teachers' dossier
/02

● History ● Languages ● Geography ○ Science

Belare:
the station was not built in a day!

INTERNATIONAL
POLAR FOUNDATION

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THEORETICAL NOTE

110 years after the *Belgica* expeditions and 50 years after the construction of the first King Baudouin Station (see pedagogical dossier 'Belgians in Antarctica through the centuries'), the International Polar Foundation marked a new era for Belgium in Antarctica with the realization of the first 'zero emission' research station: the Princess Elisabeth Antarctica (PEA) base! But how does one start such a project? Which steps need to be taken? Is it possible to build a station without having been to the site beforehand? Setting up such a project requires a lot of preparations. These preparations have been done during the BELARE-expeditions (BELgian Antarctic Research Expeditions).
This second pedagogical dossier will carry you through the exciting adventure of the BELARE-expeditions.

1) IDENTITY KIT OF THE PRINCESS ELISABETH STATION

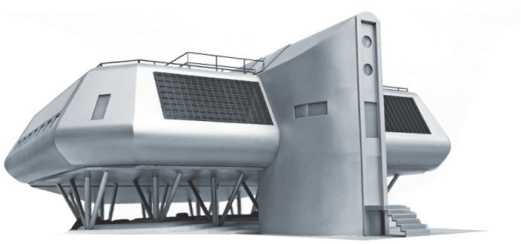
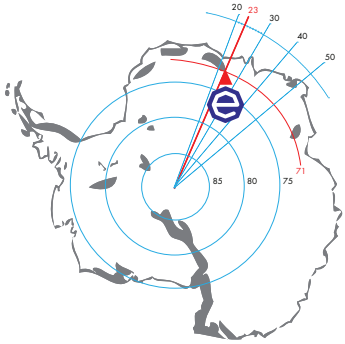


Figure 1: The Princess Elisabeth Station

First "zero emission" Antarctic station

- 100% renewable energy
- Wastewater treatment
- Sustainable technologies
- End of life disassembly



Utsteinen
71° 57'S
23°20'E

Figure 2: The location of the Princess Elisabeth Station

The New Belgian Antarctic Station

- 180 km inland
- Built on the ridge of the Utsteinen nunatak (mountain)
- Lifespan: 25 years minimum
- An average of 12 staff members, 20 maximum
- 1,500 m² usable space
- Summer station but year-round activity

There were good reasons for choosing a summer station and for carrying out the expeditions only during the **austral summer**[1]. The reasons[2] for doing this are:

- During the summer the Antarctic days are longer. On the 21st of December the sun doesn't set below the Antarctic Circle (lat 66° 33' 39''). On this day the sun shines for 24 hours. The PEA base will be located at a latitude of 71°57' South. Since its location is more southwards, there will be several days with 24 hours of sunlight. This will make it possible for the expedition members to work longer. Every year, there is a period of complete darkness for about three months.
- The rotational axis of the Earth slightly deviates from the perpendicular with respect to the plane of its elliptical orbit around the sun. This is known as the 'obliquity of the ecliptic'. It is responsible for monthly and seasonal differences in the angle of incidence of light which is in turn responsible for seasonal differences in temperature.
- During the summer the temperature in Antarctica is much higher, which makes work more pleasant for the crew.
- Finally, the continent is inaccessible during winter due to the high volumes of thick **pack ice**[3] floating in the Southern Ocean, which surrounds Antarctica. Furthermore, air transport comes to a complete standstill during this season. Those who decide to stay behind in the station would be left to their own devices for at least eight months.

1 The **austral summer** is the summer on the southern hemisphere (December-January) and is the counterpart of the boreal summer on the northern hemisphere (July-August).
2 The animations are bundled together in the CD-ROM "Polar Regions and Climate Change" which can be ordered or downloaded for free on the website www.educapoles.org.
3 **Pack ice** is a synonym for sea ice.

2) BELARE 2004 - SITE SURVEY EXPEDITION

Date: From November 25th to December 4th, 2004.
Objectives: Choosing a suitable location for building the station and carrying out the first field activities on-site.
Crew: Nine expedition members: Alain Hubert[4], Johan Berte[5], Luc Deleuze (architect), Nighat Amin[6], Frank Pattyn[7], Maaike Vancauwenberghe[8], Kazuyuki Shiraishi (a geologist at the NIPR (National Institute for Polar Research), Tokyo), Kenji Ishizawa (in charge of logistics, NIPR, Tokyo), and Shigeo Shiga (a technician from Komatsu Ltd., a Japanese company that manufactures construction equipment) are divided into two teams, the Utsteinen team and the Asuka team.

