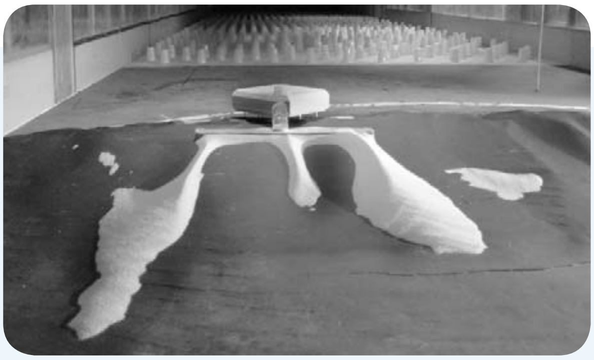
teachers' dossier
/03

⬡ History ⬢ Languages ⬡ Geography ⬢ Science

The Station:
from the inside out!



INTERNATIONAL
POLAR FOUNDATION

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THEORETICAL NOTE

Thanks to a lengthy preparation, to careful studies carried out back home and to a wealth of observations and measurements taken during various BELARE expeditions (see the educational file 'BELARE: the station was not built in a day!'), a tight-knit team of designers, engineers, scientists and other specialists has succeeded in completing the design of the Princess Elisabeth Antarctic (PEA) Station. The final building plan, after countless additional modifications to the original idea, has at last taken shape. All of the adjustments made were related to the zero-emissions concept, the aim being to have as little an impact as possible on the Antarctic environment.
In this educational file, we will analyze the final result of the Princess Elisabeth Antarctic Station from the inside out and have a good look at what makes it tick. We will also dwell a little on some of the amazing technological feats and achievements that have made the new base possible, a 'taster' for the in-depth version to be covered in the next educational file: 'The technical side of the Princess Elisabeth Station'.

This dossier presents the station using a fiction. A scientist is touring the station with four students.

Heaven and Earth seem to have become one. It feels like the mother of all storms is blowing at us. Visibility is virtually down to zero. We have been dropped off by a small plane with the four lucky winners of a competition after what might be euphemistically called a bumpy flight. We are alone at the foot of the **Nunatak** (1) in Utsteinen. In the background, if you look closely, you can make out a black shape bent over in the distance. We assume this is Mark, a qualified bio-engineer. He is just one of the fortunate people allowed to conduct research on the frozen continent during the four months that compose the **southern summer** (2) - something that will forever remain a dream for so many others. Suddenly, the black dot begins to move. It grows and gradually changes into a black line. The nearer Mark comes, the more the sky clears. And before you know it, heaven and earth split into a blue sky and a snow-white ice plateau. Wrapped up warmly from head to foot, Mark shakes our hand and immediately suggests he gives us a tour in and around the station. A wonderful and unforgettable adventure has begun out here in the middle of nowhere.

1 A **Nunatak** is a mountain that is party or totally covered with ice and/or snow from the icecap.

2 The **southern summer** is summer in the southern hemisphere (December-January) as opposed to the northern summer in the northern hemisphere (July-August).

THE EXTERNAL DESIGN

We have only been here a couple of hours and we have already seen a storm, wind and sunshine. We can see that the station has to be built to stand up to extreme weather conditions: temperatures anywhere between minus 50 and minus 5°C, a monthly average wind speed of 20km/h with dominant **katabatic winds** (3) that can whip up to 250km/h mainly coming in from the south-east, an average atmospheric pressure of 830hPa, a varying precipitation rate that depends on the **snow drift** (4) and 24 hours of daylight during 100 of the 120 days of the southern summer season.
Luckily, the sun is now shining down beautifully from a bright blue sky and Mark begins his explanation. We are all ears and, like lambs following their mother, we keep close to Mark. He has been involved in the project since the beginning and can tell us all about the concept behind the Princess Elisabeth Antarctic Station from A to Z.

3 **Katabatic winds** are powerful winds driven by the force of gravity and the weight of the cold layer of air, that blow from the more elevated interior of the continent, down the inclines of the icecap to the lower lying coastal areas.

4 The **snow drift** is a change in direction of the snow caused by the wind.

The shape

"The shape of the station was chosen to comply with the **laws of aerodynamics** (5)," Mark tells us. A number of different designs were tested by the Von Karman Institute (VKI) in the biggest subsonic wind-tunnel in Belgium. The tests involved looking at the position (height), orientation and shape of the station on the ridge, because the structure has to be exposed to as little impact from the wind and snow as possible. At the same time, the conceivers had to ensure the right conditions for safety, maintenance and accessibility.

5 **Aerodynamics** is an area of dynamics that studies the movement of air in relation to a given object.

