

Winter Ecology



Learning about winter ecology
using outdoor learning and
interdisciplinary teaching methods



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Preface

During the winter months, plants and animals living in the northern hemisphere face a number of challenges. Many hours of the day that used to bring light are now dark; warmth is replaced by coldness; water turns to snow and ice; and food and nourishment become scarce. Despite these challenges, plant and animal life returns each spring with force, diversity, and vitality. How is it possible to survive the harsh winter conditions? What strategies to plants and animals employ to get through the cold winter months?

To let the pupils experience and learn about some of the difficulties plants and animals face during the winter, we have chosen coldness as the theme for this field trip and related exercises. Lack of food, light, and water are also important factors but somewhat too complicated for the audience we are targeting. The cold affects all plant and animal life, and the pupils will surely feel it after a day outside!

The overarching task for the pupils is to learn about keeping warm. What can be learnt from birds, mammals, frogs, insects, and plants when preparing for the field trip? What techniques can the pupils themselves employ to handle the cold? What equipment and technology is useful for keeping warm?

Apart from showing the pupils the impressive ability of plants and animals of coping with winter conditions, the purpose of this theme is to leave the pupils better prepared for future outdoor activities during all seasons.

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The national curriculum Lpo 94 on...

...Biology

The purpose of biology education is to explain nature and living organisms from a natural sciences perspective. Biology education is also to reinforce the pupils' natural thirst for discovery and their fascination and curiosity regarding all things living.

Goals stated for grade five pupils

Pupils are to:

- 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.
- Have insight into laboratory work and field observations performed in the local environment.

...Physical education and health

Physical education also connects to the Swedish cultural traditions concerning co-existing with all plant and animal life. Through outdoors activities and regularly spending time in country-side and forest environments, the pupils gain experience and knowledge to inspire future interest in outdoors activities and concern for environmental problems. In this way, physical education contributes to awakening the pupils' interest for preservation of natural habitats.

Goals stated for grade five pupils

Pupils are to:

- Have basic knowledge of outdoor life and know the guiding principles of the Swedish right of common access.

Goals stated for grade nine pupils

Pupils are to:

- Be able to determine their position and orient themselves in outdoor surroundings using different methods.
- Be able to plan and undertake an outdoor journey or stay during different seasons.

...Physics

Goals stated for grade five pupils (regarding nature and human life)

Pupils are to:

- Have insight into how the planets revolve around the sun, how the moon and the earth move in relation to each other, and be able to relate this knowledge to our calendar and the changing of the seasons.
- Have insight into basic meteorological phenomena, their causes, and relation to each other.

Strategies of plants and animals for surviving the winter

Plants

Plants require water, light, nourishment, and warmth for survival.

Winter conditions for plants in Sweden:

- ü Precipitation in the form of snow; water in the upper soil layer freezes to ice.
- ü The days grow shorter and the sun lies low on the sky.
- ü Nourishment becomes more difficult to take up since all water is frozen.
- ü Most plants require a certain temperature in order to grow and many freeze to do death when the weather turns too cold.

How plants adjust to cope with winter conditions

Felling leaves

Examples of plants that fell their leaves but remain standing with trunks, stems, branches, and twigs are deciduous trees, bushes, and blueberry shrubs. Benefits of felling leaves:

- ü Plants breathe through their leaves and by felling them the need for water is reduced.
- ü Leaves are the part of a plant most sensitive to cold; stems, twigs, buds, etc. are not as strongly affected by the cold:
 - § Buds are surrounded by bud scales which prevent water from evaporating and bark fills the same function for trunks and branches.
 - § Buds also contain a lot of sugar which prevents them from freezing.

Staying green all year round

Trees and bushes that stay green all year round include pine, spruce, and the juniper bush.

- ü These plants do not need a lot of water. They breathe through pores inside their needles which prevents the wind from increasing evaporation. The pores can also be plugged shut by small wax plugs, visible as small white spots on the needles. Furthermore, the entire needle is coated with wax to make it water tight.
- ü Needles, as opposed to leaves, are hard and do not curl up when there is a shortage of water.
- ü Needles also contain a lot of sugar during winter which lowers their freezing point so they do not freeze and break so easily.

Smaller plants that stay green all year round include lingonberry shrubs, liverleaf, and common wood sorrel.

- ü Most of these have high sugar levels in their leaves to lower the freezing point.
- ü Some of these have hard leaves which do not curl when there is a shortage of water.
- ü Some of these have breathing pores underneath their leaves to prevent the wind from increasing evaporation.
- ü Almost all of these are low growing which means they are protected by the snow which both isolates against the cold and acts as a supply of water.

Staying green under the cover of snow

Examples of plants that keep small green leaves and buds under the cover of snow are grass, dandelion, thistle, and buttercup.

- ü These are protected by the snow which isolates against the cold and also prevents dehydration.
- ü Some of these have sugar in their leaves to lower the freezing point.
- ü Buds are covered by bud scales.

Living through the winter under earth

Plants which live through the winter under earth as stems, onions, or roots include wood anemone, lily of the valley, coltsfoot, gagea, pilewort, and potato. Below the surface soil layer, temperatures below zero degrees Celsius are very rare. Nourishment is stored in the underground parts of these plants over winter and come spring they are well prepared to quickly send up shoots and buds in order to bloom early.

Withering

Plants which wither completely and continue their lives only through seeds include scentless mayweed, chickweed, and goosefoot.

- ü For many of these plants, the seeds lie protected under earth during the winter months.
- ü The seeds contain only very little water and therefore are very cold resistant.
- ü The seeds also have a protecting shell.
- ü Many seeds require a period of cold in order to grow.
- ü Many seed sprout already during autumn and live through the winter as small sprouts or leaf rosettes with high sugar levels to make them resistant to the cold.

