627362\\_20e687fbee\\_b.jpg](http://farm4.static.flickr.com/3045/2933627362_20e687fbee_b.jpg)

The teacher tells about why deciduous trees drop their leaves in comparison to the coniferous trees. What happens? Each pupil should choose their own deciduous tree. They should write down the geographic location of the tree. Is it inside the forest, on open ground or is it close to water? Ten leaves of the same branch should be marked with plastic tape. The pupils should draw their own observation scheme, about what they think will happen, i.e. their hypothesis.

### Abscission/dropping of leaves

- Why? Due to dehydration, because the frozen ground cannot transport water from the roots up to the tree.
- Before the abscission the green chlorophyll is decomposed, which contains proteins.....
- The yellow colours come from the carotenoids in the leaf but have been hidden by the green chlorophyll. Red colours mainly come from the anthocyanins, which are affected by the temperature and is reproduced during the autumn.
- The trees are aging and the leaves die almost simultaneously, which

	Month			
Leaves	September	October	November	December
10				
9				
8				
7				
6				
5				
4				
3				
2				
1				
0				

Write down the number of marked leaves that have not yet fallen. The pupils should compare their trees with each other and reflect about: Are there differences between different species? Are there differences within the same tree species, which is located geographically in different places? Using the table above, a diagram can be drawn.

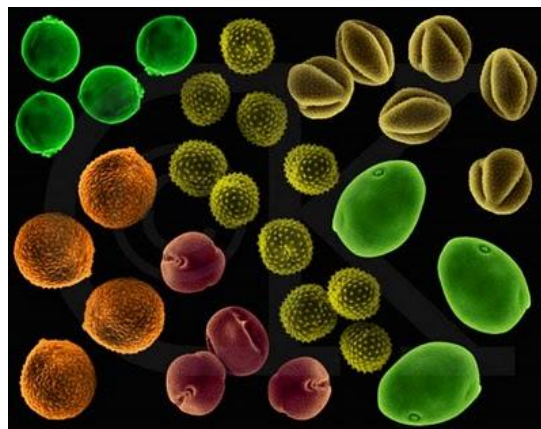
## Pollination

### Exercise 1: Scents of Hops (Grades 1-6)

The purpose is to discover the importance of scents to be able to find the way as well as to find a partner



<http://plommenad.blogg.se/2009/february/>



[skaggmesenskartbok.blogspot.com/2007\\_07\\_01\\_ar...](http://skaggmesenskartbok.blogspot.com/2007_07_01_ar...)

Pollenkorn

This exercise can be done in two different ways.

### Find the way

The teacher divides the pupils into two groups. One group sits down in a forest hill. They pretend to be flowers. Each one gets a scent, a perfume, which they should rub somewhere on the body. The other group should stand in a circle. Blindfolded they should pretend to be bumblebees. Each bumblebee gets a scent and should try to find the flower with the same scent. They can sound like bumblebees; bzzzzzz... bzzzzzz, but no flower is allowed to say anything. When all the bumblebees have found their flower, the groups should change places and do the exercise once again.

### Find a partner

The teacher divides the pupils in pairs. Each pair gets a scent, such as cinnamon, orange, carnation, roses... They should rub the scent somewhere on the body, for example on the arms. Each pair should then split and walk a bit apart from each other. Everybody should be blindfolded, and by using the sense of smell they should now try to find their partner.

## Exercise 2: Follow a Bumblebee/a Bee (Grades 1-9)

The purpose is to understand what and how the insects pollinate and their importance to the crops. Pollination is a free ecosystem service.



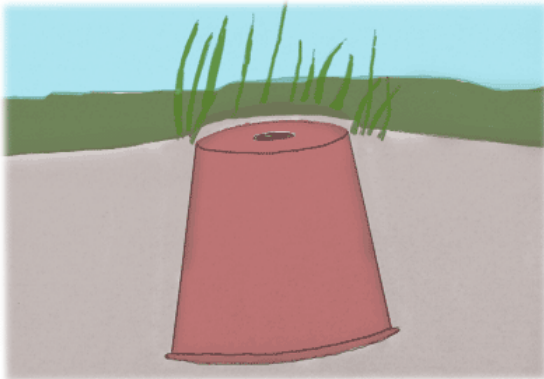
[www.farfars-handelsbod.com/humlan.htm](http://www.farfars-handelsbod.com/humlan.htm)



The teacher chooses a sunny day when bumblebees and other insects are out flying. The lesson starts with gathering and a briefing about bumblebees and their importance as pollinators. The teacher divides into groups and lets the pupils work with the following assignments. The list may be copied and handed out.

1. Catch bumblebees using a sweep net. Watch with a magnifier and use the charts to determine the species. How many species do you find?
2. Follow a bumblebee for 5 minutes. How many flowers does it visit? How long does it stay on the flower? Going very close, you can see pollen on the bumblebee. Where do you find the pollen?

3. Draw flowers in five different geometrical moulds, e.g. a triangle, a square, a circle, roundels with petals on yellow paper. Duplicate so that you have two of each. Put a lump of sugarwater paste on one of each moulds. To which ones do the bumblebees fly? Those with sugar or those without? Which mould is most attractive?
4. Build a simple bumblebee nest of the following material: a flower pot, some grass from an old mouse nest. Bumblebees are attracted to mouse urine. Place the pot upside down and bury it halfway in a slope. Grass should have been put inside the pot already. Protect the hole in the pot against rain but do not cover it. Return to the place to see if it becomes habited.



#### Bumblebees

- 40 species incl. Cuckoo bumblebees
- Pollen is the most important nutrient for larvae
- Sallow and willow plants, clover, apple trees, forest and garden berries are important pollen sources
- A bumblebee can pollinate 2000 flowers/day

#### Anna M. Roos

See the bumblebee, she tumbles  
And bumbles and stumbles  
Continuously falling down!  
Among blossoms she fumbles  
And falls and fumbles  
Of honey her flesh

She mumbles and buzzes  
and buzzes and hoorays  
And bawls of joy:  
"May I just the blossoms peck  
and drink and hiccough  
Then I will be so satisfied!"

#### Do like this:

- Take a flower pot made of clay and about 15 cm wide. Make sure there is a hole at the bottom of the pot.
- Dig a hole in the ground enough big to fit the pot upside down and the bottom should be even with the ground surface. It is recommended to use a sunny and protected place, surrounded with high grass.
- Fill half of the pot with nesting material, preferably from old vole or mouse nests. Loosely packed hay or sawdust can also be used. Ask at an animal shop to get sawdust that has been inside the mouse cages and is smelling of mice.
- Place the pot in the hole and pack soil around it. Put some stones around the hole so that it looks more natural.

(The description is retrieved from the book "Vilda grannar" published by The Swedish Society for Nature Conservation)



### Exercise 3: Butterflies and Flowers (Grades 1-9)

The purpose is to understand what and how the insects pollinate and their importance to the crops. Pollination is a free ecosystem service.



[www.guteinfo.com/scripts/lankar.asp?id=2179](http://www.guteinfo.com/scripts/lankar.asp?id=2179)

Apollo butterfly

This exercise requires a place where there are a lot of butterflies, e.g. a meadow or a garden. Some plants attract butterflies, such as thyme, nettles, thistles, butterfly bushes, umbelliferous plants and even the whole herb garden. The teacher prepares the exercise by copying an observation scheme (see below). At the briefing the teacher needs to emphasise the importance of sitting silently for about 15 minutes.

The pupils get one magnifier each, a sitting pad, a piece of paper and a pencil. The pupils should be placed a bit away from each other so that they can observe the flowers peacefully. First they should choose a flower to observe and discover which butterflies arrive and how long they stay. The older pupils (M, H) should follow the scheme, i.e. by writing some descriptive words about colour, shape, patterns for Butterfly 1, and then the time in seconds. After half the time, they should choose a new flower, which differs from the first flower. The same observations for flower number 2. When the exercise is finished, they should use a magnifier to study flower 1 and 2. What do they discover?

