Nynäshamns Naturskola

Bugs

Outdoor learning and interdisciplinary teaching methods

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Preface

The purpose of this booklet is to demonstrate how outdoor learning can be used to teach biological diversity in an interdisciplinary way, integrating many school subjects. Moving the learning experience outdoors also increases physical activity for pupils. Research has shown that we remember 10% of what we read, 20% of what we hear, 30% of what we see, 50% of what we both hear and see, 70% of what we discuss, 80% of what we experience, and 95% of what we teach to others (William Glasser). Thus, outdoor learning, collaboration in small groups, and using all senses should be an excellent learning method.

Biological diversity is a prerequisite for life on earth. Ecosystems with few species are always more vulnerable than ecosystems rich in variety. In ecosystems with great diversity there is always a species ready to take over a position or an ecological function that becomes available due to, for instance, a climate change. For future success in our endeavours to preserve biological diversity, we first need a broad awareness of the issue. In this booklet we present a smorgasbord of projects and activities to stimulate learning about biological diversity.

Bugs

Bugs is not a scientific term, and perhaps a teacher does not need to be scientific in order to get his or her pupils interested in the wide range of life forms that hide deep in the forest. However, a base of scientific knowledge might provide the teacher with a sense of security and the inspiration needed to successfully drive an educational idea. For some pupils, a bug can be anything that is small, does not walk on its hind legs, and does not look like a dog or a moose. However, for the teacher, bugs are insects, spiders, crustaceans, molluscs, amphibians, reptiles, and a few other kinds of animals.

Knowing more that the pupils is a mixed blessing and the teacher must exercise this advantage with care. Trying to make pupils learn the names of as many species as possible by heart usually leaves the pupils with a very shallow understanding of biology. Of course, some pupils will ***want*** to know the name of everything they come across and in this case it is good to provide them with as much information as possible.

Sometimes, when you answer all a pupil's questions on a bug he or she has found, it appears that the pupil loses interest and runs of to find a new bug to ask questions about. Although this does not facilitate the creation of any deeper knowledge, it might be a good way of learning for children who are very restless. If a pupil needs to move about a lot it might be difficult to sit down and concentrate on studying a single bug for a longer period of time.

Sometimes, it is advisable to avoid answering a question by asking a question back; How many legs does it have? Where did you find it? What does it look like underneath? In this way, a teacher can guide a pupil to more information. Using the basic facts learnt by answering questions such as the above, the pupil can look the bug up in a book and learn more about the animal. Thus, not answering questions can be a way of guiding pupils into the world of books.

In his book Children, Animals and Nature[1] (1999), Bent Licht Madsen argues that the method of asking questions back can leave the pupil feeling let down or exposed in his or her lack of knowledge. Madsen claims that a child that asks questions does so in the hope of getting answers or contact with a grown up—not to be questioned himself. There can also be great differences in *how* you answer a question. A brief answer, e.g. "a shield bug" when asked "what is this?", will result in a different reaction than if you get down on your knees, examine the bug together with the pupil and say "but look! It's a beautiful shield bug with piercing mouthparts to suck sap. Be careful with it, we'll show it to the others later".

For teachers with little knowledge in the area of bugs, let curiosity take the upper hand and observe and discuss what you see with the pupils. A teacher that shows a lot of curiosity and joy of learning can inspire pupils just as much as a teacher with extensive knowledge of the area. However, when the pupils are to be guided into the next phase of learning, where they need to broaden and deepen their knowledge and incorporate it into their understanding of ecological systems, a teacher who knows a lot about the field has a great advantage.

Irrespective of if a teacher has extensive knowledge or not, it is important to set an example by always having at least one knee on the ground—because that is where you will find both bugs and pupils.

What does the Curriculum for the compulsory school system (Lpo 94) have to say…

On the area of biology…

National goals to be reached by all pupils by the end of grade five:

- Recognise and identify several common plants, animals and other organisms in the local environment and know their habitat requirements.
- Be able to give examples of life cycles for some plants and animals and their respective requirements during different life phases.
- Be able to participate in the ongoing discussion on the preservation of nature types and biological diversity.

Excerpt from the Swedish Environmental Objectives

The 16:th objective: "*A Rich Diversity of Plant and Animal Life*"

Definition of the generational perspective according to government bill 2004/05:150:

- government and citizens alike are widely knowledgeable about and aware of the importance of biological diversity.
- traditional and local knowledge about biological diversity and its benefits is safeguarded and used appropriately.

[1] Title translated, the book might not be available in English.

Preparations

Before and After Drawings

A good way to start, before any field trips and before any literature has been read, is to let the pupils draw bugs. You can either specify which bugs are to be drawn or simply let the pupils draw any bugs they like. After working a few weeks with the bugs theme, let the pupils draw the bugs once again.

This exercise serves two purposes. Firstly, it lets pupils process what they have learnt; did the bug have both wings and antennas and how many legs did it have? Secondly, the before and after pictures provide a visible manifestation of what the pupils have learnt. Let each pupil reflect on his or her pictures; what differences are there and what has been learnt about the bug? What does the bug eat and where does it live? The pupils' drawings can also be used to put together a before and after exhibition on the bugs theme.

Spotting Bugs on the Schoolyard

Bird watchers often have a list of birds where they tick off one after another in the pursuit of joining the prestigious 300 birds club. How many bugs can the pupils find on the schoolyard? Divide the class into groups and set them off on a bug hunt! Which groups get into the 20 bugs club? This exercise is a good introduction to the biological diversity of the schoolyard. A good discussion point is how you can increase biological diversity, i.e. get more species to settle down on the schoolyard.

Bugs from a Human Perspective

We often talk of bugs as pests in the same way we talk of some plants as weeds. These words indicate that a certain bug or plant is unwanted from our point of view. However, a pest or a weed might be crucial for the survival of other animals. Discuss this with the pupils. What insects or bugs are there which are directly beneficial to us? Are there other values or reasons for letting bugs live apart from identified services they provide us?