Animals

Winter conditions for animals in Sweden:

Lack of food

Insects are scarce during the winter which is a problem for insect eaters. Also, animals need more nourishment during the winter in order to keep warm. Animals unable to find enough nourishment have to migrate or go into hibernation during winter.

Cold

Larger animals are warm blooded, and have roughly the same body temperature as humans. They need a lot of food during the winter to sustain this temperature. If they do not find enough food, they freeze to death.

Snakes, lizards, worms, insects, and other bugs are cold blooded. Their body temperature varies with their surroundings. During summer they have a high body temperature which gradually decreases during autumn. In order not to freeze to death during winter, cold-blooded animals must find a place warm enough to hibernate.

Water

Many animals can eat snow to obtain water but there can be problems if the temperature drops too low.

Snow

With too much snow, animals have trouble moving around and finding food. Some small animals can live in the space between the ground and the snow which is warmer than above the snow. These animals benefit from a thick layer of snow.

Darkness

A lot of animals depend on day light for finding food. When the days grow shorter it becomes difficult to find enough food.

How animals adjust to cope with winter conditions

Winter active animals

Winter active animals must find food and cope with the cold. The biggest challenge for most animals is finding enough food to keep warm. During late summer and autumn, these animals eat a lot and build up a layer of fat under their fur. The fat layer both isolates against the cold, and acts as an energy reserve when there is not enough food. Some mammals will hoard food during the autumn.

Food available for herbivores tends to contain very little nourishment and is difficult to digest. These animals primarily eat buds, bark, and shoots. Their thick fur protects them from the cold.

Winter active mammals

The herbivores' winter food (buds, bark, and shoots) is often poor in nourishment and difficult to digest.

- ü The forest hare has thick, white fur and the field hare has brown winter fur. During winter, hares often follow tracks where the snow has already been trampled down.
- ü The roe deer is not well adjusted to winters with plenty of snow and Sweden is at the very outskirts of its range. The roe deer's fur insulates well against cold but thick snow constricts their movement and hides the ground growing plants which they eat.
- ü The elk is better adjusted to the Swedish winter. It moves easily through snow and can find food easier since it is a browser.

Carnivores usually find it easier to locate and kill their prey during winter. They pursue prey that are weak or injured and therefore cannot flee.

- ü The fox usually hunts small rodents that live under the snow.
- ü The ermine has white winter fur and a black tail tip. It hunts rodents that live below the snow surface.

Rodents often live below the snow surface where they are protected from the cold. They build tunnels under the snow which are reinforced using grass. When the snow melts away in spring, you can see these tunnels. Close to stones, bushes, or stumps you can sometimes see small holes in the snow leading down to the tunnel systems. Sometimes the rodents come out from their tunnels in search for food or to flee from carnivores.

- ü Field mice are herbivores and live on seeds, bark, and green plants below the snow.
- ü Wood mice are omnivores that hoard seeds, nuts, and cones in preparation for winter. They also eat bugs which they find under the snow.
- ü Shrews hunt insects and bugs beneath the snow surface. They also eat some plants during winter.

Some animals hoard food for the winter months.

- Squirrels and beavers are mammals with decreased activity during winter. They hoard food for winter as well as growing winter fur and gaining excess fat. The squirrel largely rests through the winter but also has periods of activity. To get by, it hoards nuts, acorns and mushrooms during autumn. The beaver fells trees during autumn and carries the branches under water. During winter, it lives off the bark and leaves of these branches.

Winter birds

Birds which stay in Sweden during winter have an extra layer of fat, feathers, and down that isolate against the cold.

Some birds can cope with the lack of food during winter because:

- They are omnivores (e.g. crows)
- They change their eating habits (e.g. black grouse, hazel hen)
- They eat other animals (e.g. owls, hawks)
- They scavenge large areas for food (e.g. crossbills)
- They store food for winter (e.g. coal tit, nuthatch, and jay)

Some birds manage cold well because:

- They have extra down under their feathers during winter.
- They put on an extra layer of fat during autumn.
- They usually choose nests where there isn't a lot of wind.
- They eat a lot more to be able to cope with the cold, a great tit needs to eat a fourth of its body weight each day to get through the winter.

Advantages of not migrating

- They do not need to make the dangerous journey.
- They can start breeding directly when spring comes.
- They can choose the best territories.

Winter active bugs

Bugs that can find food and handle the cold can be active during winter. Some insects are active under the snow where it is humid and not very cold, e.g. springtails and beetles. Some primary consumers live up in the trees branches, e.g. mites, while carnivores prey on the primary consumers, e.g. spiders and carnivorous mites.

Animals that migrate

About 180 species of Sweden's 240 bird species migrate every autumn. These are insect eaters, e.g. swallows, flycatcher, and willow warbler; birds which are dependent on unfrozen water, e.g. wild ducks, grebes and common coot; and those that need ground not covered in snow, e.g. curlew, northern lapwing, and common snipe. The advantage of migrating is spending the winter in a place which is warm and rich with food. The disadvantage is the risky flight which consumes a lot of energy. Many birds do not return—they die during the migration.

Some insects, e.g. the red admiral butterfly, also migrate during winter.

Animals that hibernate, sleep or rest

Bears and badgers rest through winter because of the lack of food. During other seasons, bears eat berries and badgers eat insects. They have an extra layer of fat. Even the squirrel will rest if the weather turns too cold.

Hedgehogs, bats, bush mice and hazel mice sleep through the winter because of the lack of food. Hedgehogs, bats, and bush mice usually eat insects and hazel mice eat nuts. While sleeping, they have a low heart beat frequency, low body temperature, and decreased breathing which helps them save energy.