After the exercise, the pupils gather in a circle and the teacher discusses about the butterflies that were there and how long time they were there. The discussion continues about: What are they doing inside the flower? What happens there?



<b>Observation scheme</b>			
<b>Flower 1</b>	<b>Description</b>	<b>Time - sec</b>	<b>Scent – Sight</b>
Butterfly 1			
Butterfly 2			
Butterfly 3			
Butterfly 4			
Butterfly 5			
Butterfly 6			
Butterfly 7			
<b>Flower 2</b>	<b>Description</b>	<b>Time- sec</b>	<b>Scent - Sight</b>
Butterfly 1			
Butterfly 2			
Butterfly 3			
Butterfly 4			
Butterfly 5			
Butterfly 6			
Butterfly 7			

### **Pollination**

- Pollination is a condition for fertilisation when female and male cells melt together. Exchange of genes occur.
- The anther's (male organ) four rooms contain pollen, which actually are spores. Inside the spores are three cells of which two are the sperm cells.
- The ovule (female organ) with the pistil, which stigma captures the pollen particle and transfers it in the style down to the ovary. Inside the ovary are the ovules to be fertilised.
- The pollen is captured onto the sticky stigma and a stalk-like conduit, the style, reaches the ovary where the sperm fertilises the eggs.
- Pollination is an ecosystem service, i.e. we receive fruits, berries, oil plants, etc. when crops are being fertilised.

## Manual pollination in China

”The farmers in one of the most famous fruit districts in China have not seen any bees or bumblebees since the end of the 80’s. Instead they themselves move around and pollinate using cigarette filters or tassels of chicken down. The reason why insects disappear is the overuse of chemical pesticides. And the crop-spraying continues.”

“The modern agriculture has not been careful enough to protect the pollinating insects. Lately there have been reports of mystical deaths of bees in America, and in China the people have already taken over the role of the bees. Professor Tang Ya, who works at the institution of biodiversity at the University of Sichuan, tells about people pollinating fruit trees is very common in China. Between 80 and 90 percent of all the apples and pears that are sold in China is the result of manual pollination.”

”One reason for the take-over of manual pollination in China is that small areas can produce a lot of crops. Another reason is that the Chinese agriculture uses too much of pesticides so the insects get killed.”

Vetenskapsradion, Sveriges Radio 8/2 2008

## The food of insects

- Butterflies seek energy-rich **nectar**, which is retrieved with a haustellum inside the flower. The nectar is sugarwater, with a complex variation of 2-80% between species. The amount of sugar depends on the pollinator, e.g. bee-pollinating species have less sugar than bat-pollinating ones. The nectar secretes from nectar glands/nectaries that have restructured from some of the petal’s parts, e.g. the anthers (pasque flower), the petals (butter cup), the flower bottom (cherries).
- The butterflies’ taste organs are located on haustellum and feet. Hawk moths are fast and need a lot of energy, a lot of nectar.
- The insects may also seek food where there is secretion from sweet substances. They are attracted to places with rotten fruits or animal products, sapping trees, gnatflies secretion, etc.

## How do the insects find the flowers?

- How do the insects find their way to the flowers? If they use their eyesight or smell organs can be determined by observing the way the insect fly to the flower.
- **The scent** is ethereal oils, which are volatile and have different intensity in the separate parts of the flower. On insects, the smell organ is located on the antennae.
- The **colours and shape** of the flowers are adjusted to the eyesight of the insects. They can see ultraviolet light, which means they see the world in a different way than other organisms. The flowers can be lacklustre or shining. Lines and patterns in the flower, often on the petals (e.g. wood sorrel) are called nectar signs, which help the insects finding their way to the nectar. Sometimes there are landing places, such as viola tricolor or a funnel like hemp-nettle. The flowers have more tricks to attract insects, e.g. many together, such as the yellow bedstraw, or having sterile edge flowers, e.g. marguerite.

## Pollen

- Pollen contains nutrition, such as proteins, fat, carbohydrates, vitamins, minerals.
- Pollinating plants contain both sex organs (bisporangiate strobilus).
- Pollen is particles, mostly jagged or sticky by greasy substances, so that they can stick onto the animals. The animals are mostly hairy.
- The plants open their anthers at a specific time every day, although different depending on species. The light intensity, the temperature, soil humidity and air humidity have impact on the flowers’ opening time. That is the time when insects can “fetch” new pollen. Many animals feed on both nectar and pollen, e.g. bombyliidae, bees, beetles, bats.
- A primitive moth only feeds on pollen.

## Soil

### Exercise 1: Play Millipede (Grades 1-3)

The purpose is to discover the coordination of an animal with many legs



[www.guteinfo.com/scripts/gotland\\_utflykter.asp?id=2528](http://www.guteinfo.com/scripts/gotland_utflykter.asp?id=2528)

Millipede

Many pupils recognise the slow millipede and maybe even the fast centipede. All the pupils should stand behind each other with their hands on the shoulders of the one in front of themselves. The teacher asks: How many bones do you have altogether? When the group have found out, they discuss the importance of cooperation to make their legs walk in the same direction.

The first one should be the leader and thus is the head, taking the decisions. “The head” decides the different movements by the head and body. Everybody must do the same thing, i.e. in the same way. After a while “the head” changes place and moves last in the line. The game is interrupted after a while and the teacher discusses with them how they felt doing this exercise.

## Exercise 2: Five Steps to Soil (Grades 1-9)

The purpose is to discover the different stages of biodegradation



[www.ostersund.se/boleva/nyheterboleva/nyhetsarkivboleva/nyheterboleva/2009/primajordtillsalu.5.2380a76712110d8b30480008150.html](http://www.ostersund.se/boleva/nyheterboleva/nyhetsarkivboleva/nyheterboleva/2009/primajordtillsalu.5.2380a76712110d8b30480008150.html)

The teacher starts without introduction by telling the pupils to search for leaves of different ages. A short while later the pupils return and they should sort the leaves in five different piles of biodegradation stages. The teacher puts a pile of soil beside the last and oldest leaf and then asks the pupils what has happened to the leaves. They all discuss, based on the pupils' age and their knowledge.

## Exercise 3: Garbage Board (Grades 1-3)

The purpose is to discover how long time it takes for different materials to decompose and what it depends on



Ammi Wohlin. [www.hällbarframtid.se](http://www.hällbarframtid.se)

The teacher prepares by taking out wooden boards and litter/garbage, such as aluminum cans, pieces of glass, paperboard, hard plastic, soft plastic, bottle caps, orange peel, potato peel, pieces of bread and sausages. Required is also a felt pen and nails, a hammer or a stapler. The teacher tells about the decomposition process.

The pupils are grouped and each group gets a wooden board and the opportunity to choose litter/garbage. The group should discuss which different types of garbage they want to choose

and in which stages they think it decomposes. They should nail or staple the material in ranking 1-10 where 1 is the fastest. On the wooden board they should write a number and which material it is. Otherwise it might be difficult later on to see what material it is. The group should draw a copy the board with numbers and text on a piece of paper. They should also note how long time they think it takes for each material to decompose.

Number	Material	Time
1	Bread	
2		
3		
4		
5		
6		
7		
8		
9		
10		

The wooden boards should be put upside down in the local environment. Hide them with grass and other nature material and mark the place. The groups should draw a map and write a description of the place on a piece of paper, so they can find the place again.