Creating groups

Before the field trip, the class should be divided into five groups. Groups should be put together so that pupils who normally do not spend time together are given the possibility to get to know each other. The social rules during the field trip can differ remarkably from a classroom situation. This can provide new openings in a class with hard set social ties.

Equip each pupil with a small container and let them catch a bug each. Let each pupil tell the class what he or she has found. Use the bugs to create groups in some way. An example: if five pupils have found ants, you can appoint them as group leaders and let them select group members according to some rule such as "all groups must have at least three different bugs".

Clothes

It is very important to make sure that the pupils are properly dressed for the field trip. No matter how beautiful the butterfly or how scary the spider, any experience is drab when you are wet and cold. Thus, making sure the pupils are properly clothed is essential to making possible a fun and rewarding day outdoors. Take the opportunity to teach the pupils how to dress in layers well before the day of the field trip. Also make sure that this information reaches the parents. Knowing how to dress warmly also improves the possibility of children playing outdoors during their leisure time.

Discussion Topics: Why is wool a warmer material than cotton? Which function does wool serve for sheep? Why is cotton inferior to synthetic fibres for body clothing on a cold day?

Assembly and Introduction

Use the assembly to give the pupils an idea of what to expect and to build up anticipation for the coming exercises. Begin by going through the programme and other practical details and then move on to setting the mood for the walk. A short story or a poem can be used to spur curiosity for the bugs you might encounter.

The loupe is carried around the neck at all times so that the pupils can quickly examine anything exiting that they find.

Suggested Programme:

08.30 Assembly and introduction

09.00 Walk

09.30 Morning snack

10.00 Collecting bugs

11.15 Assembly

12.15 Looking at bugs using stereo loupes

13.00 Review of discoveries

13.30 Termination and evaluation of day out

The Walk

A short walk around the area is a good way to get the pupils acquainted with the surroundings. The walk also provides the opportunity for pupils to clear their minds and focus on the tasks at hand.

Guiding a group of up to 30 pupils naturally requires an ability to be exiting and draw the pupils' attention. One way of doing this is to bring a suitcase with an assortment of objects connected to the theme of the walk. Puppets in the shape of different bugs, a jar with an old bumblebee nest, and a large insect sucker are good objects to bring.

A spider puppet, a plastic dragonfly, and other exiting objects in a suitcase.

When I do the walk, I often bring a landing net and a white cloth. During the walk I occasionally run the landing net though the vegetation and then empty the contents onto the white cloth. After this, the insect sucker is used to collect any bugs. The filter on the short pipe of the insect sucker prevents you from swallowing bugs. The walk continues and I produce some of the items from the suitcase to stimulate the children in a conversation on which animals we might come across. I'll make a few more short stops and comment on things I come across. Then I round off the walk by sitting down with the class for a morning snack.

Methods for Catching Bugs

After a short snack break, it is time to show the pupils the equipment and methods they will use when collecting bugs. Each group is given a landing net, a sieve, an umbrella, a white cloth, and four containers. Each pupil gets an insect sucker and a loupe. Once out in the forest, the teacher's job is to demonstrate how to catch bugs. Do not be afraid to get your knees or hands dirty.

The Insect Sucker

Use the short pipe to suck on and the long pipe to catch bugs. The filter on the short pipe prevents bugs from ending up in your mouth. Do not attempt to suck worms, snails, or large bugs since they will get stuck in the pipe.

The Landing Net

The landing net is run back and forth (try to use an eight-shaped movement) through grass and lower vegetation. Quickly clasp your hand round the top of the net to prevent the bugs from fleeing. Now empty the contents onto a white cloth and catch any bugs using the insect sucker. Do not use the landing net in water and do not try to dig using the landing net.

The Sieve

First tie a knot round the bottom of the sieve to hold anything that filters through. Then fill the sieve with litter and shake for at least one minute. Litter is the layer of more or less decomposed fallen leaves, needles and other plant residues at the soil surface. Now replace the litter from where it was taken—the bugs need it to keep warm during the winter. Next, hold the sieve over the white cloth and untie the knot. Catch any bugs using the insect sucker.

The Umbrella

Hold the umbrella upside down under a tree. Shake the branches and use the insect sucker to catch any bugs that fall into the umbrella.

The White Cloth

The white cloth is used to see the bugs properly when you have emptied the landing net or sieve. For group work, the white cloth also provides a convenient meeting spot, the group's own place in the forest. The group can keep their containers on the cloth. It is also good to gather the pupils round the white cloth when you want to check up on how a group is progressing.

The Containers

Containers of see-through plastic material are good because pupils often want to study their catch without the bug getting away. If none are available, film canisters are a good and cheap alternative. Each group should have at least four containers. The first container is used for insects, the second for spiders, the third for slimy crawlers, and the forth for other bugs the pupils come across. The reason for separating different kinds of bugs is that spiders constantly spin webs that other insects get stuck in and the toxic slime will kill both insects and spiders. Of course, a secondary objective is that the pupils will learn to tell the difference between insects, spiders, and other bugs.

Tips

There are at least two ways of sorting bugs; you can classify them according to where they live or how they look. Discuss different ways of dividing bugs into groups. Which ways can the pupils come up with? Which system is the best?

The Teacher's Role

Many pupils are not use to spending time outdoors, especially during school hours. Outdoor learning provides the pupils with an opportunity to complete tasks and solve problems in their own way. Many pupils need support in this process and the teacher plays an integral role as a guide and source of inspiration.