Snakes, lizards, snails, worms, spiders, insects, and other bugs hibernate because they cannot handle the cold. These are cold blooded animals which mean that their body temperature adjusts to their surroundings. Some of them can survive temperatures below zero.

Most insects die during winter. Some insects can hibernate, e.g. some butterfly and ladybugs. Most of the insects live through the winter as eggs larvae or cocoons in protected places.

Preparations

- **Clothing plan.** Let the pupils discuss what type of clothing is appropriate for outside activities during winter. Explain the multilayer principal and the importance of wearing clothes which do not let the heat out. Compare this with the birds' winter down isolates the warm air and the feathers protect against the wind.
- **Experiment.** Why is it so important to wear a hat? Do an experiment with two buckets or cans of hot water. Start by measuring the temperature of both cylinders. Then put a lid on one of the cylinders. Compare the temperature of the cylinders every ten minutes. Let the pupils create their own lids and compete to see who has made that isolates the best.
- **Too think about.** Why is wool better than cotton? What function does cotton fulfil out in the wild? Why would you want synthetic textiles close to your body on a cold day rather than cotton?
- **Why do the seasons change?** Let the pupils think about and describe the phenomenon that is winter. Let the pupils explain what happens when summer turns to winter using models of the earth and the sun. Models can be made outside if there is snow. Squeeze a snow ball and push a stick through it to symbolize the earth and its axis. Let the earth revolve around another snow globe symbolizing the sun. Mark your country on the earth globe to clarify which globe is which.



The multilayer principal

One benefit of the multilayer principal is that you can take a layer off if it gets too hot and put one on if one gets too cold.

- The *innermost layer* should have a tight fit and be able to transport sweat away from the body. Cotton is the worst textile for this purpose since it absorbs moisture. Wool or synthetic textiles are the best alternative since they let moisture through and do not get as cold as cotton when wet.
- The main purpose of the *middle layers* is isolation. The number of layers can be adapted to the outside temperate. Cotton is not a good choice for this layer either.
- The *outermost layer* should protect against wind so that the warm air in middle layers is not blown away. At the same time, the outer layer should not be completely airtight since sweat will condensate on the inside of the outer layer and make underlying layers damp.

The multilayer principal is applicable to all body parts including hands, feet, and head. Shoes must have a good sole that prevents heat from the feet going straight into the ground.

Assembly and introduction

We begin the day by going through the schedule and practical details after which we discuss the purpose of the field trip with the pupils. One of the goals is that no pupil should freeze during the day—and if they do, they should understand why.

We often use the gold crest to demonstrate the difficulties birds face in surviving the winter. We also relate the old folk tale of how the gold crest got its name:

A long time ago, all the birds in the forest decided to compete over that could fly the highest. The last contender was the golden eagle and he flew higher than any other bird had done. However, as he looked triumphantly down, a little bird that had ridden on his back took off and flew just a little bit higher. This little bird won the competition and was from then on called the gold crest.

The gold crest

The gold crest is an insect eater and is Sweden's smallest bird weighing only 5g. The bird is very common and its favourite habitat is the spruce forest. To survive the winter, the gold crest must eat 1000-2000 insects and spiders per day. Not all gold crests stay in Sweden over the winter; some migrate and thereby secure the survival of the species years when a harsh winter kills many birds. The gold crest is difficult to spot but a yellow Mohican haircut is a sure way of identification. The gold crest's song is very easy to recognize, it sounds like the gold crest is riding a rusty bicycle up in the tree tops.

Suggested schedule

08:30	Assembly and introduction
09:00	Hot water bottle part 1
09:15	Snack break
09:45	Walk to the camp site
10:00	Maps & exercises
10:15	Group work
12:00	Spruce and needle tea
12:15	Games
13:00	Walk back
13:30	Hot water bottle part 2
13:45	End of day and evaluation

The hot water bottle

We use this classic experiment to start and round off the day. The pupils are divided into 5 groups and each group is given a bottle of hot water. The water temperature is measured and written down. The task for each group is to isolate the bottle and keep the water as hot as possible during the day. At the end of the day the temperature is measured again and the pupils show how they succeeded (or failed) in keeping the water hot.

Snack break

Food has the same function for us as for other animals. It provides the energy needed to move around and heat is produced as a bi-product. During the snack break, we talk about what food is recommended for a day outdoors during winter.

Walk to the camp site

If there is ice on the lake, we cross over it and talk about the ice and what equipment is needed to make the journey safe. If we have to walk around the lake, we talk about the plants and animals we come across on the way. We also measure temperature and wind using temperature/wind tables we can find the apparent temperature. We also discuss what clothing is appropriate to avoid the chill effect of the wind.

Wind chill chart

Apparent temperatures:

Wind	Temperature												
	+10	+5	± 0	-5	-10	-15	-20	-25	-30	-35	-40	-45	-50
Calm	+10	+5	± 0	-5	-10	-15	-20	-25	-30	-35	-40	-45	-50
Slight winds 5/m/s	+4	-2	-9	-15	-21	-27	-33	-40	-46	-53	-59	-65	-71
Moderate winds 10 m/s	± 0	-7	-15	-22	-29	-37	-44	-51	-58	-66	-73	-80	-87
Hard winds 15 m/s	-3	-11	-18	-26	-34	-42	-49	-57	-65	-73	-80	-88	-96
Hard winds 20 m/s	-4	-12	-19	-28	-36	-43	-52	-59	-67	-76	-83	-92	-99

If the thermometer shows -5°C and there is a wind of 10 m/s: go to the -5°C column for calm and follow the column down to 10 m/s. The apparent temperature in the wind is -22°C .