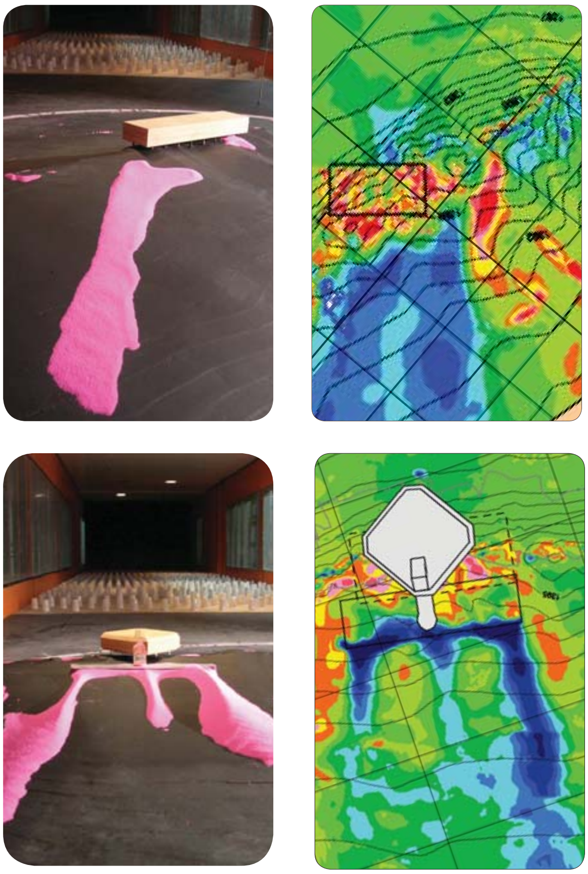

Figure 1: Various designs were tested in a wind-tunnel for snow erosion.

The station is situated 2 metres above the mountain ridge. High enough still to allow people to walk under the station, it is oriented from east to west so that it can withstand the strong south-easterly wind. The original plan was to have a rhomboid-shaped design, but this gradually evolved into an octagonal structure.
To restrict wind stress and snow erosion around the main building and the 'garages', it was decided to have a combination of sharp and curved angles. The sharp angles enable to control turbulence caused by the wind. These angles are not built into all of the external walls but are situated in carefully selected locations to reduce wind stress on the building. This reduces both cracking noises and movement of the walls.
Conducting these studies is important because, in the past, many stations have had to deal with snow accumulation, resulting in some structures ending up partly or totally buried in the snow. Mark suggests that one of these days we should go and take a look at the abandoned King Baudouin base, or what's left of it. Over the years, the old base has become totally buried in the snow (see 'Belgians in Antarctica through the centuries'). To prevent this, bases are now often built on pillars, allowing the wind to blow the snow out from underneath the building.
When we come to the rear of the station, we notice a special feature worthy of a mention: this is *the wind conductor*. Mark immediately sees what we are looking at and pre-empts our questions with a word of explanation: "Because the station is higher off the ground at the back than at the front, the wind is channelled and sped up significantly. To reduce the wind strength, the ground clearance at the rear is diminished by a wind conductor, so that the wind strength is better distributed."

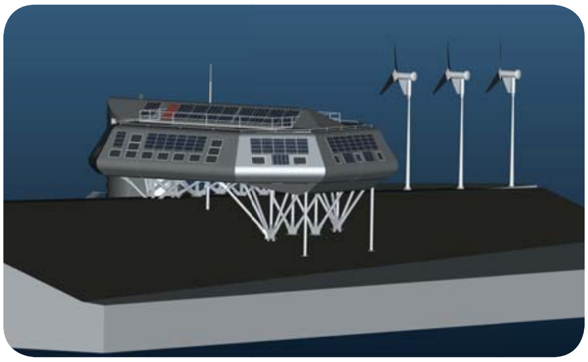

Figure 2: The wind conductor can be seen clearly under the rear side of the station.

The pillars

We may think we would like to take a walk underneath the station, but Mark strongly recommends we do not: "The winds can be enormously powerful down there sometimes and I don't want you blown off your feet on your first day," he adds with a wink. We begin counting and get as far as 34 pillars. The decision to build the station **on pillars** placed on **granite foundations** was based on the fact that first and foremost stone provides the necessary stability, whereas the surface of the ice and snow constantly moves. The second reason was to prevent the snow from piling up, because the strong winds blow through underneath the building through an area that is naturally free of snow. The height of the pilars can vary from 2 to 6 metres, depending on the location. It sounds logical to us.

I ask how the pilars are anchored. Mark has to think about it for a moment. But in a matter of seconds, he conjures up an answer: "First, holes up to 6 metres deep were drilled into the granite base. Once the structure was installed, the holes were back-filled using a resin that hardens when heated. Getting it to set was no easy task, but the problem was solved by circulating hot water through the hollow core of the anchoring poles for a number of days." For the wind turbines, though, the engineers working with the **composite materials**[6] came up with another brilliant idea: 1) six anchoring points with a maximum depth of 2 metres were drilled at predetermined points; 2) steel supports with heated wire were then fixed in the drill holes; 3) the base of the windmills was installed

6 **Composites** are made from artificial materials.

at a right level and then resin was poured round the electrical wires in the drill hole. Once that was done, the resin hardened due to the heat given off by the electrical cables. Very clever.