### Exercise 4: The Decomposers (Grades 1-9)

The purpose is to discover the diversity of insects in a lump of soil/compost soil and to understand their importance to the biodegradation



<http://home.astrakan.hig.se/matsvin/hemsida/book/export/html/7>  
Springtail



[www.artportalen.se/bugs](http://www.artportalen.se/bugs)  
Geophilidae

The teacher has taken out plates with compost soil. The pupils are grouped and they get a plate, magnifiers, pictures and petri dishes (small plastic plates). The groups should investigate the soil and search for insects, and then observe and study the

insects using magnifiers. They should write down their questions: Why do they look like they do? How do the insects behave? Each pupil should draw an insect. The teacher discusses about the questions and reflections. The drawings can be used in the follow-up work. A suggestion is to draw compost and place the insects in it. Or cover the outside or inside of the insect drawings with a real compost.

### Which organisms live in the compost?

Worms, insects, fungi, bacteria

- **Worms** belong to the group Ringed worms (Annelids) with three classes; earthworms, polychaetas (ragworms) and leeches (one of 12 groups in the animal world).

They have segments. The frontmost segment contains of the heart, the nerve center and the sense organs (reacting on light and sound). The other segments contain intestines, the blood vessels with red blood cells and the nervous system. Each segment regulates the water balance.

The worm breathes using the whole body, i.e. skin respiration. The worm inhales oxygen which is dissolved in water. Each segment has 4 bristles (chaetae), which are used for locomotion together with the transverse and longitudinal muscles.

The worm is a hermaphrodite, i.e. it has reproductive organs associated with both male and female sexes. Mating occurs when two worms lay down beside each other and sperm is transferred close to the "collar/girdle" (the clitellum - a thickened section of sexually matured worms). The clitellum produces a cocoon that collects ova and sperm, at the same time as the cocoon is drawn backwards. The cocoon closes and falls off. It is lemon-shaped and militarygreen-coloured. The Tiger or Brandling worms (*Eisenia foetida*) are chestnut-coloured with yellow cross-stripes of 5-10 cm. The Red Earthworm (*Lumbricus rubellus*) is reddish brown or reddish violet with no cross-stripes, and longer than the *Eisenia foetida*.

- **Springtails** are small animals, normally less than 5 mm long, with one pair of antennae, six legs and a furcula (tail-like appendage shaped like a fork) found on the abdominal segment, which can be folded under the abdomen. When the furcula is released, the animal is propelled upwards. They jump 100 times their own length. They feed of fresh or decaying plant parts, algae or hyphae. They belong to the phylum Arthropoda and subphylum Hexapoda (insects).

- **Acari** are millimetre-sized animals and belong to the class Arachnids. They feed both of plants and other animals.
- **Nematodes** are small thin worms. They belong to the group Roundworms and do not have any segments. They are both free-living and parasitic. The free-living ones live e.g. in the water capsules around the soil particles. The biggest ones are 2,5 mm. A rotten apple may contain around 90 000 nematodes.
- **Enkytreer** white, up to 2 cm. They are often numerous. Live in seaweed, leaf litter and rotten organic material. Belong to the group Annelids (ringed worms).
- **Woodlice (Isopoda)** belong to the group (phylum) Arthropoda and the subphylum Crustacea. They live of decaying plant organisms. They have more than 8 legs and long jointed antennae.
- **Earwigs** belong to the Arthropoda's subphylum Hexapoda and class Insects. They have long antennae, two pairs of wings (forewing/elytra (to cover the hindwing) and hindwings (used for flying) respectively), pincers on their abdomen used as weapon and help to fold their wings. Feed mainly on plants.
- **Millipedes** have two pairs of legs per body segment and one pair of antennae. They feed on decaying trees and leaves. They belong to the phylum Arthropoda.
- **Centipedes** have one pair of legs per body segment and sharp poisonous claws. They are predators.
- **Hoverflies**



### How does compost work?

- Organic materials are biodegraded and converted into soil. Nitrogen and phosphorous are emitted and become resources/nutrients for new plants.
- The compost needs: Nutrition, Oxygen, Moisture  
 Nutrition – the balance of carbon and nitrogen is important.  
 Carbon-rich materials are last year's leaves, chopped branches, dry plant parts (although too much stops the biodegradation process)  
 Nitrogen-rich materials are freshly cut grass, fresh plant parts, household waste (although too much do not bind the nitrogen but emit ammonia)
- About 1/3 of the added material should be carbon-rich litters material, which keeps smell and flies away.
- The compost mass cannot become too wet and compact, then it does not get enough oxygen. Problems may arise, such as bad smell and leachate water. The compost may even get fermented. It is important to alternate with dry material (peat moss, bark, humus, saw dust, chips, sprucetree or pinetree needles, straw, etc.) and to aerate. Use smaller parts for composting, and it is favourable to break them into even smaller pieces – that makes the process faster.  
 All household waste, including household paper, coffee filter, eggshell, fishbones, chicken bones (not meat bones).  
 Weed (depending on which temperature is used – high temperature kills seeds), leaves, smaller tufts of grass

### Remember!

- Mix dry with juicy
- Cover with litters
- Atomize the material
- Airily material in the bottom
- Keep enough moisture
- Add e.g. horse manure, urine

## Exercise 6: Leaf Board (Grades 1-9)

The purpose is to watch the biodegradation process of different leaf species and to understand the dependencies



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The teacher prepares by taking out wooden boards, felt pen, nails and hammer or stapler. Then telling about the biodegradation process and asks: Which ones are mainly eating old plant parts?

The pupils are grouped and during five to ten minutes they should search for several different leaves from trees and bushes. The groups get a wooden board each. Within the groups the pupils discuss which leaves they want to choose for their experiment, which sequence they think the leaves decompose, why they decompose and which are the decomposers. They should nail or staple the leaves on a scale from 1 – 7, where 1 equals the fastest decomposition. They should also write down a number and the name of the leaf on the wooden board, otherwise it might be difficult later on to see what it is.

Number	Material	Time
1	Common Ash	
2		
3		
4		
5	Oak	
6		
7		

The wooden boards should be put upside down in the local environment, and covered with grass and other nature materials and then the place should be marked. The groups draw a map and write a place description so that they will find the place again.

## Exercise 7: Organic or Inorganic? (Grades 4-9)

The purpose is through experience comprehending the meaning of organic versus inorganic matter



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The teacher has six petri dishes (small plastic plates) filled with sand, clay, crushed stones, soil, peat and watery mud. The materials should be of both dry and wet material.

The pupils should gather in a circle. The teacher starts by asking: What is the difference between the contents in the bowls? Are there any similarities? How would you sort them? Suggestions? The pupils should try to sort and then tell what they think. Younger pupils may suggest dry-wet, light-dark, hard-soft. A usual comment is that the difference between organic and inorganic is living and not living respectively.

It is recommended that the teacher continues with a seed exercise. The above question formulation could be modified: Is it possible to plant in sand? If yes, for how long?

### Inorganic

- Materials without carbon
- Material in different sizes ranging from mountains and rocks to sand, silt and mud
- Material that requires long time perspective to decompose

### Organic

- Material that contains carbon
- Material that requires short time perspective to decompose
- Material that has been part of any living organism

## Exercise 8: Soil Words (Grades 6-9)

The purpose is to discover the diversity of different soils; soil types



[www.frw.ca/rouge.php?ID=38](http://www.frw.ca/rouge.php?ID=38)

Silt



<http://info1.ma.slu.se/IM/program/SC.html>

Podsol

The teacher has prepared notes with different soil names (see textbox). A small group of pupils should gather in a circle and the teacher lets them sort the soil words in different piles. Examples of piles could be carbon – not carbon or organic – inorganic. Afterwards they discuss what the pupils think the soil words define.