At the camp site—maps and exercises

When we have arrived at the camp site we sit down by the fire. The groups will be working in different parts of the forests and therefore they are given maps which indicate which area they are to work in. In order to use the map we need to know which way is north. This is done using lichens, the sun, or ant hills. When everybody knows their position on the map and where they are supposed to go it is time to assign exercises.

The exercises—three approaches to learning

The most appropriate way of working and learning outdoors depends on the group. Well prepared pupils can handle more complex instructions and tasks than unprepared groups. Likewise, groups that have an idea or vision of what they want to learn need different assignments from groups who are completely new to the theme. In short, one must adapt to the pupils.

The fundamental choice is between assignments which are highly structured or task where the pupils' own initiatives and desire to learn are given more room. Highly structured assignments typically involve giving the pupils a number of tasks to perform and later present at the home school. Below are three different ways of working outdoors with winter ecology.

Approach 1: Structured group assignments

We often divide a school class into six groups where each set of tasks will be done by two groups but in different parts of the forest. Each group is provided a laminated sheet of paper on which assignment is written. During the preparatory work, the pupils have had the opportunity to send questions and thoughts on the day via email.



Trees and bushes

Tasks:

- Gather needles and seeds from spruce and pine.
- Collect buds from different trees.
- Collect seeds from perennial plants.



Buds of ash, hazel, oak, aspen, and alder

Equipment:

- Map of the group's working area.
- Assignment instructions—laminated sheet.
- Bags and containers.

Follow-up activities inside:

- Study the findings using a stereo loupe.
- Find out which tree each bud comes from and laminate the buds on pieces of paper with the names written at the side.
- Make a bouquet of perennial plants by sticking them in some clay (add the names of the plants using tape).



Winter perennial plants in clay. The name of each plant is written on the strips of tape

Snow depth, plants under the snow, and birds

Tasks:

- Measure the snow depth.
- Measure the temperature above and under the snow.
- Collect plants under the snow.
- Bird watching.
- Collect mosses and lichens.

Equipment:

- Map of the group's working area
- Assignment instructions—laminated sheet
- Thermometer and ruler.
- Spades and knives.
- Binoculars.
- Bags and containers.



Looking for bugs using a loupe with built-in lamp

Follow-up activities inside:

- Study the findings using a stereo loupe.
- Look up the names of the mosses and lichens, laminate with the names written on the side.
- Make a table comparing snow temperature an outside temperature.
- Look up facts on birds spotted.

Bugs and tracks of bigger animals

Tasks:

- Find tracks of animals and mammals.
- Shake down bugs from branches and catch them in an upside down umbrella.
- Search for different kinds of animal food.

Equipment:

- Map of the group's working area.
- Assignment instructions—laminated sheet.
- Umbrella
- Insect sucker.
- Magnifying glass with an attached light source.
- Bags and containers.

Follow-up activities inside:

- Study the findings using a stereo loupe.
- Define the species of bugs collected.
- Photograph the bugs through the loupe.
- Search for bugs in broadleaf cattail.



Pine cones processed by squirrels

Approach 2: The Brownie – a winter story with digital documentation

This approach combines story-telling with facts, outdoor experiences, and digital photography.

The brownie that each group brings with them during the day becomes the leading character in a story that pupils create. It is the brownie which will make all discoveries during the day—the task for the pupils is to help the little brownie and document his journey. As preparation, all pupils have read an episode from the story and learnt it by heart. Out in the field, the pupils have a time slot when they tell the story and do the exercises connected to this episode. In the field, the pupils need only bring the list of tasks, a medicine box, and a camera.

For younger pupils, the teacher can gather the class round a camp fire, tell the episodes of the story, and then let the groups do their tasks. After a short while, the class gathers round the camp fire again for the next episode and new tasks.



The brownie—story episodes

Once upon a time there was a brownie. He had a deep knowledge of plants and animals, so many humans would come to him for help. In exchange for his help, the brownie would demand that the humans learn more about nature. He would often quote a famous half brownie who said that “If you do not know the names, you cannot understand the things!”

Brownies are small creatures, often dressed all in gray, that live closer to humans than ordinary trolls. Mostly, they stay underground, preferably under stones, trees, or stumps. They live in families as trolls but are not as prone to steal. One may not laugh at the brownies because then they will seek revenge and disturbing them in their home is extremely dangerous. Because they live underground, it is important to warn them before pouring out water or peeing on the ground or they will get very, very angry. So before pouring any liquid one should always shout “look out below!”

Episode 1

One autumn day, a little boy came crying and asked why his plants no longer were green.

“Don’t be sad said the brownie. Your plants need water light, nourishment, and warmth. Soon the winter will come and water will be snow and ice, light will be darkness, and warmth will be cold. It is time for your plants to sleep.”

“Sleep? Can they ever wake again?” The boy asked with hope in his eyes.

“Some of your plants will live through the winter in part of them that is under ground. Others will die, they will dry up and stand majestically with their needles and seeds surrounded by beautiful urns.”

“How long will they sleep?”

“In spring, snow will become water, darkness light, and cold will become warmth. Have patience, and like your flowers get some rest.”

The boy was immediately relieved by this answer and went home to dream of all the beautiful flowers of spring.



Help the brownie fill his medicine box so that he can help animals and humans:

- Gather dried up perennial plants. Be careful and make sure the seeds do not fall out. Then help the brownie plant the seeds inside in moist earth. When spring comes, move the plants outside so that the brownie can use them as medicine for all kinds of diseases.
- Try to find a root from a plant which is waiting for spring, and place it in the box. The wall ferns root tastes like liquorish dissolves phlegm. It is good for people who have a cough.