The best way of guiding the pupils is to get down on your knees and examine and discover together with the pupils. Wander around among the groups and see what bugs they have found. Remember that a discovery you might find trivial could be a sensation in the eyes of a pupil—be ready to support this enthusiasm! When examining a bug together with a pupil, comment and ask questions on an appropriate level depending on the pupil's knowledge and the bug at hand:

- How many legs does it have?
- What kind of animal is that?
- Later, we will use the stereo loupes to find out how many eyes the spider has.
- Be careful with that bug so that we can show it to the others later.
- Does it have more than eight legs? What kind of animal does that make it?
- How do you know that it's a frog?
- What a strange animal, what can it be?

Sometimes, a straight answer is the best solution when the pupil asks: what is this? Knowing the name of the bug will spur some pupils' curiosity while others will instantly loose interest. If it could prove difficult to determine the species of a bug using available literature, simply telling the pupils what they have found is good option. However, if a pupil finds a bug whose species is easy to determine, tell the pupil that you will need to look it up in a book. A partial purpose of the field trip is to practice determining species using literature.

Of course, if you do not know the name of a certain bug, looking the animal up in a book will be necessary. Do not worry about not knowing the name of every bug the pupils find—there are few things that can make pupils more enthusiastic than finding a bug that the teacher has never seen before. Apart from that, learning about new bugs is exiting for the teacher too, even if some teachers probably wish that they knew the name of every bug there was.

When Pupils Loose Interest—a Short Trouble-Shooting Guide

Every now and again you will come across pupils that quickly grow tired of collecting bugs. The explanation is usually one of the three below:

1. The pupils grow tired because they cannot find any bugs. Usually, this is because they have been looking in the wrong place or in the wrong way. *Solution:* Ask the pupils where they have looked for bugs and then go along with them to see for yourself. A place with no animal life what so ever is an exiting discovery in itself!
2. The pupils think they have grown tired when in fact they are afraid of bugs. *Solution:* Catch some bugs together with the pupils. Get down on your knees and look for bugs under a stone. Use your loupe to examine the bugs and let your own joy of discovery rub off on the pupils. Be sensitive to how the pupils react and lift the next stone together.
3. The pupils grow tired because they do not know what to do. Usually, this is because they were not paying attention during the demonstration. *Solution:* show the pupils what bug catching methods are available or let them learn from friends.

Books carry a certain status and when the pupils see that someone has written a book with wonderful illustrations of the bugs they have been collecting, they understand that it is an important topic. Pupils also find it exciting that someone has written a book about what they themselves have just been doing. Many pupils make thrilling discoveries in these books and find animals they did not know existed, a small insight into the world of biological diversity.

Determination of species using books is also important in higher education; there is simply no way of learning all different species by heart. However, to speed up the search process it helps to know of the all larger groups of animals and which books to look in.

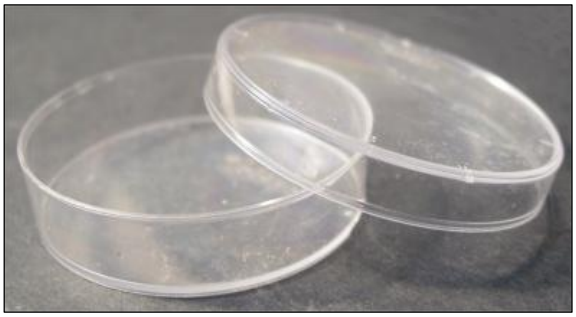
The joy of catching a bug is usually proportional to the bug's size. This ground beetle, one of largest beetles in Sweden, received a lot of attention.

Examining, Writing, Drawing, and Taking Photographs

After lunch it is time to take a closer look at the bugs. Loupes, two-way loupes, and stereo loupes open up new worlds to the pupils. The pupils can take photographs or draw the bugs they examine. The pupils can also write about the discoveries they have made and learn more on various topics using the books available.

The Stereo Loupe

The animals are placed in a petri dish and studied at 20 to 40 times magnification. A new world opens up.



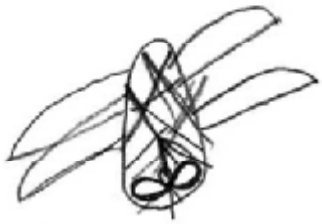
The Two-Way Loupe

The animal is placed in the two-way loupe and can be examined from above or using the side view to see what the bug looks like underneath.

Bug Models

A good way to end the day is with a discussion on the bugs that have been found. Large scale models can be used to ease the discussion. How many legs, eyes, and antennas do the bugs have? What did the pupils discover when looking through the stereo loupes? Are these findings consistent with the models?

Exercises to do after the Field Study



Before and After Drawings

If the pupils have drawn bug pictures before the field trip, it might be interesting to let them draw the same bug again. Compare the before and after pictures. Was it easier or more difficult to draw the bug after the field trip? Are the legs in the same place?

Catch Seven

Send the pupils off to collect seven different bugs, for instance; a spider, an earwig, an isopod, a shield bug, a fly, a millipede, and a springtail. The exercise can be done individually or in groups. Each group or pupil will need seven containers or a box that has seven compartments. The exercise can be turned into a competition or simply done as an exciting bug hunt. You can also vary the game by letting the pupils search on the schoolyard or in the forest. This is a good way to practice identifying bugs you have seen before. The pupils need to know both what the bug looks like and where to look for it, i.e. its preferred habitat. At the same time there is a lot of running, searching, and discussing. Adapt the difficulty of the exercise to the knowledge level of the children.

Bug Reporters

Letting the class put together their own digital magazine is a good way to learn about bugs while simultaneously practising language and word processing skills. The pupils could begin with this project before the field trip by defining what they want to learn about bugs, i.e. what articles are to be written for the magazine. The completed magazine can be distributed to the children's parents to spread knowledge on the plant and animal life of a certain area and show them what the children are learning at school. To save paper, it can be distributed digitally.

Outdoor Presentations

In order to re-establish contact with the natural area visited during the field trip, you can return for oral presentations. This works especially well if the different groups have worked in different biotopes. Then the pupils will learn from each other and develop a clear picture of how animal life differs depending on soil and vegetation. The pine forest will be quite different from the meadow, the deciduous forest, the flat rock forest, or the schoolyard lawn.