The teacher tells about rock and soil types respectively and shows on a soil types map how it looks on the place they are standing. The pupils should choose three different soil types on the map and walk to these places to dig some shovelfuls of soil. Each lump of soil should be put on a plastic plate and compared to the other types.

### Soil types

**Brown earths** are mostly located on the southern plains of Sweden and there it often grows deciduous trees. For brown earth to develop, a high pH is required, fine-grained soil type and rather warm climate. Brown earth is more fertile than podsol, which is located in areas with coniferous trees. The brown earth is today used within the agriculture. It is characterised by litter which decomposes fast into leaf mold due to saprophytes, such as earthworms and bacteria. It has no distinct layers in the earth profile.

**Podsol** is a common soil classification type that covers about 50% of the land in Sweden. It has a distinct earth profile, of which the top is a centimetre-thick layer of *plant litter* (not yet decomposed plant parts, recognisable) and a layer of *morhumus* (decomposed plant parts, unrecognisable). Beneath is a whitish and leached layer of 1 dm (*E-horizon*). The water that has seeped down through the humuslayer will become acid due to low pH from e.g. needles of pinetree or spruces. In the E-horizon the acid water has drained the soil of the base substances such as iron, calcium and aluminium. On the way down through the soil, the water is neutralised and the substances which earlier were dissolved will now be emitted, especially iron, which results in a layer of rust soil. Beneath is unaffected mineral soil.

### The different layers of the soil type

- Plant litter
- Humus
- Leaf mould
- Mor humus
- Peat
- Topsoil is the layer of soil on the surface, rich of leaf mould, and is the part of arable land with the nutrition in the ground, down to the plough pan (a packed zone beneath the depth of ploughing). Beneath comes the subsoil.
- Leached soil (Eluviation layer)
- Ironrich soil/rust soil (B Horizon)
- Mineral soil
- Subsoil

### Soil words

Classifications according to the particle size/fractions:

**Soil type**, a term used when describing the soil content of fractioned rocks, such as moraine, clay, organic peat and mud or chemical deposit such as limestone mud.

**Concrete** – mixture of sand, cement, water gravel

**Rocks** – bigger than 200 mm

**Diamond** – pure carbon, which has been exposed to high pressure and temperature

**Gravel** – mineral soil, particles smaller than 20 mm, bigger than 2mm

**Mud** – not clay, contains dead plants and animals, which have been sedimented on sea bottoms, decomposition occurs in oxygen-poor environment

**Ice river sand** – wellsorted soil type with rounded, polished particles

**Quicksand** – is produced when silt becomes wet and soggy, heavy items can sink into the semi-floating mass

**Mud** – mineral soil, particles smaller than 0,002 mm

**Mineral soil** – soil beneath the mor/humus layer that only contains mineral particles, such as sand

**Fine silt** (Swedish old term: Mjåla)– mineral soil, particles smaller than 0,02 mm, bigger than 0,002 mm

**Fine sand** – mineral soil, particles smaller than 0,2 mm, bigger than.....

**Moraine** – a soil type formed by a glacier or ice sheet, through an unsorted deposit of rock material directly from a glacier ice

**Mor** – a definition of humus

**Sand** – fine particles (0,06-2 mm) of stonelike material, usually comprising mostly of silicon dioxide and silicates

**Silt** – fine particles of size 0,002 - 0,06 mm. Older terms for silt is “mjåla” (here: fines silt) and “finmo” (here: fine sand)

**Stone** – piece of rock type, particle size of 60–200 mm

**Peat** – plant parts in mosses and bogs, which are decomposed only partly due to lack of oxygen

## Exercise 8: Rotary Cultivator (Grades 1-6)

The purpose is to experience the biodegradation process with earthworms



[www.bioresurs.uu.se/myller/skog/mask.htm](http://www.bioresurs.uu.se/myller/skog/mask.htm)

The teacher tells about biodegradation and which function the earthworms have. The teacher has prepared by taken out high plastic pots, soil, sand, spades and dark pieces of cloth. The pupils should be grouped and each group should start to search for earthworms, as well as plant materials, which have been decomposed partly, i.e. plant litter.

The groups should start their experiment by filling the high plastic pot with soil in the bottom and then sand about 1 cm. Soil, sand and soil should be alternated. The earthworms, the plant material and maybe some potato-peel should be put on top. Add some spoons of water if it is not wet. The pot should now display at least two light layers of sand. Cover the pot with a dark piece of cloth. Each group should write their hypothesis of what they think will happen and how long time it will take. After three to four days they should observe what has happened. Study the worms before they are put into the pot. Use magnifiers and the questions below for help.



**Questions about worms****Attention-questions Uppmärksamhetsfrågor**

- How can the worm move forward?
- How can you differ between the behind and front of the worm?  
Can it move backwards?

**Count and measure-questions**

- Do all worms have the same number of segments?
- How long and how short can your worm become?
- How fast does it move?

**Comparison-questions**

- Does the worm look the same on the upperside as the underbody?
- Which are the differences between different types of worm?
- Are different colours relevant to the size?

**Research-questions**

- Which kind of food waste does the worm prefer?
- What does the worm eat – bananaskin, potatoes, paper...?
- How much soil is produced by the food left-overs. Estimate.

**Discussion-questions**

- Why does the worm like old coffee filters, do you think?
- How old do you think a worm can be?
- What do you think happens if ...

## Seed Dispersal

### Exercise 1: The Common Blackbird, the Codling Moth Larva, the Apple (Grades 1-6)

The purpose is to understand the term food chain



[www.artportalen.se/bugs](http://www.artportalen.se/bugs)  
Green Budworm Moth



[www.artportalen.se/bugs](http://www.artportalen.se/bugs)  
Cherry-bark Moth



[www.konsumenter.se/blogg/?p=1311](http://www.konsumenter.se/blogg/?p=1311)



[www.artportalen.se/birds](http://www.artportalen.se/birds)



[www.jaha.se/index.cgi?visa=trad&sida=1](http://www.jaha.se/index.cgi?visa=trad&sida=1)

A big card or photo of a common blackbird is shown by the teacher. A discussion starts. What does the common blackbird eat? How does the bird find food? The teacher shows a picture of a codling moth larva and a picture of the grown-up codling moth. Afterwards the pupils can play.

The game is: Who is afraid of the bogey man? But it has been replaced by “Who is afraid of the Common Blackbird?” All the pupils should stand on one side of the field. They are codling moth larvae. The teacher starts by being the blackbird and stands in the middle and shouts: “Who is afraid of the blackbird?” The pupils answer: “Not me.” The teacher replies: “Come on then!” The pupils try to run across the field without being caught and eaten by the blackbird, i.e. not being tagged. The blackbird should try to catch, by tagging, as many larvae as possible. Those who have been tagged/eaten up should stand in the middle of the field together with the blackbird. The teacher says something like: The blackbird has eaten so many larvae that it managed to breed and get babies. That is why there are so many blackbirds now.

### The Codling Moth

- a greyish-brown coloured moth
- severe pests
- pesticides – usually a synthesis of phosphor, but recently the confusion method has been tested, which means that the males are trapped by synthetic pheromone – a scented female – which causes mating disruption, i.e. the real females will not have the opportunity to mate

### The Common Blackbird

- common, same family as the Fieldfare, Redwing, Mistle Thrush and the Ring Ouzel in Sweden
- used to be a shy forest bird, but during the 20th century also common in cities
- partly migratory bird to the Western and Southern Europe
- the nest is located in dark dense leafage among branches or on the ground
- the eggs are faded green with brown spots, usually 4-5 eggs
- omnivore, mainly insects and worms but also fruits, berries and seeds

## Exercise 2: The Apple Symbolising the Earth (Grades 4-6)

The purpose is to see the apple as a symbol for knowledge, sustainable development, our planet or our religion



[www.konsumenter.se/blogg/?p=1311](http://www.konsumenter.se/blogg/?p=1311)

The apple can be the opening to the work about sustainable development. The teacher brings about ten apples. The apples may be of different kinds and/or different colours. The teacher introduces about knowledge and which symbols illustrate wisdom. Another way is to present the meaning of the term sustainable development and what it means in reality.