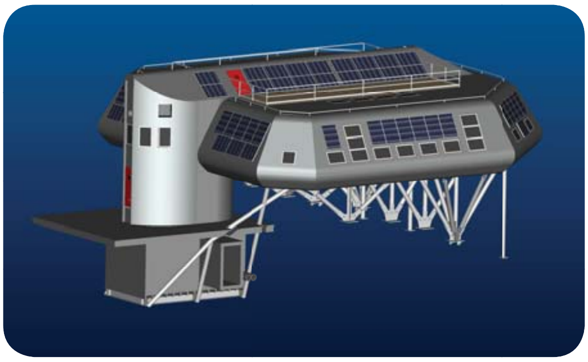

Figure 3: The height of the pillars can vary from 2 to 6 metres. The roof terrace is reached through doors in the dormer windows.

The roof terrace

Up on the roof, we see two people 'walking'. Mark calls out to one of them: "Leooooooooooooo? How's it going with the **aerosol** readings [7]?" He adds that the two roof terraces are each 30m² in size and can be reached through two doors in the dormer windows. But why have a roof terrace when there is so much open space all around the station? Because some measuring instruments have to be at a certain height and can only operate using short cables that send the details of the readings back to the labs below.

The solar panels and wind turbines

We continue on our tour. The station is supplied with electricity which is generated by a combination of wind turbines and solar panels. The reason for this is to reduce the consumption of fossil fuels (which are used only in case of an emergency) to a minimum and to limite the station's impact on the environment. We can now see with our own eyes how the eight sturdy windmills, each having a capacity of 6 kWh, supply the station with electricity at 230V. The 9-metre-high turbines jut out proudly above the horizon to the north of the station, on the Utsteinen mountain ridge. The first of them is just 50 metres from the station. Each turbine consists in 3 blades, manufactured from extremely strong yet flexible **thermoplastic** [8] composite material, has a **direct-drive generator** [9] and a **self-regulating rotor** [10] that turns with the wind.

7 An **aerosol** is an extremely fine mist of solid or liquid particles found in the atmosphere or in another gas.

8 **Thermoplastic** involves making something soft or 'plastic' by heating it.

9 A **direct-drive generator** is connected directly to the rotor, which minimises any energy loss. This means that the amount of power generated is directly dependent on the speed at which the rotor turns.

10 When the speed of the wind is too great, the turbine normally switches off automatically. A **self-regulating rotor** prevents this from happening and ensures that the wind turbine is merely slowed down.

Figure 4: A wind turbine supplies the station with electricity.

At the front, we can also see the solar panels. However, what we didn't know is that there are two different kinds of solar panels: thermal and photovoltaic. Once again Mark comes up with an explanation on the difference: "The thermal solar panels take up an area of 22m² and provide heating (see the term 'thermal') and hot water. The second type of solar panels converts solar energy into electricity ('photo' means light, 'voltaic' means electricity – think of volts). There are 109.5m² of photovoltaic solar panels on the station itself, with a further 270m² installed out on the rock. Together, they have a total output of 50.6kWh." When we look out, we can see the other panels, fitted to metal structures, that have been installed on the rocks.

More information can be found on the station's energy requirements and production in the educational file entitled 'The technical side of the Princess Elisabeth Station'.

The walls

We have already been outside for an hour. Time flies when you're having fun. Although the sun is still high in the sky, the cold is gradually seeping through our clothing. Our fingertips are going numb. How can we explain that the cold doesn't seep through the walls to cool down the inside of the station? Once again Mark knows the answer.

The walls make up the wooden support structure. Nine layers provide a thermal barrier between the outside and inside of the station. The walls are capable of withstanding winds of 300km/h while, at the same time, preventing wear and absorbing shocks. These walls also provide a sufficient level of insulation. The cold would have to penetrate a highly insulated wall, approximately 53 cm thick, before it gets inside. All of the joints are sealed in such a way that no air passes through. Now that's insulation!

The successive layers from the inside to the outside are:

- woollen felt (stuck to the next layer with Velcro) is the final layer inside;
- an aluminium foil water vapour skin (barrier made up of tiny pores) to prevent any inside humidity from getting into the wood;
- kraft paper (very strong paper made from Abaca (*Musa textilis*), which is a type of banana);
- a layer of glued and laminated pine wood, 74 mm thick;
- a 400 mm thick graphite layer coated with low-density polystyrene (main insulating layer);
- a layer of glued and laminated pine wood, 42 mm thick;
- a 3-mm thick resistance layer which, at the same time, serves as a watertight layer on the wood to prevent any outside moisture from coming in;
- a layer of closed-cell foam, 5 mm thick;
- a layer of stainless steel sheeting, 1.5 mm thick.