Forest Models

Working with three dimensional models is a good way to enhance the pupils' understanding of the shape and size of animals and plants. Choose materials and artistic techniques freely; clay bugs could live in a forest made of recycled paper, toilette rolls, and other cheap material. Each group can model its own biotope.

Terrarium

The pupils could also make use of what they have learnt in creating terrariums. Each group models the biotope where they found their bugs. Letting the pupils describe what would be needed for bugs to survive in their terrarium is a good way of thinking about the prerequisites for life in both time and space. Some bugs could probably survive a long time on a few square centimetres of soil for years if considerably more space. Some animals might have different requirements for survival during different life phases.

More Bug Activities

Outdoor Activities and Games

The Centipede Game

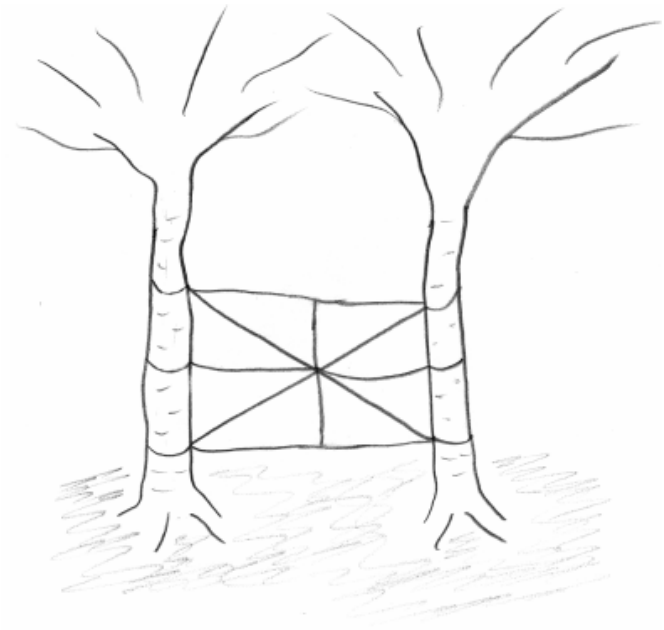
Divide the class into four groups. Each group will pretend to be a centipede and the object of the game is to move as quickly as possible from the starting point to an agreed finishing point. This must be done in following manner: The pupils in each group line up. Each pupil puts his or her hands on the shoulder of the pupil standing in-front of him or her. All pupils except the last pupil in each line close their eyes or are blind-folded. The pupil at the back of the line must now steer the centipede by sending signals forward through the line. A squeeze on the right shoulder means turn right, a squeeze on the left shoulder means turn left. The pupils are not allowed to talk during the exercise. To make the game more complicated you can add additional signals, e.g. for stopping or stepping over large stones. The difficulty level of the game can also be controlled by varying the size of the groups.

Lizard Relay Race

Divide the class into four teams, e.g. forest lizards, sand lizards, monitor lizards, and agamas. Decide on the distance each "lizard" must run before handing over the baton. A "lizard" consists of two pupils, one standing behind the other with his hands on the foremost pupil's shoulders or round his or her waist. The baton, approximately 50 cm long, is squeezed between the pupils' lower legs. To move forward, one pupil will move his left leg while the other moves his right leg and vice versa. This is the way lizards walk and the explanation for their fishlike movement. If the baton is dropped, it is allowed to pick it up and replace it. When a lizard has covered his or her distance, the baton is handed over to the next pair of pupils.

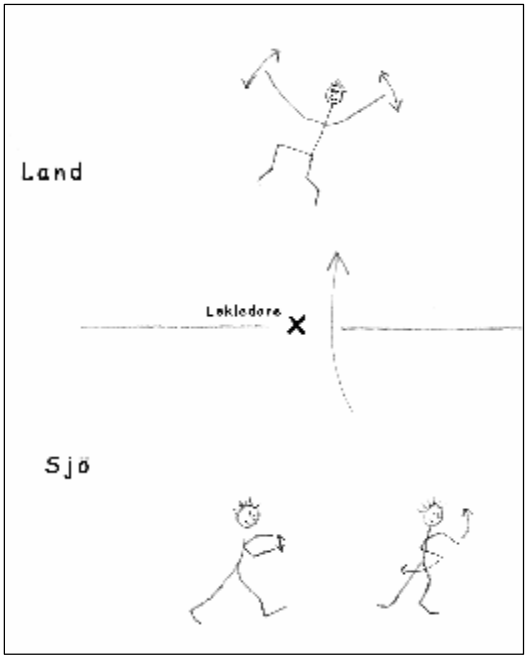
The Spider Web

This is a classic team building exercise. Tie threads between two trees in the shape of a spider web. Each opening in the web must be large enough for a pupil to fit through. The pupils play insects and the objective of the game is to get through the spider web without touching it. The whole group is to pass through the web but an opening can only be used once (mark used openings using clothes pegs). If a pupil touches the web while passing through, he or she is eaten and must start over again. Pupils who have already passed through the web may help other pupils by lifting them, etc.



To make the exercise more difficult you can rig the spider web with bells which jingle on the slightest touch. The exercise becomes even more difficult if the pupil to pass through the web must carry a mug of water that may not be spilled. You can also put points on different openings, depending on the difficulty to pass through, and calculate the team's total points after everyone has passed through the web.

The Dragonfly Game



Divide the playing field into two areas; water and land. Mark the border between water in some way, e.g. using a rope. The class is divided into two groups; baby fish and dragonfly larvae. Each pupil playing a baby fish starts off with a pinecone in each hand while the dragonfly larvae carry nothing. The baby fish move around making swimming movements with their arms while the larvae clap their hands (to show that they have a lower lip that can be shot forward to catch prey).