The pupils are grouped using apple cards. Each group gets an apple and during ten minutes they should build a still life using the fruit and other nature material. When the still life is ready, a title of three to six words should be added. The groups should demonstrate by everyone moving around as at an exhibition of new creative art.

## Exercise 3: Winter Seedheads (Grades 1-9)

The purpose is to discover the flowers and their seed dispersal during wintertime



[www.odla.nu/artiklar/november-2009.shtml](http://www.odla.nu/artiklar/november-2009.shtml)



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The pupils should work in pairs and the assignment is to find as many winter seedheads as possible during the late autumn or during winter.

Examples of activities the pupils can do. The list can be copied and handed out.

1. Sort the plants so that all the winter seedheads are put in the right piles.
2. Try to determine some of the species.
3. Shake out seeds from the winter seedheads and plant them in a pot, one for each species. Watch if they grow during the winter. If 100 seeds are put in a sowing box, then the growth can be calculated in percent.
4. Tie the winter seedheads together to a bouquet. It is recommended also to use dry flowering perennials that make the bouquet more colourful.

### Winter seedheads

- Dry seedheads from one year old plants that protrude above the snow are named winter seedheads
- Common winter seedheads are meadowsweet, yarrow, red campion and tansy.
- Advantages of spreading seeds during winter are that more animals and birds eat seeds during winter and that the snowpack makes it easier.
- Different types of seeds of the winter seedheads
  - Small and round seeds – the wind shakes the seedheads so that the seeds fall out

## Exercise 4: How do Seeds Disperse? (Grades 4-9)

The purpose is to discover the plants' strategies of spreading their seeds



[www.luontoportti.com/suomi/sv/kukkakasvit/liten-kardborre](http://www.luontoportti.com/suomi/sv/kukkakasvit/liten-kardborre)  
**Small burdock**



<http://dahlarna.blogg.se/2009/june/>  
**Dandelion**

The teacher introduces the plants' strategies and where the pupils can find seeds. Make groupings. They should try to find as many seeds as possible.

Each group should draw a square grid where the different squares represent seed dispersal, such as wind, water, animal and humans. By using magnifiers and binocular magnifiers (i.e. extra big magnifiers) the group should sort their seeds according to what they think is the right strategy. Then each pupil should make drawings of enlarged seeds as careful as they can.

See attachment: Extra\_2005\_Juli sprids växter

### The plants' strategies of seed dispersal

Wind	Water	Animal People
Self-dispersal		

### The strategies of seed dispersal

#### Through the wind

- The dandelion seed with its umbrella can ascend and fly away
- The poppy has a seedpod that shakes out the seeds into the wind like a rattle
- The linden seed swivels like a helicopter
- The wings of the birch seeds are blown away

#### By animals and humans

- Fruits such as cherries with sweet, nutritive fruit pulp will be eaten and the kernel/seed is thrown away or spread further via faeces
- Thistles and carnation roots have hooks and barbs, which get stuck onto fur/hair and clothes

#### By water

- The seeds of the alder tree have air bubbles that can float in water streams and rainwater

#### Self-dispersal

- The plants of the pea family, such as sweet peas, meadocks and crane's-bills, eject their seeds via the pea pod/fruit tissue and burst open.

## Examples of Lessons

In all the lesson examples the pupils can be grouped using the plant cards, butterfly cards, beans, etc. The introduction contains a section about grouping and its methodology.

### Grades 1-3

(2 occasions of 180 minutes each)

Half a day about the plants' lifecycle, with outdoor exercises may provide young pupils an opportunity to widen their understanding of the different seasons of the year. The age of the pupils determine whether all the exercises can be performed during half a day. Otherwise it is possible to use the lesson suggestion during two occasions during the spring and two during the autumn respectively. Breaks can be taken when suitable.

#### Occasion 1: The Spring

The pupils should gather in a circle to do an exercise with the senses, about the plant division: Gymnosperm and angiosperm (Seeds, exercise 2). Continue the lesson by both watching the diversity of the seeds and putting them in pots and bottles (**Seeds, exercise 3**). If sowing is done early in spring, there may be quite a number of plants for sale at the end of the spring term. Sunflower drama (**Seeds, exercise 1**) is suitable if it is warm outside so that the pupils can lie down on a lawn. That exercise requires concentration, so in case there are many other excitements in the surroundings, rather continue the lesson with the plant exercises.

Make grouping with the use of plant cards. The groups should pick plants with the help of pictures and sort them so that they will discover the diversity in the area (**Plants, exercise 3**). It is suitable to play a game after the plant collection. "Change trees" or "tree tag" is done like this:

*The pupils get their own tree, which they mark with e.g. a scarf. One of the pupils or the teacher does not get a tree but should be the "barker" (shouting person), i.e. shouting "Change tree" and then all the pupils should run to another tree while the barker tries to tag a tree. The person who loses the tree will then become the new barker.*

Let the pupils continue their work in groups after the game. Following bumblebees or butterflies when they seek food is usually quite exciting (**Pollination, exercises 3 or 2**).

#### Occasion 2: The Autumn

The teacher starts by giving feedback about the spring activities. If cultivation was performed during half a year, then the transfer to the autumn exercises will become natural. Groupings should be made with the use of the butterfly cards. The exercise "Who decompose the plants" is always easy to do. Usually the pupils are fascinated by the small animals in the soil (**Soil, exercise 4**). The investigation of compost soil can be ended by the game: The Millipede (**Soil, exercise 1**). Finish the theme by letting the groups preparing an exercise that requires them to return to the place some occasions during the coming year. The groups should arrange a wooden board and reflect on what decomposes fastest and slowest (**Soil, exercise 3**). End the whole theme with a discussion about the lifecycle of the plants or the year of the plants.



## Grades 4-6

(4 occasions of 80 minutes each)

To follow the year/the seasons, occasion 1 and 2 can be performed during the spring and occasion 3 and 4 during the autumn.

### Occasion 1: The Spring

The pupils should gather in a circle to do an exercise with the senses, about the plant division: Gymnosperm and angiosperm (**Seeds, exercise 2**). Make groupings using seeds. Let the groups then continue by studying seeds (**Seeds, exercise 3**), by choosing some examples, e.g. making a list of seed characters, sorting them and writing questions. Start the experiment with: Where do seeds grow? (**Seeds, exercise 5**); this will take a couple of weeks to do and will be suitable in connection to occasion 2. A seed poem makes up a nice ending of the lesson (**Seeds, exercise 9**).

### Occasion 2: The Spring

This occasion is suitable during the end of May or beginning of June since there is a larger diversity of plants at that time. Use plant cards to group the pupils. Chasing plants (**Plants, exercise 4**) provides the pupils the opportunity to discover the biodiversity in a pasture or meadow. At the same time it is the competition that is the excitement, which makes everyone getting engaged. After chasing the plants it will be easy to continue with plant sorting (**Plants, exercise 3**), since the place has already been researched. It will be easy to sort the plants, since the pupils already discovered the plants in the previous exercise when they used the plant cards and flowers. Moving on to play with the flowers (**Plants, exercise 2**) will be a nice ending of the lesson about plants in the open landscape.

Let the pupils do the pollination exercise with butterflies or bumblebees when they are seeking food, to give the pupils an understanding of the plants' reproduction (**Pollination, exercise 3 or 2**). Finally discuss about parts of the plants' lifecycle, from pollination and fertilisation to seed and plant.