Figure 5: The cross-section of a wall module.

Mark has a few more numbers to impress us with: the walls of the station are made up of 168 panels of which there are 40 different types. Each panel has a surface area of approximately $7 m^2$ and weighs about 500 kg. The panels were designed in such a way that they fitted inside 120 containers like a jigsaw puzzle so as to be shipped off to their final destination in Antarctica… where we are standing now!

The windows

Through one of the windows, Kate waves at us from her desk. We wave back. Because scientists spend most of their time sitting at their desk, it was decided to position the windows of the station in such a way that they would have a direct view on the endless white scenery – and see us. The glass in the windows can bear temperatures that reach minus 71°C and winds up to 280 km/h. The windows also have a little handle that enables the air pressure inside the cavity between the panes to be adjusted. The position and location of the windows contribute greatly to the temperature inside the building.

Mark draws the cross-section of a window in the snow, showing the various layers to allow us to appreciate just how thick they are. Each window actually consists of 2 separate windows, one on the outside of the wall and the other on the inner side. Each of these windows has two layers of special double-glazing and a **sun heat filter**[11] in the empty part in the middle. The window on the outer side is reinforced with 3 layers of glass along the outside. The space between both windows is a space of 400 mm thick filled with air.

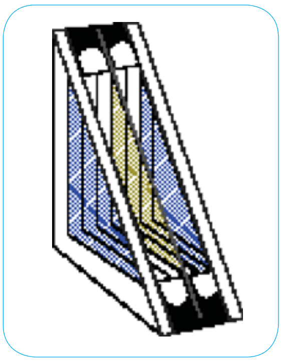

Figure 6: The cross-section of the inner window, with double-glazing and a sun heat filter in the middle.

Even the silicone glue, required to create a secondary seal for the insulated units, was chosen for its ability to resist ultraviolet radiation and for its permanent elasticity and proven long service life. They seem to have thought of everything.

11 A **sun heat filter** filters out certain wavelengths from the sun to prevent the heat from penetrating inside. The internal temperature is regulated via a ventilation system that is discussed in detail in the education file on 'The technical side of the PE Station'.

THE INTERIOR DESIGN[12]

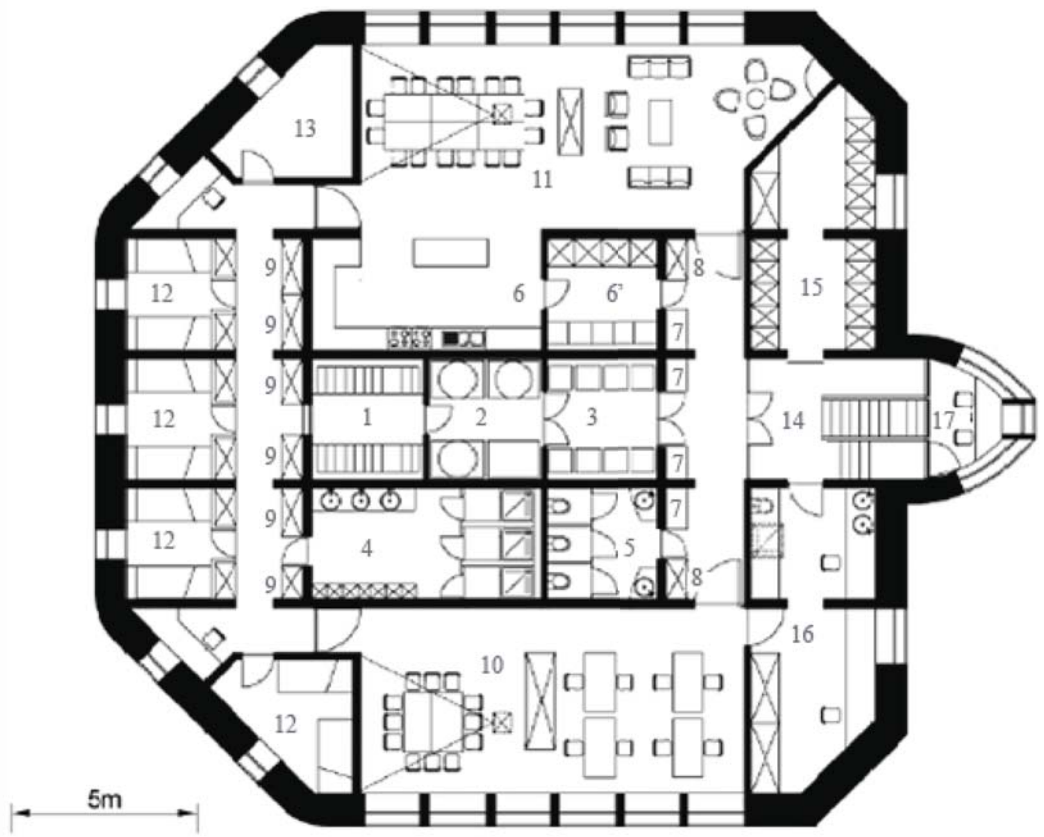

Figure 7: A diagram of the interior.