The larvae must now chase and catch the baby fish. When a baby fish is caught, one of the pupil's pinecones must be handed over. When a larva has acquired two pinecones, it is time to develop to a full grown dragonfly. This is done by moving to the land area of the playing field and showing the pinecones to the teacher when passing the border between water and land.

Fully grown dragonflies move around the land area while flapping their arms to simulate wing movements. This is done until two dragonflies meet and mate by exchanging pinecones with each other. After this, the dragonflies die but the pupils carry on playing by starting over as baby fish in the water area of the playing field.

A baby fish that looses both its pinecones becomes a dragonfly larva and continues playing. The game can be modified by experimenting with different larvae to baby fish ratios or by varying the number of pinecones.

Wanted Alive

Distributing wanted posters or descriptions to the pupils is a good way to make searching for bugs more exiting. A wanted poster could consist of a sketch artist's picture of the bug or a description in the form of a riddle. An example description for a shield bug might read:

"At the time of the crime, the wanted felon was wearing green clothes but has also been observed wearing brown or red striped outfits. The offender has half grown wings and was last seen sitting in a berry bush. This criminal is wanted for smelling very bad in public."

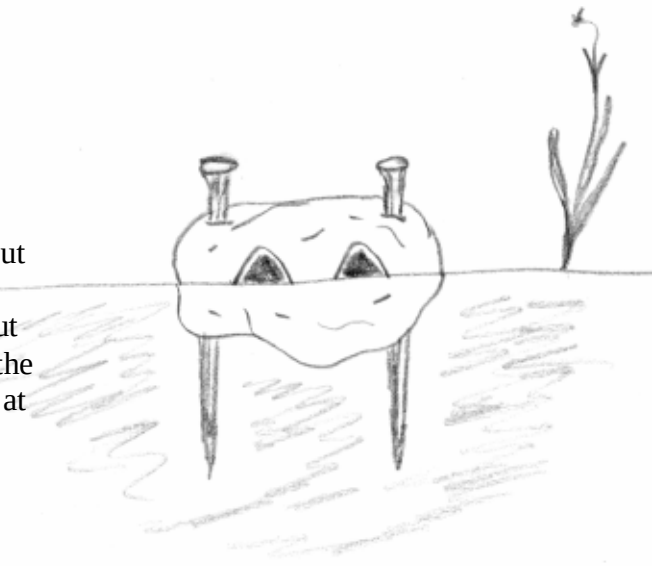
Missing Person

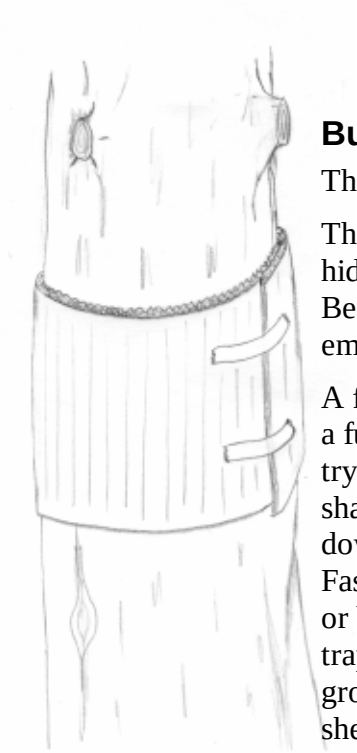
The missing person was last seen wearing green or perhaps brown clothes. It is unknown if the missing person has wings since we have not been able to determine his age. Previous search efforts have been hampered by the great leaps the missing person can achieve with his almost ridiculously long legs. The missing person can also detect people in his surroundings using antennas longer than his own body. However, the missing person has one weakness which is a difficulty of keeping quit, especially during evenings and nights. If all else fails, you will simply have to find a witch with a very long nose to lure him out of his hiding place.

Arts and Crafts

Building a Potato Trap

Cut a potato in two and hollow out both halves. Put the two halves back together and run a couple of nails through the potato to hold it together. Cut out a pair of openings in the side of the potato. Bury the bottom part of the potato so that the openings are at ground level (see image to the right).

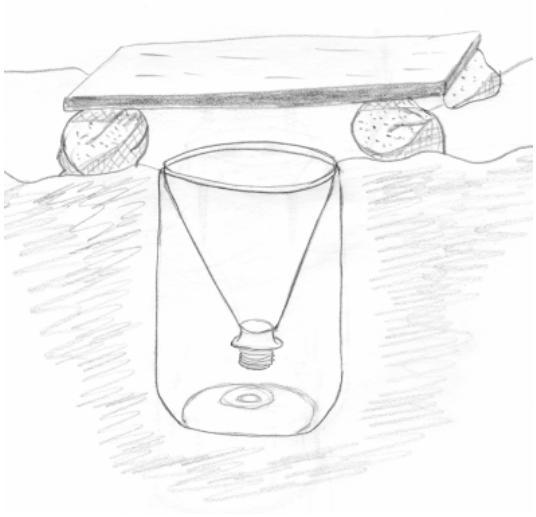




Building a Corrugated Cardboard or a Plastic Bottle Trap

The images to the left and right show two different traps.

The first is a piece of corrugated cardboard tied round a tree. This is more a hiding place than a trap. Bugs will creep under the cardboard for protection. Be ready with the insect sucker when you empty the trap.



A funnel trap is easily built with a jar and a funnel. If you do not have this material, try using a plastic bottle. Cut off the cone shaped top of the bottle and turn it upside down so that it is now facing inward. Fasten the two pieces together using tape or by stapling the parts together. Bury the trap in the ground so that the top part is on ground level. Do not forget to build a rain shelter above the trap to avoid drowning any bugs you might have caught.

Design Your Own Traps

Pupils love designing their own traps and this is a great way to integrate biology, arts and crafts, and technology. Recycled garbage can often be used for material. The optimal design of a trap is decided by how large the animal is, where it lives, what it eats, etc. This means that pupils will need to learn about the bug they intend to catch in order to build an efficient trap. Of course it is required that the bugs are caught alive.