### Occasion 3: The Autumn

It is recommended to let the outdoor room be located at an edge of mixed forest of different stages. Required is both brushwood and old forest with tree stumps and fallen trees. The teacher starts the day using tree cards to give the pupils an opportunity to see the variation of Swedish deciduous trees (**Trees, exercise 1**). Group the pupils using the tree cards. Leaf shapes (**Trees, exercise 2**) of different deciduous trees is an activity that suits to do in connection to the brushwood forest, especially if the leaves have not yet fallen to the ground.

To search for the forest oldies, such as fallen trees, tree stumps and dry pines or spruces (**Trees, exercise 3**) is usually welcomed. Before the exercise, it is good to tell the pupils how interviews can be performed.

If there is still time, the lesson outdoors may end by walking a tree path with different poems by Swedish poets. The pupils should guess the names of the trees (**Trees, exercise 4**).

### **Occasion 4: The Autumn**

Soil and biodegradation are central during this occasion. The teacher gathers the pupils in a circle and lets them reflect on the differences between different “materials” **(Soil, exercise 7)**. Thoughts around organic and inorganic matter will come up, and after the biodegradation processes it will be easy to continue to the next exercise about the decomposers. Group the pupils using the butterfly cards before the activity with decomposers is started **(Soil, exercise 4)**. The diversity of insects is usually overwhelming and the lust for discovery is often big. It is good to know that the exercise sometimes takes longer time than planned. The decomposition of different leaves is a further development of the decomposers and the Leaf Board experiment **(Soil, exercise 6)** visualises the biodegradation process.

The strategies of the plants and trees before the winter allow the seed dispersal to complete the year or lifecycle of the plants. The exercise “How do seeds disperse?” **(Seed dispersal, exercise 4)** will once more initiate the pupils to reflect. The teacher rounds up with a discussion about the importance of ones own reflections.

## **Grades 6-9**

**(4 occasions of 60 minutes each)**

To be able to follow the lifecycle of the plants, four occasions have been included, which can be done in connection to the school. During spring, occasion 1 and 2 can change places if the teacher wishes to focus on buds.

### **Occasion 1: The Spring**

The pupils gather in a circle to do an exercise with the senses, about the plant division: Gymnosperm and angiosperm/seed plants and spore plants respectively **(Seeds, exercise 2, variant)**. Make groupings using plant cards. Either chase for plants **(Plants, exercise 4)**, which requires that the teacher has visited the place before or a plant inventory **(Plants, exercise 5)**. The plant inventory may be complemented with chasing for grasses, sedges and rush plants **(Plants, exercise 8)**. Also the pollination exercise **(Pollination, exercise 3)** to observe butterflies, may be a supplement to the plant inventory or plant hunt.

### **Occasion 2: The Spring**

Trees may be part of a theme about the plants’ lifecycle, but also as part of the subject Social Studies focusing on the forest industry and its export. Group the pupils using the tree cards. If in the beginning of the spring, the groups can work with buds and their determination **(Trees, exercise 5)**. Afterwards they start the observation schedule of the trees of spring **(Trees, exercise 6)**. If occasion 2 takes place late in the spring, the pupils can work with the colours of the nature **(Plants, exercise 9)**, which is connected to the subject Chemistry.

### **Occasion 3: The Autumn**

To achieve understanding of the biodegradation process and the nutrition supply, the education should focus on the soil theme during this occasion. The teacher starts with soil

words (**Soil, exercise 8**). Group the pupils using butterfly cards. If there is time, cards of insects can be made for the purpose of groupings. The groups should discover and study the decomposers (**Soil, exercise 4**) and then complement with the worm questions in the “Rotary cultivator” exercise.

#### **Occasion 4: The Autumn**

The way seeds spread (**Seed dispersal, exercise 4**) is a natural completion of the plants’ lifecycle. The teacher continues by letting the pupils reflect on when different crops started being cultivated in Sweden (**Seeds, exercise 8**). Another opportunity is to write seeds poems (**Seeds, exercise 9**). If late in the autumn, they can continue with winter seedheads, the dry seed pods from e.g. yarrows, meadowsweets and burdocks (**Seed dispersal, exercise 3**).

## Chapter 3 Insight and Action

To *experience, discover and understand* is the foundation of learning - illustrated in the previous chapter through the forty different exercises of the plants' lifecycle.

The environmental perspective and learning towards sustainable development require two further steps before achieving insights and actions. The goals of the curriculum emphasise the responsibility-taking by the pupils and the opportunity to their personal standpoints in global environmental issues. To be able to directly influence the environmental issues is a major part of the school's education. Then the local perspective may be easier and more comprehensible.

The subject Biology provides e.g. knowledge about species, life environments, lifecycles, ecosystems and the development of life. The photosynthesis is the primary, which enables life on the earth. Since the plants are producers of both oxygen and green biomass/material, they comprise food for people and animals. Besides, the plants are of great importance as ground cover and water binder.

The importance of biological diversity, a rich plant and animal life are emphasised both in the curriculum and the environment quality goals. The diversity is the foundation of a diverse landscape, which provides nature and culture values and is also a part of sustainable development.

To increase the engagement of sustainable development the learning must be established through insights about the nature resources as limited and that we must change our lifestyle.

All conversations about thoughts and values concerning understanding any theme may open on to insights and pave the way for each pupil's own action. In this folder the conversations and discussions are followed by value exercises and simple activities. Focus is the plants and their significance in different contexts.

Two important issues about the plants that should be discussed continuously are about the food and the farmer's role in the landscape and the ecological footprint respectively. A third discussion visualises the biological diversity and the ecosystem services.

## Discussions about the Food and the Role of the Farmer

The teacher may work with question formulations concerning the landscape, the agriculture, the plants and the food.

- **How did the Former Historical Landscape use to be?**

More than 5000 years ago the people started to cultivate smaller farm plots and to raise domestic cattle. Two hundred years back almost the whole population in Sweden was still occupied with food and food production at their cottages and farms. Neither artificial fertilizer nor mechanical equipment was available, but people were farming in a traditional manual way, where the meadow determined the size of farming land. The size of the meadow provided forage to a certain number of cattle. The amount of cow manure limited the size of land that could be farmed.

The landscape was diverse and miscellaneously characterised by muzzels (noses) and tools.

Read more at:

Environment research <http://miljoforskning.formas.se/sv/Nummer/Juni2009/Innehall/Temaartiklar/Biologisk-mangfald-i-historiska-landskap/>

SLU [www.agrarhistoria.se/](http://www.agrarhistoria.se/)

The Museum of Västerbottens [www.vbm.se/avdelningar/kulturlandskap1/jordbruk.html](http://www.vbm.se/avdelningar/kulturlandskap1/jordbruk.html)

- **What is Organic Farming?**

The organic farming (Organic and Biodynamic products) differs from the traditional farming by not allowing any artificial fertilizer or pesticides. The cultivation is mainly based on what can be produced on the own farm using a recycling way of thinking, which implies a balance between plant cultivation and cattle management. This means that organic farming does not leak nitrogen to the same extent as the traditional, which reduces the risk of eutrophication in the streams of the local environment.

Read more at:

Your garden on the net, questions about organic cultivation

[http://www.odla.nu/artiklar/for\\_fun/faq\\_sw.shtml](http://www.odla.nu/artiklar/for_fun/faq_sw.shtml)

SVT <http://stallom.se/tag/ekologisk-odling/>

Skolverket [www.skolverket.se/sb/d/388/a/16144/func/kursplan/id/3562/titleId/ODL1201%20-%20Ekologisk%20odling](http://www.skolverket.se/sb/d/388/a/16144/func/kursplan/id/3562/titleId/ODL1201%20-%20Ekologisk%20odling)

Wikipedia – terms such as organic products, organic food, biodynamic agriculture, organic – biological farming

## • How is Agriculture Affected by the Food Production?

The use of land has changes during a century of many deviations from the historical and traditional agriculture.