Episode 2

One day in December, the brownie was woken up early in the morning

“Wake up brownie, please wake up.”

The brownie shrugged and looked up from his stump. There he saw a boy and a girl, both looking very anxious.

“What do you want so close to Christmas?” the brownie asked and rubbed his eyes.

“We are going to help mom and dad decorate the advent candle holder” the children replied together.

“Oh really” said the brownie. “What are you going to decorate it with?”

“Peat moss of course”, said the children looking confused. A brownie should know that they thought.

“Peat moss?!” the brownie exclaimed. “You humans really mix apples and pears don’t you.”

“What are you rambling about?” the children asked.

“Tell your parents that it is not peat moss you want for your advent candle holder” said the brownie a tad irritated. “It is star-stripped reindeer lichen. It is easily to recognize; it looks like thick clouds and grows on dry places like mountain sides.”

“But then what is peat moss?” the children asked.

“Peat mosses are mosses which grow in moist places. There are different kinds: some are green and some are red but when they dry most of them turn white.”

“Thank you nice, kind brownie” the children shouted as they ran home to mommy and daddy to tell them what they learned.



Help the brownie fill his medicine box so that he can help animals and humans:

- Fill a pocket with four different mosses. Do not forget hair-cap moss, the brownie will use it to make a broom for sweeping his stump when he is spring cleaning.
- Fill a pocket with four different lichens. The Linnaeus lichen is a good cure for stinging nettle burns. Ignite the lichen and let the smoke flow onto the rashes.

Episode 3

One midwinter day, when the ground was since long covered in snow, the brownie met his old friend the forest hare. The hare was sitting by an alder eating buds.

“Tell me forest hare do the buds on the tree really taste good?”

“Buds are the best—sweet and tasty. Did you know that a sweet bud never freezes? If they froze, no leaves would come in spring”

“But there will still not be any leaves if you eat all the buds!”

“Well my dear friend, there are more buds in the forest than I could ever eat. Besides, I can’t eat the outermost ones; they give me such a terrible tummy ache.”

“Tell me hare, are there other sweet things in the forest which you can eat?”

“Yes there are many good things to eat such as lingon berries, hepatica, and sorrel. They are green all year around” said the hare and jumped away.



Help the brownie fill his medicine box so that he can help animals and humans:

- Fill a pocket with buds from different trees: one so pointy that it makes you say “ouch” when it pricks you; one so lilac that it makes you feel happy; one so hairy that it tickles; and one so scaly so that you would think that it was a fish.
- Fill a pocket with leaves. Try tasting them, but be careful so that they are not protected by conservation laws.

Episode 4

One very cold winter day, the brownie was walking through the forest when he heard a strange noise. It sounded as if someone was angry. Behind some spruces, the brownie could distinguish an angry old man shouting at a little girl. He hurried up to them since he felt sorry for the young girl.

“Excuse me sir, but what is the problem?” the brownie asked carefully.

“This girl is a walking accident. Look how she has destroyed the ant hill. Look at this hole” the angry old man replied.

“Did you make this hole?” The brownie asked the scared little girl.

“No it wasn’t me!” the girl exclaimed.

“That’s what I thought” the brownie said. “Because I know who did this.”

“How could you know?” The angry man demanded.

“It is as simple as knowing that the sun will rise in the morning” replied the brownie. “During winter, the ants sleep deep within their ant hill and the only way for the green horn to get to them is to dig a hole in the hill.”

“A green horn?” said the old man. “How can you be sure? Do you have any evidence?”

“Look at the surface of the ant hill” the brownie told the old man. “Do you see the small white objects? That is the dropping of the green horn and if you poke at it you will find that it is full of ant shells. How’s that for evidence?”



Help the brownie fill his medicine box so that he can help animals and humans:

- Fill a pocket with dropping from different animals. How many types of dropping can you find? The hare’s dropping can be put in moist earth and then maybe the question of what the hare has eaten will be answered.

Episode 5

One day in February, when it had been colder than 15 degrees for over two weeks, a farmer’s son came to the brownie for help. He had found a little gold crest that was totally exhausted.

“Please brownie, the gold crest needs food, what should I feed it?”

“Look at the beak young boy. Is it a strong beak to eat seeds with?”

“No it is a small pointy beak.”

“Exactly! A perfect beak for catching and eating insects.”

“Insects? In mid winter? You must be joking!”

“The spruces tree hides many secrets, that is where you will find food for your gold crest. Go home and get an umbrella. Hurry up, we need to find 2 000 bugs before nightfall.”

An umbrella? The boy did not understand why, but he did as he had been told.



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- Help the boy fill his container (insect sucker) with bugs from the spruce’s larder, so that he can feed the gold crest. Use an umbrella to maximize your efficiency (used upside down).

Episode 6

One beautiful day in March, the brownie started to suspect something was happening. For many weeks he had heard the great tit and the nut hatch sing and late at night he had heard the owls.

He pushed through the mushy snow and stopped by a bush. It looked like a giant bouquet which someone had put Christmas decorations in. There was no doubt that his friend the squirrel had been there earlier that winter, the tracks told him that. But what the brownie saw now was of no interest for a squirrel. It was a hazel bush but all the nuts were long gone. What now hung in the bush were the male flowers. The brownie then started to look for his first sign of spring and after a little while he found it. At the end of a bud he saw a small red flower, the hazel flower, the first sign of spring.



“Squirrel! It is spring, your hazel nuts are on their way” he shouted out into the woods.

Because even if you love nature as much as the brownie does, you cannot always be sure that spring will come after such a cold winter.