Remember

All traps must be constructed in such a way that the bugs are not hurt or killed. The traps must be emptied every day and remember not to leave them out when you have finished collecting bugs.

Who caught the largest bug? Who caught the longest bug? Who caught the fastest bug? Who caught the most colourful bug? Who caught the scariest bug?

Tips

The pupils can make their own maps showing where they have hidden their traps. Let the pupils empty each other's traps. A variation on this idea is using written directions on how to find the traps. This way pupils will practice both language and maths skills.

Build Your Own Insect Suckers

The insect sucker to the right was built using a baby food jar and a plastic tube. First make two holes in the lid of the jar. Now glue the plastic tubes to the lid so that they cover the holes. Cover the hole leading to the short tube with a small piece of band aid as a filter. The sucker can be constructed in several variations and sizes. Use your imagination!

Spin Your Own Spider Web

Start by going outdoors to study spider webs. Late summer or early autumn are especially good times for this. Let the pupils think about how the spider spins its web and then let them create their own webs between two trees or sticks using thread or yarn. The spider webs can be made in different sizes and using different techniques. Why not make your own spider and prey for the web and have a spider web exhibition?

Build Your Own Isopod Nest

Let the pupils gather isopods around the schoolyard. Place a potato with dug out tunnels for the isopods in a jar. Put leaves in the jar and make air holes in the lid. Let the isopods live in the jar and spray the leaves with water every second or third day. Be careful that too much water does not gather at the bottom of the jar. Put new leaves in when the isopods have eaten the old ones. Try different leaves, which ones will the isopods eat and which ones do they avoid? During winter, when leaves can be difficult to find, you can use toilet paper as a substitute.

Arts and Music

Bug Art

Catching a large number of bugs is easy. However, in-depth studies of a single species require both a keen interest, patience, and plenty of time. Let each pupil examine a bug using available equipment such as loupes and stereo loupes. Let the pupils study each part of the bug in detail noting colour, form, etc. Then let the pupils draw the bug or sculpt it using papier mache, clay, or using pipe cleaners and cotton pulp balls. Round off the exercise with a vernissage serving bug inspired snacks.

Sketch Artist

This exercise can be done in several ways. The teacher could describe a bug in detail in front of the class. The description should cover the bug’s appearance and behaviour without revealing its identity. The pupils’ task is to draw the bug. An “aha” effect can be achieved if you start off as if you were describing a fantasy animal but at the end show the pupils a photograph of the bug.

The pupils could also work in pairs where one pupil describes the appearance and behaviour of a bug and the other draws a picture. The pupil describing the bug can use a live bug as reference or use a book on bugs for inspiration. Let the pupils take turns describing and drawing bugs. This is also a good exercise in communication, especially of details, and practices language skills.

Comparing Colours

Let the pupils catch different bugs. Study their colours and then let the pupils fetch plants, stones, or other outdoor objects of the same colour. Draw the bug and try to match the colours as closely as possible. Fasten a flower or a stone with a matching colour to the drawing. Together, the class can create a full palette or rainbow of colours using objects and drawings of bugs they have found.

Catching Bugs on Camera

An alternative to physically catching bugs is to take pictures of them using a digital camera. A class could collect photos during a whole semester and make their own collection of bug images. Bring the camera each time you go on an outdoor activity. Make digital works of art of the images using photo editing software.

Theatre and Carnival

A fun but time consuming undertaking is to set up a school play on the bugs theme. The play could draw on the pupils' experiences (see Speaking Bug below). Textiles handicraft will be integrated into the theme if the children make their own costumes. If you want to integrate arts and crafts and music, a bug festival or carnival might be a good idea.

Bug Orchestra

Divide the class into groups. Each group will pretend to be a bug orchestra. The pupils themselves chose which bug they want to be. An orchestra could consist of bumblebees only or of several different types of bugs. What sounds do different bugs make? Let the pupils use both their voices and any objects that can be used as instruments. Write suitable lyrics for your bug songs and sing them to each other. How about organising a bug song contest?

A digital image of a raft spider

Speaking Bug

Interview with a Bug

Pretending to interview a bug is a great way to learn more about an animal. It is more important to encourage curiosity than to find the correct answers as quickly as possible. For the pupils, spending time with an animal makes it more than just a bug; it becomes an individual of some importance. Thus, the pupil's sense of empathy is trained.

This exercise can also be done in pairs were one pupil asks questions and the other pupil studies the bug and answers questions in its place. Another way is to use a theatrical dialog to get the pupils thinking about a bug's life. One pupil can play a reporter researching an article on for instance a wasp and the other pupil plays the wasp that answers the questions. When the pupils sit down to write their article they will also be developing their language skills. Of course, the large number of unanswered questions can initiate further projects.

My Life as a Bug

Letting the pupils imagine that they are a bug is a good way to get them thinking about how bugs live their lives. What does a typical day look like for a spider, an ant, a snail, a viper, or an earwig? Other interesting topics to write about from a bug's perspective are; how do I reproduce? How do I survive the winter? Am I a social bug? Where do I live? What do I eat?

To add maths this exercise you can let the pupils scale all numerical information they find to the equivalent for a bug of human size. How big would my mouth need to be if I was a human sized viper and wanted to eat an equally enlarged field-mouse?

Naturally, writing the stories requires some knowledge of the bug that can be acquired through field trips, books, or on the internet.

Spidergirl's Diary

One day when I was out walking I saw a jummy little fly caught in a spider web. As I was eating the fly, a spiderboy suddenly came and started making love to me. It all happened so fast but it still irritated me a bit. He interrupted me in the middle of my meal and he hadn't even introduced himself. So I grabbed hold of him using my large jaws and let my stomach fluids dissolve his inner organs. I then sat down with a straw to suck up this delicious spiderboy cocktail. To be quite frank, I sucked the life out of him. But of course, it was all for the sake of our future children.