The entrance hall, observation area and garages

And now, finally, we are able to take our first steps inside the station. Mark takes us to a long pipe located just behind the accumulation area and that forms a tunnel which runs from the garages to an area where the wind doesn't blow so hard. Just like in a science-fiction film, we walk through the tunnel until we reach the tower. Up we go, step by step. But why do we come in using this route and not through the red front door? And why red? For greater visibility, Mark tells us. It would not be the first time that someone froze to death just a few metres away from a base. Many other stations are totally red. This particular door is only used in the case of an emergency. So, it's actually an emergency exit and not an entrance door at all.

Figure 8: Look out for the pipe that forms the entrance to the garages as well a to the station itself.

Anyway, as soon as we have climbed the tower, we find ourselves in the *hall* (see figure 7, n° 14), from where we can see out in every direction. Although there's no lift as such, there is a sort of hoist in the tower that can carry heavy equipment from the garages to the internal areas of the station. Oh yes, there are the *garages* (see figure 3). They are totally buried beneath the snow and take up an area of 350m² out of the total 1050m². They are linked to the

12 An animation can be viewed on http://www.antarcticstation.org/flash/virtual/index.html

station via the tower. The garages are divided in two and separated by the tower: 1) the North or 'dirty' garage, where repairs are carried out and which also houses the emergency generators, and 2) the South or 'clean' garage, which accommodates the snow melters, cold laboratories, scientific equipment and food. If there is a storm, the inhabitants of the station can take shelter here and continue working.

When we reach the top of the stairs, Mark asks us to look behind us. We are struck dumb. From the station's *control room,* which is also the *observation point* (see figure 7, n° 17), we look out over a never-ending sea of snow and ice. Once we have absorbed the view, Mark leads us by the hand to explore the inside of the station, layer by layer.

He compares the various layers of the station with those of an onion. While the living accommodations are found in the outermost skin, the **bioreactors**[13] and other sensitive equipment can be found in the center of the station, where it is always warm.

The outermost skin

Changing room

We follow Mark into the *changing room*. We are wearing our sturdy footwear and our thick jackets which are lined with a good 3 different layers of fabric and have hoods with a fur ruff that hide our faces like an **Inuit**[14] (see figure 7, n° 15). The changing room is located here for safety reasons. If the station has to be evacuated, the inhabitants can quickly pull on the clothing they need to survive outside before they leave the building. For us, however, it's time to take everything off and store it away. This immediately makes us feel a lot lighter.

The laboratory/sickbay

Next stop is the '*laboratory*' which incidentally can be converted into a sickbay (see figure 7, n° 16). It is equipped with only the bare minimum since most of the scientific research takes place in the labs that are located in the garages. Mark takes out of his jacket some of the samples he has taken earlier in the day from a frozen pond. He will analyse these samples and study them in detail at a later stage (for information about the scientific research conducted at the station, see educational file 'Putting Polar Science to the Test').

The office area

It suddenly occurs to us that everything is rather quiet around us. Where is everyone, we wonder? We had only just said this when we came across our first resident of the station, apart from Mark that is. And, who should it be but Kate, still at her desk, immersed in articles. Without realising it, we had come into the *office area* (see figure 7, n° 10). This is where the first results obtained in the other labs are further examined by the scientists, who can also consult reference books and so forth. We move on so as to not disturb Kate.

The sleeping quarters

Before he introduces us to the rest of the team in the station, Mark shows us the *sleeping quarters* (see figure 7, n° 12). There are five mini-dormitories in all, each capable of accommodating up to four people in 2 sets of bunk-beds. They're a bit like the cabins you would find on board a boat and make the best possible use of the available space.

The living quarters

Ah, now we can at last meet the rest of the crew. As we go into the *living quarters* (see figure 7, n° 11), we pass by a small fitness area (see figure 7, n° 13) and then see everyone sitting around in comfortable chairs. One person is reading, another is watching a DVD and a small group is playing a board game… Something to suit everyone.

The middle skin

"We've done the outermost skin," says Mark. "Now it's time for the next skin". These words pique our curiosity once again. It appears to us that this middle skin houses what is important for sustaining life. Food, provisions and other items such as sleeping bags, toilet paper, etc. can be kept and stored in the *west and east storage areas* (see figure 7, n° 8-9). They also provide a thermal and acoustic buffer for the technical core of the station.