Help the brownie fill his medicine box so that he can help animals and humans:

- Fill a pocket with hazel flowers. First pick the male flower and then pick the female if you believe spring is on its way.
- Look for squirrel tracks, and fill a pocket with the left-overs from its meals.
- For a squirrel the best food is cones. Preferably from spruce but pine cones will also work. Can you find cones in any other trees? Fill a pocket with three different cones.

Approach 3: The winter cross word

The aim for the pupils is to do the winter cross word, and then find out what word is hidden in the vertical blue boxes. You can either provide the pupils with all questions at once or hand out the questions one at a time. You can also choose to base all exercises throughout the day around the cross word or use it as a half hour activity sometime during the day.

- 1) During the day we brew some tea. What plant parts do we use?
- 2) Find a dead plant which stands upright. What are the small loose pieces where life is stored called?
- 3) Find a spruce cone and a pine cone. Two animals depend on these cones to survive the winter. One is the squirrel which needs to eat about 30 cones a day. You can see that the squirrel has been eating when the cone is totally bare apart for the tip where some scales have been left. But if the cone still has all its scales but looks ruffled, which animal has eaten the seeds? Hint: has a very long tongue.

- 4) Use an umbrella to catch 10 spiders. In Sweden there is a bird that has to eat 1000-2000 insects a day during winter. The bird weighs 5 g and is Sweden's smallest bird. Contrary to its name it does not wear a crown.
- 5) The spiders you caught in the umbrella probably were not very lively. If you take them inside, you can watch them come to life. Spiders and many other animals, such as bats and snakes, sleep very deep during winter. What is this sleep called?
- 6) What do the plant parts from question 1 contain that is important to prevent sicknesses, e.g. scurvy? Hint: third in the alphabet
- 7) Find two different mosses. Now there are only about another 1000 left to discover in Sweden! Mosses are green all year round and are not affected strongly by cold or snow. What is the name of the moss that looks like stars from above? Hint 1: you can use it to make brooms. Hint 2: Sweden's largest carnivore uses it in its lair.
- 8) Find two different lichens. Now there are only about another 1000 left to discover in Sweden! Lichens consist of two different organisms living in symbiosis. One of them is an algae, which aided by sunlight can produce sugar. Which is the other organism? Hint: some have tubes and some have discs.

Please note that the cross word has not been updated to fit the English answers to the above questions. Illustrative purposes only!

1											
2											
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8											

Reassembly at the camp site

After completing one of the three approaches to learning, we gather round the warm camp fire for a relaxing lunch. Bringing something to sit on is important so that we do not waste heat on the cold log beneath us.



Spruce needle tea

While the pupils were out completing their assignments, we took the liberty of picking some spruce shoots which we put in a pot together with some water. At the camp site, we light the fire and hang the pot over it. It is important to make sure that the pupils are aware what the law says about picking shoots from spruce trees. One is only allowed to pick shoots if one has approval from the land owner. The spruce needles contain a lot of vitamin C, especially during winter, and therefore make superb tea. If the shoots are cooked for too long the tea will be bitter.



Inside activities

The last part of the day will be used for studying the material we collected during the day. Some pupils also need a chance to warm up their cold feet. Now the pupils will have a chance to study mosses, lichens, buds, and bugs in stereo loupes. The groups will complete the crossword, make close-up photographs of material gathered, find facts in books, prepare their presentations, etc. We end the day with an evaluation.

Follow-up activities

Warm water bottles 1

Each group is given two bottles of hot water (same temperature). The bottles are left outdoors in temperatures below zero degrees. One bottle is put somewhere unprotected and the other is placed in a protected place. The following day, the temperature is measured once again and results compared between groups. What protection did the bottles that did not freeze have?

Warm water bottles 2

This experiment highlights plants' and animals' ability to survive in severe weather and temperatures. You can either use plastic bottles and study what happens to the water or use glass bottles for a more dramatic effect. Five bottles will be needed:

- Bottle 1 is filled to the top with water.
- Bottle 2 is filled to two-thirds with water.
- Bottle 3 is filled with a water and sugar mixture.
- Bottle 4 is filled with a water and ethanol mixture.
- Bottle 5 is filled with a water and salt mixture.

The water in all five bottles should have the same temperature at the beginning of the experiment. Leave the bottles outdoors over night or place them in the freezer. Discuss the results.