The structural change meant changed crop sequence, artificial fertilization, machinery, the disappearance of meadows and the farming of forage plants.

On the traditional farms, the yield increases due to commercial and artificial fertilizers, which make smaller fields and pasture used for areas of forest production. Grazing for cattle management is then taking place on specific farmed grazing-grounds or the regrowth of the mowing ley.

This has caused environmental problems such as eutrophication, pollution, less biodiversity, increased energy usage and increased water usage. All the environmental problems are connected to the food production, which makes it a global climate issue.

It is possible to turn the question. The foundation to well-tasting food is the farmer's work on the farm.

Read more at:

Environment research: <http://miljoforskning.formas.se/sv/Nummer/Maj-2010/Innehall/Ovriga artiklar/Jordbruk-nyckelomrade-i-EUs-forskningssamarbete/>

Naturskyddsföreningen about agriculture and food:

[www.naturskyddsforeningen.se/natur-och-miljo/jordbruk-och-mat/](http://www.naturskyddsforeningen.se/natur-och-miljo/jordbruk-och-mat/)

Hälsofrämjandet about climate smart food

[www.halsoframjandet.se/?b=1&id=11&a=klimate-smart](http://www.halsoframjandet.se/?b=1&id=11&a=klimate-smart)

Lantmännen [www.lantmannen.se/Bra-mat/](http://www.lantmannen.se/Bra-mat/)

### Activities

In addition to discussions there are role plays and valuation exercises that develop the pupils' learning and ability to argue and achieve standpoints in environmental issues/sustainability issues. To make the pupils aware of the food's importance is to provide insights that may change food habits and purchase.

The Sustainable Food material by WWF provides recommendations of food habits and which effects they have.

### Recommendation

1. Eat more vegetables and less meat!
  
2. Eat food depending on the season and cultivated on open land and transported short distance!

### Effects

Reduces the energy usage.  
 Reduces the amount of climate affecting gases.  
 Reduces emissions due to eutrophication

Reduces transports and energy usage  
 Reduced climate effect.  
 Reduces the acidifying emissions.



Investigate where the food has been produced!

- |   |   |
|---|---|
| 3. Eat more organic farmed food!  | No use of artificial fertilizer reduces e.g. the energy usage and the inflow of cadmium to the soil.<br>No usage of chemical pesticides reduces the pollution in the environment.<br>Greater animal care. |
| 4. Eat energy-saving cooked food!   | Less energy usage and thus less climate effect and acidification.   |
| 5. Reduce the wastage, use everything possible of the raw material, make use of food waste instead of disposing it! | Less energy usage and less resource waste in all steps  |

To use evaluation exercises together with the pupils, make them training into making judgements, stand for their opinions and to discuss and concentrate about interest inspiring themes. It is important with conversation rules in connection to the evaluation exercises (see the attachment Evaluation textbook). The teacher should be the discussion moderator.

In the Line and Hot Chair exercises the teacher can use statements from the text above.

*I eat energy-saving cooked food*  
*Eat organic farmed food*  
*Always check where the food is produced*  
*I eat more vegetables than meat*

or try your own

*I love meat*  
*If everybody becomes vegetarians, then the world will be saved*

#### Evaluation exercise

- **Line**  
An exercise where the participants take standpoints between two extremes, i.e. a statement that can be answered yes/no or nuances in between.
- **The hot chair**  
The pupils sit on chairs in a circle (also possible to stand in a circle outdoors on an empty space). They should judge a statement. If they agree, they should stand up and change chair. If they disagree to the statement, they should continue sitting or if they need longer time for consideration. The pupils remaining will have the opportunity to change chair during the discussion. Let the pupils motivate/tell why they have changed chair or why they are still sitting. The teacher decides who will speak.

#### Four corners

A problem with four alternatives is presented. Each solution equals to a corner of the room. The participants choose a solution and stand in the corner representing the solution. The discussion includes all the corners' opinions.

#### Four corners-exercise

*Who is responsible for organic farming to conquer traditional farming?*  
*Who is responsible for organic farming to increase in Sweden?*  
*(the politicians, the farmers, the consumers, the EU-officials)*  
*Who is responsible for the food wastage in Sweden? (the restaurant owners, the families, the politicians, the shops)*

## Discussions about the Ecological Footprint

- **What are Ecological Footprints?**

The footprint is a statistical measurement of production and consumption.

*An ecological footprint is a way to measure the use of resources and waste production per individual or nation. The footprints are measured in hectares (ha) of biological productive areas (land and sea) per individual and per year ([www.mfot.be](http://www.mfot.be)).*

In reality the footprint is a result of people's consumption. The influence on the environment when food, things, housing, public buildings, infrastructure, transports, etc., are produced affect the forests, the oceans, waterstreams, land, air and the biodiversity (plants and animals). Studies of ecological footprints give a picture of the exploitation of nature resources, which makes it easier to understand and change the consumption patterns.

Read more at:

WWF [www.wwf.se/v/ekologiska-fotavtryck/1127697-ekologiska-fotavtryck-startsida](http://www.wwf.se/v/ekologiska-fotavtryck/1127697-ekologiska-fotavtryck-startsida)  
[www.wwf.se/utbildning/skolan/elevrum/testa-din-skola/1180390-ny-smart-kalkylator-hjalper-ungdomar-och-skolor-att-mata-sina-ekologiska-fotavtryck](http://www.wwf.se/utbildning/skolan/elevrum/testa-din-skola/1180390-ny-smart-kalkylator-hjalper-ungdomar-och-skolor-att-mata-sina-ekologiska-fotavtryck)

UN – Association [www.globalis.se/Statistik/Ekologiskt-fotavtryck#bars](http://www.globalis.se/Statistik/Ekologiskt-fotavtryck#bars)

Climate smart: <http://klimatsmart.se/?page=videos&id=43>

Environment collective FOOT <http://www.mfot.be/fotavtryck.html>

- **How is the Ecological Footprint Affected by Food?**

The food affects the ecological footprint in several ways, such as

- the Swedes' food consumption amounts to a third of the Swedish households' energy usage.
- long transports from the production area to the consumption area, mainly import from countries far away.
- natural substances disappear while others are added during refinement of raw materials.
- intensive fishing and intensive farming impoverish waters and soils respectively, e.g. resulting in damages to animals, water pollution, soil erosion, eutrophication, etc.
- when the Swedes eat imported food footprints will be made on other continents, such as pesticides, water usage, etc.

Common for all the reasons is the increase of emissions of carbon dioxide, which hastens the climate changes. Therefore the concept "Climate smart food" has been invented.