Laundry

Our personal guide shows us the *washing machines* (see figure 7, n° 7). Nothing special about them, we think – while in fact we could not be more mistaken. "A set of two washing machines can meet the laundry needs of 12 to 20 people living at the station," says Mark, raising his finger to make the point. Each machine has a load capacity of 7 kg and spins more quickly than a conventional machine. This means that the clothes come out drier so as to require less time in the tumble-dryer, a very quiet, energy-efficient machine.

The *tumble-dryer* has been especially designed with

13 A **bioreactor** is a reactor that uses controlled biological processes to produce pharmaceuticals, chemicals or foodstuffs.

14 **Inuit** (meaning 'men') is what Eskimos (translation of 'eaters of raw meat') call themselves.

a shelf built into it for drying shoes and boots. Great. You can also put in the dryer clothes that are made from wool, an excellent insulator. Each machine is equipped with a special condensing system that enables the water from the clothes to be collected and reused for washing, rinsing, cleaning, etc. All of this is totally in line with the station's low-energy design.

The two sets of machines, each one composing of both a washer and a dryer, are used alternately so that if one should break down, there is always a spare one. Clever thinking.

Toilets and bathroom

Our guide can't hold on any longer. He needs to visit the *smallest room* urgently (see figure 7, n° 5). What a coincidence, we happen to have just reached it! Once he is back, Mark shows us the *bathroom* (see figure 7, n° 4). How an ordinary bathroom can be so special! There are three showers and, with the right timing, there's no need to queue.

Kitchen

All that running around has made us hungry. Two scientists are in the kitchen, cooking for the whole gang. There's a real group spirit as the pots and pans clink and clatter away. On the menu today are lasagne and moussaka. Once the ingredients have been put together and the necessary mixing done, two dishes of lasagne and another two of moussaka are ready to be put in the oven. But how are they going to fit four dishes into two ovens? Not a problem. The *kitchen* (see figure 7, n° 6) is equipped with two double ovens, which means that different dishes can be prepared at the same time. And if only part of an oven is being used, that section is all that is heated, resulting in less energy being used. Brilliant.
Any other cooking is done on an induction stove. Induction cooking is the most economical way of cooking because there is virtually no energy wasted. Only the base of the pan is heated.
Waste from preparing the vegetables is broken down in a special grinder and a pumping system sends off the residue to the bioreactors.

The kitchen is also linked to a '*weekly store*' (see figure 7, n° 6') in which the food stocks for one week can be kept. There are also freezers and refrigerators, and lots of storage space.

The technical core

While we are waiting for the lasagne and/or moussaka, Mark wants to show us the final skin. The core of the station contains most of the machinery that generates heat loss and is divided into three technical areas: the Station Control System (SCS), the Water Treatment Plant (WTP) and the Energy Storage Area (ESA). They are located behind a double automatic door that opens as we walk by. At the far end of the core is a fire safety door.

The Station Control System (SCS)

In the first room, you'd think you were in a mini power station (see figure 7, n° 3). Mark stresses the importance of having a reliable electrical system that is affected as little as possible by any external or internal disruptions. In fact, all of the scientific equipment relies on a dependable power supply to operate. The decision to have the electricity supply cables located *on* the walls (meaning that inspections and repairs can be carried out quickly), just as the electricity switching diagrams and distribution boxes are, follows predetermined guidelines.

The Water Treatment Plant (WTP)

As we go into the next area (see figure 7, n° 2), Mark is able to boast about 'his' water treatment plant. The scientists at the Princess Elisabeth Station are the first in Antarctica to reuse their own wastewater, just like space travellers. 75% of the water used is recycled for secondary use. The actual treatment takes place in several phases: bioreactors, filters, UV radiation and activated carbon. After it has been treated, part of the water is discharged into a cleft between the ice and rocks. No wonder Mark is so proud of it.
He also shows us the collection tanks under the roof, which are filled with melted snow and ice, and which supply drinking water. This water is carried out of the snow-melters that are topped up both automatically and manually with fresh snow via a hydraulic pumping and piping system from the South garage. Underneath are the bioreactors for the wastewater treatment system.

The Energy Storage Area (ESA)

Last but not least, we come to the heart of the station, where the batteries store the power which is generated by the solar panels and the eight wind turbines (see figure 7, n° 1). No batteries means no electricity which, in turn, means no scientific research and no base. Total annual energy requirements are approximately 54MWh. In view of the fact that this is a summer station, more power is consumed during the four months of the southern summer (7000**kWh**[15] per month) than during the eight winter months (2000kWh per month). In case of an emergency, there are also

15 A **kilowatt hour (kWh)** is a unit of work or energy. Example: a 100-watt light bulb left burning for 10 hours uses up 1 kWh.

two 44kW diesel generators available.