Warm water bottles 3

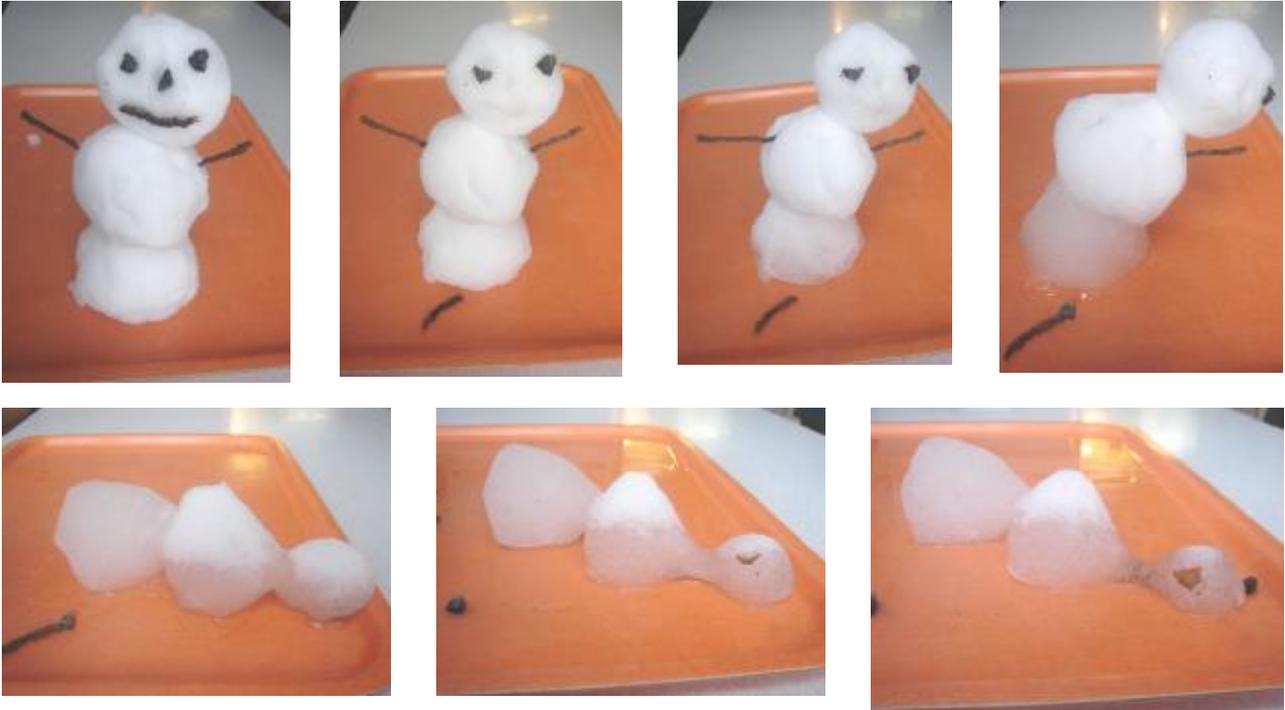
Each group is given two bottles. One bottle is painted white and the other black. Both bottles are filled with water of the same temperature and left outdoors in the sun for some time. The bottles are brought inside and the water temperature measured. Discuss the difference in water temperature and the properties of white and black colour.

Warm water bottles 4

Each group is given two bottles with water of the same temperature. Both bottles are left outdoors but one bottle is put out alone and the other bottle is put together with other groups' bottles. After some time, bring the bottles inside and measure the temperatures. Discuss the results.

The melting snowman

Let the pupils make mini snowmen and put them on a tray. Let the pupils guess how much water each snowman contains. Photograph the snowmen at regular intervals until they are completely melted. Print the pictures and make a slide show or do the slide show on the computer. Measure how much water the snow men contained. Discuss the different forms of water.



Hot as a bee

First measure the temperature in the air. The class then stands in a circle and one pupil stands in the middle measuring the temperature. Make the circle tighter and tighter until there is only a small area in the middle left. What happened to the air temperature in the middle? Compare this with how a bee community keeps their queen warm.

Even without a thermometer, you can feel the difference. Let the pupils alternate between standing close together and individually and feel the changes in temperature.

Life and death

Let the pupils gather outdoor objects, either in groups or individually. Use one container for living objects and the other for dead objects. Let the pupils present the objects they have gathered and argue the reason for putting the object in one jar or the other.

additional activities

Outdoor activities and games

The march tit game

This game highlights the march tit's struggle for survival during winter. The march tit stays in Sweden over winter and hoards food to survive.

Start by placing a pile of sunflower seed on the ground. The pupils play march tits who must fetch and hide sunflower seeds. However, they can only carry one seed at a time since their beaks are so small. March tits usually hide seeds well over ground level so that they will not be covered by snow.

There are also one or two great tits in the forest. These will try to steal the seeds that the march tits hide. So the challenge is to hide the seed when the great tits are not looking. Once in a while, a sparrow hawk might swoop down and take a tit. The "dead" bird then has to run around a tree a few times before joining the game again.

After a while, stop the game and ask the march tits to fetch the seeds they have hidden. The winner is the bird with the most seeds. Now tell the pupils about the harsh winter. You might introduce rules such as that only birds that found more than 7 seeds survived the winter. For a mild winter, 2 seeds might suffice. You can either set these rules down before the game starts or adapt them to the amount of seeds the pupils have managed to gather.

Searching for hiding places

Search the forest for animals' hiding places. Which is the best place to look? What can one expect to find? What animal could each hiding place belong to?

Long jump and gliding

Create an icy skid-run and let the pupils see who can glide the furthest. This is a good exercise for improving balance.

Curling

A lot of people would probably like to try curling. However, the availability of curling rinks and equipment is very limited. Using home made curling stones of ice, the pupils can both get to try curling and practice problem solving.

The task put to the pupils is to create a curling rink and stones. One way of making the stones would be to fill a 10 litre bucket with 5 litres of water. A rope or a crooked branch can be used as a handle. The challenge is to fasten the handle in the water so that it freezes in the correct position. Making two knots at either end of the rope will make it sit more securely in the ice.

Give the pupils freedom to solve the problem their own way. If each pupil wants to make their own stone it can be a good idea for the pupils to prepare their stones at home.

Handicrafts and technology

Bricks of ice

Fill milk cartons with water and let them freeze. Loosen the ice blocks and use as bricks. Place the cartons in a bucket of hot water if it is difficult to loosen the ice blocks from the milk cartons. Use the blocks for building and use snow mixed with water as mortar. If you want bricks of various sizes, simply use other cartons.



Ice lantern

Place a plastic bottle filled with stones or sand (so that the bottle does not float) on the bottom of a bucket. Fill the bucket with water and let it stand outdoors over night so that the water freezes. The following day, or whenever the water is all frozen, pour hot water in the bottle so that it comes loose from the ice. Put the ice from the bucket upside down and place a candle where the bottle was previously. Drill a hole through the top to let out smoke and make sure the candle has access to oxygen. If you want different colours or textures in the lantern, use outdoor objects such as leaves, needles, etc.