Tales, Myths, and Folklore

Stories are often a good way to get the pupils excited and interested in bugs. There are several good books on the topic, e.g. Gunilla Ingve's books on Bruno the Bear[2]. Many myths surround our most common bugs, but these tales often need to be put in perspective. If you think about the way people lived in olden days there is often an explanation to how a myth might have come about.

So what myths are there about bugs? Choose a bug and let the pupils write down what they know about it. Then compare these ideas with outdoor observations our information from books. Compare the pupils' knowledge before and after the exercise. What was fact and what was myth?

The Earwig

Is it a myth or a fact that the earwig sometimes crawls into the ear of a sleeping person to lay its eggs? Can the earwig use its claws to get through the eardrum and enter your brain?

[2] Title translated, the book might not be available in English.

Foreign Language Bugs

Bug Poetry

Let the pupils sit in the forest and write poems. Pupils who have not learnt much English yet can simply write down what they see. Poems that rhyme are nice but this is not a must. Spring is a great time for this exercise.

The ant was carrying a small twig
but it was too big
He left it on a leaf
the ant felt great relief

Verbs, Nouns, and Adjectives

Let each pupil find a bug and write down a verb, a noun, and an adjective to describe it. No let the pupils build sentences using the words they have written down. Read the sentences aloud to the class or in smaller groups.

If the pupil finds a beetle:

- Walking
- Legs
- Black

The black insect is walking with three pairs of legs.

Ant Walk

First line up the pupils and give them a Swedish word each and its English translation. Now let the pupils spread out so that there is a 20 metre distance between each pupil in the line. The pupil standing at the back of the line now begins moving forward. Each time he passes one of his friends, he is given a word to translate. When the pupil has successfully translated all words, he continues an additional 20 metres and is now at the front of the line. The person who is now at the back of the line starts moving forward and the process is repeated until all pupils have translated all words.

To speed up the exercise, note that it is not necessary to wait until the first pupil has passed all the way to the front of the line before the next pupil starts moving forward. You can also increase physical activity by specifying a certain type of movement, e.g. running, one legged jumps, frog jumps, etc.

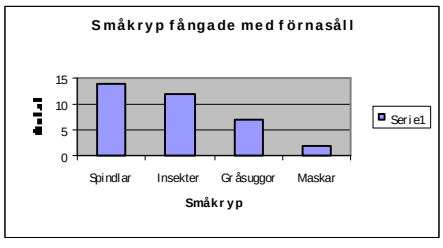
Maths Bugs

Heads and Legs

First let the pupils collect insects and spiders in a container. Now let the pupils work in pairs; one pupil counts the total number of heads and legs in the container and the other pupil must use this information to determine the number of insects and spiders. Pinecones and small sticks can aid the calculations.

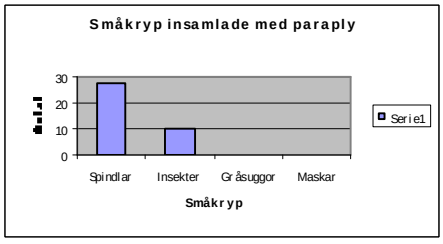
Sorting and Systemising Bugs

Let the pupils figure out different ways of sorting bugs into groups. Which systems do they come up with? One way would be to sort on colour. Other ways could include sorting on preferred habitat or different physical attributes. Discuss the pros and cons of different systems.



Tables and Charts

Once you have sorted the bugs using some kind of system, you can count them and make charts and tables. Excel provides easy to use functions this. This exercise also lets the pupils develop their ability to understand tables and charts. In the charts to the right it is easy to assume that the number of spiders is the same in both cases since the bars are of the same size. However, a closer look at reveals that the axis differ.



Breeding Bugs

Breeding Isopods

The difficulty of breeding bugs largely depends on the choice of animal. Isopods are one of the least demanding bugs to breed. They are easy to catch, they don't mind living in a glass jar, and they require nearly no care apart from keeping them supplied with moist brown leaves.

Divide the class into smaller groups and give each group the assignment to build a suitable home for isopods. The suggested solutions must be able to keep the isopods alive for at least six months. To solve this problem the pupils must find the answers to a number of questions such as; What is an isopod? Where do they live? What do they eat? How much do they eat? What do they drink? What temperature do they like? How much light do they require? How large a living space do they require? Do they have any natural enemies? What do their young look like? What attention will they need?

Clearly, the project will require a feasibility study. The pupils in each group need to define their collective knowledge base and search for that additional information which is needed. When sufficient information has been gathered, the group must agree on a hypothesis; this is what we will do and these are the results we expect.

Once the theoretical parts of the project are completed, it is time for more hands-on tasks such as catching isopods and building a home for them. This gives the pupils a chance to put their theoretical knowledge to a practical use. Taking care of the isopods is also a test of the pupils' knowledge and the bugs' survival is literally living proof of what the pupils have learnt. However, theoretical knowledge is not enough, the pupils must also develop there sense of empathy towards the bugs and strive to give them a good life.

The teacher must follow up the progress of each group regularly in order not unnecessarily put the isopods' lives at risk. At the end of the project it is also important to discuss the results: Was the hypothesis correct? Why did some groups do better than others? What have we learnt about isopods?

An additional benefit of this project is that it is interdisciplinary by nature. For example, maths is needed when counting the number of isopods and calculating growth rates. You might also want to work out how many leaves an isopod eats per month and how much soil it produces. Your imagination is the limit for coming up with isopod maths problems.