Details of energy production and consumption, as well as a description of the water treatment process and other technological matters can be obtained from the educational file on 'The technical side of the PE Station'.

We suddenly hear an alarm clock start to ring and everyone looks at each other. A Fire? An earthquake? A storm? There are no windows in the central part of the station making us completely cut off from everything around us. Anything could be happening out there. With a broad grin, Mark announces, "Dinner time!"

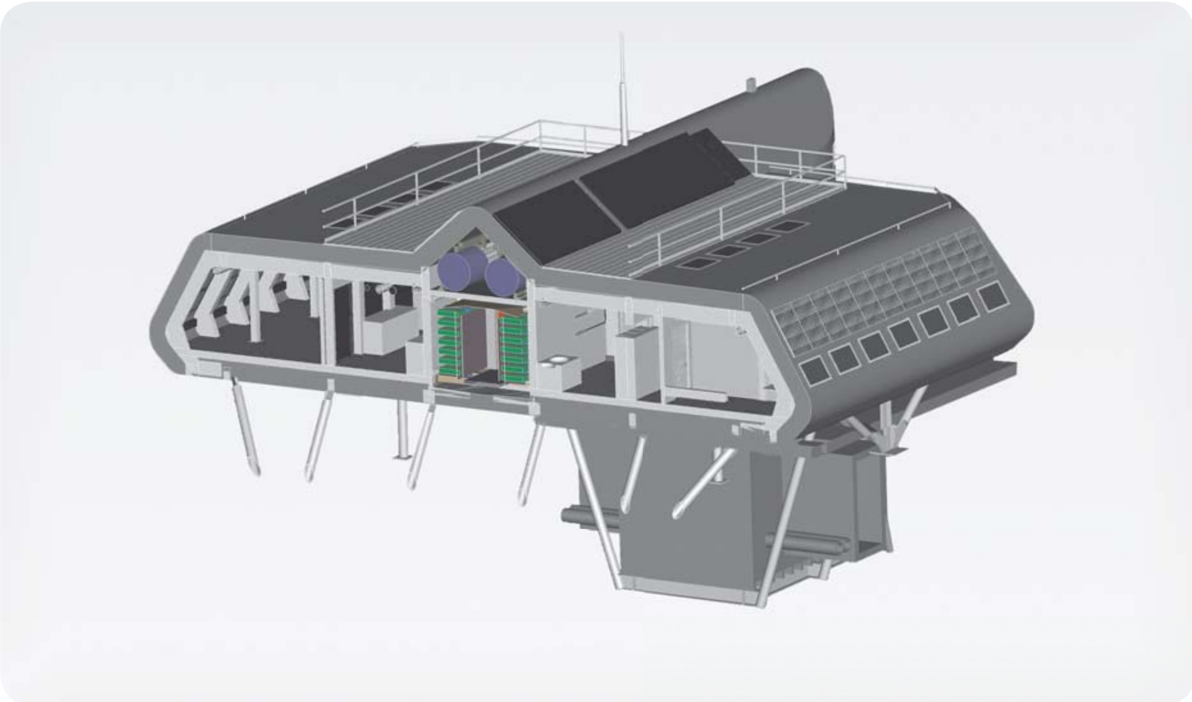

Figure 8: A section of the Princess Elisabeth Station.

EDUCATIONAL NOTE

1) NOTE FOR THE TEACHER

60 years after the King Baudouin Base, a new era has dawned for Belgium in Antarctica with the construction of its new scientific base: the Princess Elisabeth Antarctic (PEA) Station. This subject is something that can be mentioned in various lessons. The educational file on 'Belgians in Antarctica through the centuries' provides an overview of the history of international and national exploration on the frozen continent, from the 18th century to today. The PEA Station holds a central place in today's media. The preparatory phases prior to this project – the BELARE expeditions – are also discussed in a file bearing the same name. The various methods and technologies which have already been mentioned in this file are discussed in detail in a fourth file. There will be a fifth and final file dealing with the polar sciences which will be conducted at the station.

This topic naturally covers a number of different areas: history, language, natural sciences and technical education. This should encourage both teachers and pupils to work in groups to dig out information in order to create a comprehensive picture of what the station is today and of what it will do in the future.

2) OBJECTIVES

The objectives of this file imply it can be used for a variety of subjects, ranging from French or English to biology and physics. Having technological and technical knowledge always comes in handy, so it is clear that the topic is both subject-specific and cross-subject.