Snow snake

Roll big snow balls (big enough for making snowmen). Place them in a row and fill the gaps with more snow. Make the snake long enough for the whole class to sit on.

Winter shoes

In co-operation with handicraft classes, the pupils can make their own winter shoes. Let the pupils decide which material they believe is most appropriate and how best to make the shoes. The teacher will be the judge of what is possible to do.

Let the pupils test their shoes outdoors. How long can they stay out in the cold in their homemade shoes? Maybe you can make simple shoes out of newspapers and plastic bags? Why not a pair of shoes with papier-mâché soles or is it possible to make shoes of wool? Discuss how people made shoes in olden days? What are the criteria for a pair of shoes to keep the warmth?

Bulrush

Sew a textile pocket in form of a shoe sole. Pick bulrush and fill the pockets with the seeds. Close the pocket, place the soles in your shoes, and see if they isolate against the cold. To make this exercise easier, simply collect the seeds in a plastic bag and use as a sole or for sitting on outdoors. All work with bulrush should be done outdoors to avoid seeds scattering all over the room.



Bird boxes and seed dispensers

Making bird boxes and seed dispensers is an excellent way of learning functional design while helping our winter birds. Let the pupils draw up blueprints which clearly show the form and function of the object to be built. Important aspects to consider for bird boxes are: the size of the entrance hole, the distance between the bottom and the entrance hole, and if it should be possible to open the bird box. For seed dispensers, it is important that the birds cannot leave droppings in the food and that no other animals, such as rats, can reach the dispenser.

Visual art and music

Snow graffiti

Fill a couple of water sprinklers with coloured water. Use environmentally friendly pigments such as food colouring essences, beetroot juice, or water soluble colours. Decide on a motif or let the pupils paint freely on the snow.

Listen to the song of the ice

Visit a lake or the sea and take in the mystical sound of the ice. The sound comes from tension in cracks in the ice. The tension is caused by changes in temperature as well as air pressure.

Photograph hoar frost

During winter, the landscape can be made blindingly white by hoar frost (steam that freezes), or misty frost (water drops which freeze and create crystals). Make close-up photographs of the crystals on grass and plants. Also make photographs of windows where the crystals can become clear when it is very cold outside. Make an exhibition of your pictures.

Winter Swedish

A winter story

If the pupils have worked with the brownie and his adventures, this experience and the digital photographs could be used for letting the pupils write their own stories. In writing, the pupils display their creativity and knowledge of nature's ability to survive winter.

A survival story

Each pupil chooses an animal or a plant. The task is to describe the chosen animal or plant from autumn to spring. Take your starting point in the problems faced by living organisms during winter: lack of food, lack of water, cold, and darkness. The story can be written from a first person perspective, or the plant or animal can be given a name and the story can be told in third person. This task needs some preparatory work.

Mind poetry

See the section "mind poetry" in the chapter "Discovering nature using all senses".

The snow poetry trail

Poetry inspired by winter and written by the pupils can be show cased along a trail. Either use an existing track or trample down snow to make a trail. Write the poetry in the snow using water based colours and let the pupils read each others poetry. If the parents want to read the poetry after work, they can bring a torch and walk along the trail. A haiku or cinquain can be an appropriate form for this exercise (see chapter “discovering nature using all senses”).

Winter

Cold, white, grim

Walks with a squeaking foot

A pleasant shiver runs through the body

Snow time



Cinquain made out of ketchup mixed with water and sprayed on with a flower sprinkler on snow as a canvas

Snow sculpting

Snow is perfect for painting pictures on but even better for sculpting three dimensional figures. This is a good opportunity to let each pupil to use as much building material he or she wants and create shapes that feel flat in a text book.

Winter Math

Throwing snowballs

Everybody enjoys throwing snowballs at a tree. Combine this with practicing multiplication. Each hit gives a number of points according to which times table is to be practiced, e.g. each hit gives 8 points when practicing the 8 times table. Each pupil is responsible for keeping track of his or her own score.

Track temperature changes

Measure the temperature regularly during a certain period. Also measure the temperature in different locations and discuss the concept of micro climates. Present the temperature changes over time, and difference between locations, in table format. Which kind of tables is most appropriate for this? Which locations had the largest and smallest temperature variations? Which place was the coldest or warmest?

Melting snow

Bring in a litre of snow inside and let it melt. Which volume of water is produced? How many millimetres of rain does the snow correspond to? Bring a kilogram of snow inside and let it melt. How many litres of water is a kilogram of snow?

Snow diagrams

Make big diagrams in the snow. Mark the planes using natural colours or by trampling the snow. Example: Let the X plane be shoe sizes and let the Y plane be number of pupils. The pupils will then stand in the diagram to make a column diagram illustrating their shoe sizes. Discuss which shoe size is the most common and introduce the normal distribution You can also paint a curve to illustrate this concept.

Seed studies

Study which seeds birds like the most. Place the same number of different kinds of seeds in an open area. Return after some time and count how many of each kind of seed have disappeared. The more tests performed, the more accurate the result will be.

Food for thought

How cold must it be for water from a water sprinkler to freeze to ice before it hits the ground?

Literature, homepages and material

Sonia Eriksson & Hans-Georg Wallentinus (1990): *Nature during winter*, Bonneirs

The book of animal tracks

The field biologists: *Buds*

Björk & Lofterud: *The flowers of winter*

Rapp & Holmberg: *Year round flora*

Cross-word solution

1. Needles
2. Seeds
3. Woodpecker
4. Gold crest
5. Hibernation
6. Vitamin C
7. Reindeer moss
8. Mushrooms