Good Reasons for Breeding Isopods

1. The pupils get to put theoretical knowledge to practical use.
2. The pupils get to define their own issues and prioritize what they believe is important.
3. Breeding isopods is straight forward and can be done at any school
4. The pupils expand their knowledge on animal habitats and ecology which is a prerequisite for understanding our environmental problems.
5. Breeding isopods also demonstrates the process of decomposition and the life-cycle of a bug.
6. The pupils develop a sense of empathy.
7. Many school subjects can easily be integrated into the project.
8. Working with this project facilitates many methods and ways of learning, increasing the possibility that pupils find a way of learning that suits them.

Breeding Peacock Butterflies

Day 1

On July 4 we brought home a stinging nettle with 30 peacock butterfly larvae. Each larva was about 1.5 centimetres long. A mini greenhouse that had previously been used to grow asters was to become the new home for our ravenous little butterfly larvae. We padded the bottom of the greenhouse with newspapers to cover the little holes through which excrements can be emptied to prevent them from moulding.

The nettle itself was planted in a small pot filled with water. We saw to it that there were no large water surfaces where the larvae might drown. A piece of band aid was hung from the top of the greenhouse to provide the larvae with a convenient place to cocoon. We then closed the greenhouse and taped over all large cracks through which the larvae might escape.

Day 2

On July 5 we had to provide more food in the form of new stinging nettles. Before placing the new plants in the greenhouse we cleared them from parasites by placing them under water for 10 minutes. Using tweezers, we moved the larvae to the new fresh nettles. Somewhat irritated they secreted a green fluid, probably used to deter enemies. Perhaps the green fluid contains nettle cells which still have a stinging effect. The tape was easily removed and replaced.

Day 4

By July 7 we had already expanded our operation to two pots of stinging nettles. The nettles had to be bent a bit to fit in the greenhouse. We also changed the newspapers at the bottom of the greenhouse since a considerable amount of excrement had gathered there. The larvae had already grown to twice the size of when they were caught four days ago. This also meant that the bottom of the greenhouse was covered with skin fragments that the larvae had shed during the past days. We observed that some larvae were not growing as quickly as the others and that one larva had died.

Day 7

July 10. After a few days of gathering nettle bouquets of ever larger sizes, we came home to find a larva hanging apparently lifeless in the greenhouse. Our first though was that it had given up on life but then we saw that it was hanging upside down which is normal for a larva entering the cocoon stage. The reason for the slow growth of some larvae was also revealed, a finding that produced mixed feelings. From the stomach of one larva crawled a snail like being. Once out of its host, the parasite immediately began spinning a cocoon that looked like a small brown bird’s egg.

Day 8

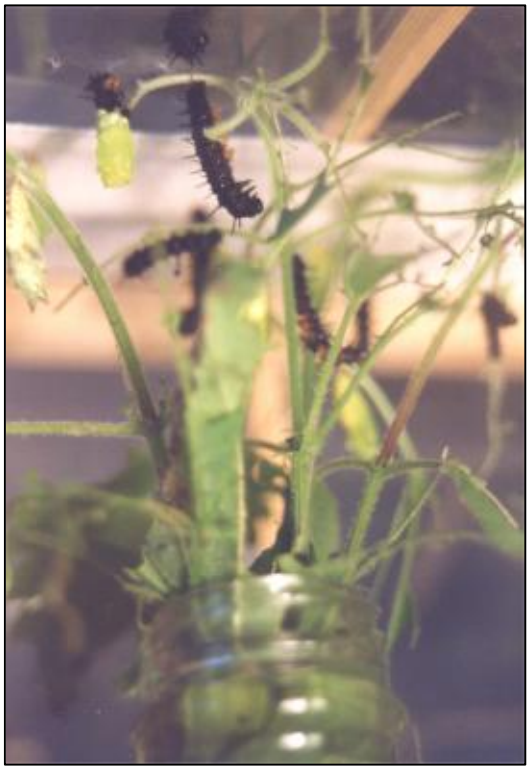
On July 11 the first larva had cocooned and during the next few days, many others followed its example. More parasites also emerged from their hosts.

Day 11

On July 14 the last larva cocooned, bringing the total number of cocoons up to 17. The band aid, it turned out, was not at all as popular for cocooning as the leaves of the nettles or the roof off the greenhouse. Thus, the band aid proved to be an unnecessary device. A total of 12 parasites had emerged from the larvae. Two of these parasites were of a different species than the one first observed, a fact deducible from the different shape and colour of the cocoons.

Day 18

During the week that passed, not much happened apart from the occasional rattle of the cocoons. However, on July 21 the first peacock butterfly crawled out of its cocoon. This was also the larva that had cocooned first.



Day 19

On the morning of July 22, the greenhouse contained a total of nine fully grown butterflies. During the day we let them all out into the beautiful weather outside.

Day 24

On July 27 we released the sixteenth and last butterfly. Thus, one cocoon never developed into a butterfly.

Conclusion and Reflections

The *lasting memory* of breeding peacock butterflies was definitely the *experience* of seeing the skin of the upside down larva crack from head and roll up towards the back of the larva which was hanging from the top of the greenhouse. The green cocoon then shakes off the skin and hangs from the roof for a little less than a week. Suddenly we *understood* the process and how long it went on for.

Putting the nettles under water to clear them from parasites was unnecessary in our case since the larvae were 1.5 centimetres long when we collected them and many had already been infected by parasites. We *learnt* that parasites lay their eggs during an earlier stage of the larvae's development. If you bring in eggs instead of larva, clearing the nettles of parasites becomes more important.

However, you should not forget that the parasites can also be *interesting*, especially if you do not know what they will develop into. In our case, the answer was not delivered until the following spring. After spending the winter in a cool storage place, two sawflies emerged from the parasite cocoons. The other parasites never developed to their mature form. The results are also have a clear *scientific* value and there are possibilities for *statistical and mathematical* analysis using the below figures.

Mini greenhouse

Results (30 larvae)

16 Peacock butterfly
10 Parasite, unknown species 1
2 Parasites, unknown species 2
1 Larva, dead
1 Cocoon, dead