Language

Having good reading and writing skills is always of great value: these skills enable you to select relevant information and to identify the structure and coherence of texts. You can organise and assess this information in a clear and personalised manner, enabling the content of informative texts to be displayed and summarised overall. The pupils learn how to write a short summary. The subject of the text is general, ranging from sustainable living to the various bases in Antarctica.
In planning, carrying out and assessing their learning assignments, the pupils can apply reading and writing strategies that promote reading targets and the use of communication strategies (i.e. deduce the meaning of unknown words from the context, consult suitable (…) electronic sources and databases, and use supporting visual material and ICT).
Pupils will read what they have learned, by focusing on what they want to learn and taking good care of the presentation of their written texts.

Natural sciences

By setting up a wind-tunnel model, the pupils learn how to conduct an experiment by abiding to the rules and instructions.
BIOLOGY – The pupils can demonstrate that individuals and society have to act responsibly for the environment. They also learn how to make a critical assessment on the interplay between social developments and the environment; and how to view and process information on electronic media. The pupils can demonstrate the importance of 'sustainable development'.
PHYSICS – Describing the concept of using energy correctly and in practical situations; identifying and recording mechanical and other forms of energy in practical situations; describing energy conversion; learning the law of energy conservation.

Pupils can understand the terms '**technology**' and '**technical**' and what hides behind them; they can also develop a constructively critical attitude towards technological and technical professions and companies.

The different aspects of **learning** and **educating about the environment** also apply to the various activities proposed.

3) SUGGESTED ACTIVITIES
(ALSO SEE THE WORK SHEETS FOR PUPILS)

Introduction

A short summary of the inside and outside of the Princess Elisabeth Station can be given via a PowerPoint presentation (which can also be downloaded from http://www.antarcticstation.org).

1) Wind-tunnel experiment

Duration: 2 to 3 lessons
Target audience: Grade 3
Subject: Natural sciences
Purpose: The pupils learn how to carry out the experiment correctly by following the instructions and working together with their classmates. Energy is also mentioned and discussed, as well as other aerodynamic laws of physics.

Divide the children into two groups. Each group has to make a model of the station and test its position, orientation and shape in a home-made wind-tunnel filled with sand. Once the model has been made, place it in the tunnel in the sand. The force of the wind is then simulated by using an electric fan.
Watch and compare how the sand moves and determine which model is affected least by the wind and by the accumulation of snow and ice. Establish the link with aerodynamics.

2) Sustainable living

Duration: 1 to 2 lessons
Target audience: Grades 2 and 3
Subject: Languages, Natural sciences, Technical/Technological Training (environmental education)
Purpose: The pupils learn how to seek, view and select usable information, analyse this information and summarise it in a carefully written text.

After a short introduction on the inside and outside of the station, in which the pupils are given an initial introduction about the station by means of a PowerPoint presentation with a range of illustrations, they can continue working at home or in class and write a short essay about how it is possible to live sustainably. The Princess Elisabeth Station can be used as an example, focusing on the sustainable equipment used in the laundry, kitchen, etc.

3) Comparison of other Antarctic bases with PEA Station

Duration: 1 to 2 lessons
Target audience: Grades 2 and 3
Subject: Languages, Natural sciences, Technical/Technological Training (environmental education)
Purpose: By referring to a list of Antarctic research stations already drawn up, the pupils need to find and select information from electronic information media. They then analyse the information they have gathered and summarise it in a carefully written text. English and French-language websites can be selected in advance.

After a short introduction on the inside and outside of the station, in which the pupils are given an initial introduction about the station by means of a PowerPoint presentation with a range of illustrations, they can continue working at home or in class and compare the Princess Elisabeth Station with various other Antarctic bases in terms of shape, position, people manning the base, location, size, nationality, etc.

4) Heat insulation test[16]

Duration: 1 to 2 lessons
Target audience: Grade 1
Subject: Technical/Technological education
Purpose: To explain the function and structure of the various building elements, including thermal insulation, using the actual example of the Princess Elisabeth Station.

Clad a scale model with 3 to 4 cm of insulating material (fabric, polystyrene, steel, glass, etc.). Make sure all the corners are sealed nicely; the insulation material to be tested will form the lid of the box (heat rises). Place the box in a tub of hot water and take the box's temperature at regular time intervals (insert a thermometer through the side wall). Repeat the test with a different insulation material each time. Which material provides the best insulation?

5) Other

- Experiments based on the first law of energy conservation can be carried out during a physics lesson, establishing how wind energy can be converted into electricity (grades 2 and 3).
- Different types of wind turbines with different blades, diameter, etc. can be tested on their number of revolutions, speed, etc. (grade 3).

16 Source: http://ond.vvkso-ict.com/leerplannen/doc//Technologische%20opvoeding-2005-037.pdf

SOURCES

WEBSITES

http://www.antarcticstation.org
– The media file provides a wealth of information.

http://www.polarfoundation.org
– Via Johan Berte, project manager for the 'Princess Elisabeth Antarctic Station' station.