Read more at:

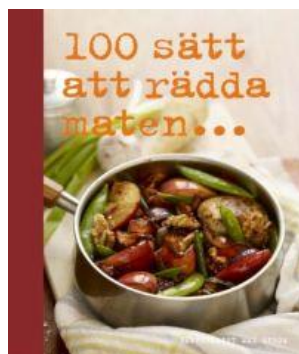
Swedish Consumer Agency [www.konsumentverket.se/miljo/Mat-och-miljo/Klimatsmart-mat/](http://www.konsumentverket.se/miljo/Mat-och-miljo/Klimatsmart-mat/)

The Lantmännen Group [www.lrf.se/Mat/Fordelar-med-svensk-mat/Klimatsmart-mat/](http://www.lrf.se/Mat/Fordelar-med-svensk-mat/Klimatsmart-mat/)

Klimatpiloterna (the Climate Pilots) [www.klimatpiloterna.se/utmaning/utmaning1.htm](http://www.klimatpiloterna.se/utmaning/utmaning1.htm)



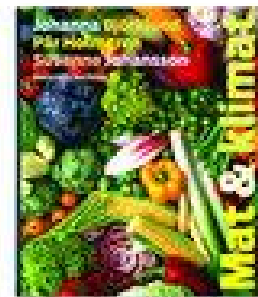
Forskningsrådet  
Formas



Om att sluta slänga mat



Mat och politik



Om våra val av mat

- **How is the Ecological Footprint Connected to Biodiversity?**

The ecological footprint is about our usage as consumption of what the earth manages to produce. The usage of nature resources effects the environment and all the living with consequences to the biodiversity. Its effects are mostly visible in the cutting off the most species-rich environment on earth, i.e. the tropical rainforest, to give space to cultivations and palm-oil plantations. In Sweden it is obvious because the biodiversity of the farming landscape is disappearing, because of many reasons, such as other land usages than agriculture that can be infrastructure or housing and industry areas. Another reason is the disappearing of pastures and meadows for the benefit of forest production.

The Ecosensus newsletter from Albaeco writes the following

*The foot prints do not say anything about how much biodiversity the mankind would need or how the ecosystems are affected by fragmentation. Nevertheless, the ecological footprint is a pedagogical tool for showing our dependency of the nature, but it is important also to know its limits ([www.albaeco.com/ecosensus/ecosensus1-02.pdf](http://www.albaeco.com/ecosensus/ecosensus1-02.pdf))*

Read more at:

WWF [www.wwf.se/.../ekologiska-fotavtryck/1127697-ekologiska-fotavtryck-startsida](http://www.wwf.se/.../ekologiska-fotavtryck/1127697-ekologiska-fotavtryck-startsida)

The Swedish Environmental Protection Agency [www.naturvardsverket.se/sv/Arbete-med-naturvard/Detta-ar-naturvard/Biologisk-mangfald/](http://www.naturvardsverket.se/sv/Arbete-med-naturvard/Detta-ar-naturvard/Biologisk-mangfald/)

### Activities

World Wildlife Foundation has a poster, which can be downloaded from their website. After plant exercises and discussions, the teacher has the opportunity to let the pupils calculate plant production, harvests and food consumption respectively and compare with the earth's own productivity. A poster focusing on plants and food can be produced.



Evaluation exercises can be performed with statements such as

*The ecological footprint shows what the world looks like  
Sweden can reduce its footprint by 50 %*

Download the ecological footprint publication

WWF [www.wwf.se/v/ekologiska-fotavtryck/1128707-ekologiska-fotavtryck-tidningen](http://www.wwf.se/v/ekologiska-fotavtryck/1128707-ekologiska-fotavtryck-tidningen)

## Discussions about Biodiversity and the Ecosystem Services

- **What is Biodiversity?**

The sixteenth environmental quality objective is about a rich plant and animal life, a biodiversity. It is a measurement on how many living organisms exist in ecological complex. It comprises diversity within species/a genetic variation, species and the interaction between species and of ecosystems and nature types.

There are four motives to the need of biodiversity, i.e. Support and welfare in the form of biological resources, Ecosystem services (mentioned under the title "What is ecosystem services?"), Aesthetical values, Ethical and existential values as a result of billions of years of evolution.

A SpeciesDatabase in Uppsala supervises and summarises the species in Sweden and specifies which ones are endangered (redlisted).

The loss of biodiversity increases rapidly around the whole world.

**2010 IS THE INTERNATIONAL YEAR OF BIODIVERSITY**



Read more at:

The Center of Biodiversity, CMB [www.cbm.slu.se/index.php](http://www.cbm.slu.se/index.php)

Swedish Environmental Protection Agency [www.naturvardsverket.se/sv/Arbete-med-naturvard/Detta-ar-naturvard/Biologisk-mangfald/](http://www.naturvardsverket.se/sv/Arbete-med-naturvard/Detta-ar-naturvard/Biologisk-mangfald/)

Miljöportalen (the Environmental Portal), the University of Gothenburg  
[www.miljoportalen.se/vaexter-djur/biologisk-mangfald/vad-aer-biologisk-mangfald](http://www.miljoportalen.se/vaexter-djur/biologisk-mangfald/vad-aer-biologisk-mangfald)

- **How is the Diversity of the Plants Affected by the Food Production?**

The area of open landscapes is decreasing, the species structure is changing and the Swedish countryside is no longer as it was during the turn of the century.

The agriculture landscape's diversity of flora and fauna is drastically reducing. Many species are endangered (redlisted), such as amphibians, reptiles, pasture plants, bats and the birds on the farming lands. The threats and the reduction are connected to biotopes disappearing due to overgrowth, forest plantations, other types of soil cultivation, less grazing and crop dusting. In a diverse landscape with many small biotopes, the possibility to keep the diversity of species is bigger.

Read more at:

SLU – about wild bees [www.fou.sjv.se/fou/download.lasso?id=Fil-001214](http://www.fou.sjv.se/fou/download.lasso?id=Fil-001214)

- **What are Ecosystem Services?**

Ecosystem services are the benefits that different species, life environments and lifecycles generate to the ecosystems. The benefit may have regulating, supporting, provisioning or cultural functions. Examples are: preventing soil erosion, regulating the composition of the air/atmosphere, recreation, energy transformation, nature resources as raw materials for food, medicine, clothes, housing, fuel, aesthetical experiences, etc.

Some of these functions or services can be replaced by technical solutions. Others can be manual solutions, such as the manual pollination of the fruit cultivations in China.

Read more at:

Albaeco [www.albaeco.se/sv/index.php?option=com\\_content&task=view&id=14](http://www.albaeco.se/sv/index.php?option=com_content&task=view&id=14)

Swedbio [www.swedbio.com/dokument/faktablad%20klimat%20och%20ekosystemtjanster.pdf](http://www.swedbio.com/dokument/faktablad%20klimat%20och%20ekosystemtjanster.pdf)

Sveaskog [www.sveaskog.se/Skogsbruk-och-miljo/Klimat/Ekosystemtjanster/](http://www.sveaskog.se/Skogsbruk-och-miljo/Klimat/Ekosystemtjanster/)

- **Which Ecosystem Services are Directly Involved in the Food Production?**

The benefit of a sustainable agriculture is that the ecosystem services and biodiversity will not get worse or disappear.

Some ecosystem services influence directly the farming and the production of crops, which affects the local economy as well. An example is that pollination of bees and bumblebees in fruit cultivations have ceased. In the USA, many places hire bees for the assignment, of considerable sums to the fruit companies in the regions.

Read more at:

Albaeco [www.albaeco.se/sv/index.php?option=com\\_content&task=view&id=40](http://www.albaeco.se/sv/index.php?option=com_content&task=view&id=40)

Eco 8 <http://eco8.se/for-lararen/lararhandledning>

The Albaeco Article about ecosystem services and companies: <http://www.albaeco.com/htm/pdf/MA-analysen.pdf>

### Activities

Evaluation exercises can be done using statements, such as

*The ecosystem services costs money*

*The ecosystem service water purification can be replaced by technology*

The Four Corners

Who is ultimately responsible for not letting the ecosystem services disappear? (the politicians, the environmental organisations, the entrepreneurs, the citizens)

Eco 8 has published working material (teacher's tutorial and pupil's folder) about ecosystem services <http://eco8.se/for-lararen/lararhandledning>

## Final Words

To meet the environment challenges of the future, several approaches are required. During 2009 the government invested in a national strategy of **entrepreneurship** within the education. Entrepreneurship is linked to sustainable development, which means not only creating companies, but also encouraging power of initiative and creativity.





Poster from the publisher "Naturpedagogen"