The nine expedition members fly to Cape Town where the last purchase of provisions and equipment takes place. From there they fly to Utsteinen with an intermediate stop at the Russian Antarctic Station, the Novolazarevskaya Station (popularly called Novo). Once on site, the team starts doing what it came to do. The Asuka team evaluates the Asuka base, which was abandoned in 1992. The Asuka base looks like an abandoned junkyard. Vehicles are scattered around the station. Year after year, the noses of the vehicles point more towards the ground down because the snow melts away under the front of the vehicles. This is caused by the heavy weight of the engines, the summer/winter seasonal cycles and the absorption of solar radiation. It's as if the snow is engulfing the vehicles. Icicles hang inside the tractors, forming an «ice curtain» in front of the driver's cabin. Kenji and Shigeo evaluate the situation and imagine what the station must have looked like in the past. In the meantime, the Utsteinen team chooses the location of the future station and selects the field activities.

Selection of the location

Whereas in the past, the Belgian King Baudoin bases were built on the shores, from which the inland expeditions were organised. Now the engineers have chosen to build inland, in the very heart of the region where many future PEA scientists will conduct field work.
190 kilometres inland from Breid Bay on the coast, the Sør Rondane Mountains rise above the immense masses of snow and ice. This mountainous area was chosen as the station site because it is well-protected from the strong autumn **katabatic winds**[9]. It is also situated near the old King Baudoin Station (180 km away) and the Japanese Asuka Station, which were closed in 1967 and 1992 respectively. Equipment, such as snow tractors, wooden beams, etc. from the Asuka Station can be easily recycled and reused during the next BELARE expeditions.
But where exactly in this mountainous area should the new station be built? In order to answer this question, eight different locations in an area of 300 km² are nominated as a potential home station. Subsequently, all members compare the different locations for the station keeping various parameters in mind: geological features, accessibility, safety, availability of drinking-water, wind-force, etc. And the winning location is: Utsteinen! The Princess Elisabeth station has a home!
Utsteinen is located 300 m to the north of the Utsteinen nunatak, on a small, relatively flat granite ridge that provides a stable station. The ridge – more or less in North-South direction – is 700 m long and a few meters wide. It rises 20 m above the surrounding snow surface in the **accumulation zone**[10]. The area is located at 71°57' South latitude and 23°20' East longitude, only a few kilometres away from the Sør Rondane Mountains. The station is easily accessible by plane and by various land vehicles. There is also soft snow in the area, which can be easily melted into drinking-water. And last but not least, there is a relatively constant wind in the area.

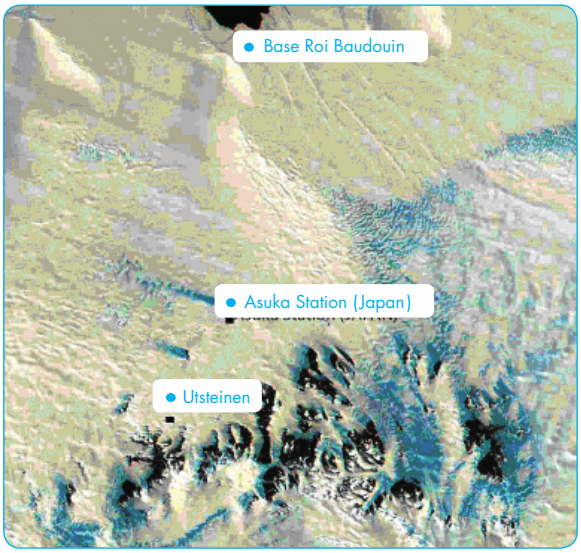


Figure 3: Satellite image of the Sør Rondane Mountains, the coastal area and the location of the former King Baudoin Station and Asuka Station

Field activities

Once the location is determined, the expedition members start to set up their station camp at the foot of Utsteinen and carry out field activities.

4 Co-founder of the International Polar Foundation (www.polarfoundation.org) and teamleader of the expedition (www.antarcticstation.org)
5 Project Manager for IPF (www.antarcticstation.org)
6 Programme administrator for IPF (www.antarcticstation.org)
7 Glaciologist at the ULB (Université Libre de Bruxelles) (www.ulb.ac.be) and advisor in the PEA project
8 Representative of the Belgian Science Policy (Belspo, Antarctica-program) (www.belspo.be/belspo/home/port_en.stm)

9 **Katabatic winds** are strong winds that blow down slopes from higher inland areas to the lower coastal areas under the weight of the cold layer of air and the influence of gravity. They can reach speeds up to 300 km/h.
10 An **accumulation zone** is a zone where accumulation of precipitation such as snow occurs.

Figure 4: The station camp at the foot of Utsteinen nunatak

First an Automatic Weather Station (AWS) is installed on the ridge in order to record the meteorological conditions of the surrounding environment. The AWS measures various parameters such as air temperature, wind velocity, atmospheric pressure, solar radiation, etc. The data is then sent to Toulouse and Brussels by satellite. The setup wasn't without problems, so the team had to improvise to replace the lost cables and repair a box that got damaged during transport. However they got he job done in the end.

Figure 5: The AWS

The expedition members also carry out topographic measurements of the area by using a GPS System. Dressed as Michelin Men, the land surveyors choose a reference point from which 3000 other points in the area are determined. In the end, all data is registered in a topographic map.

Figure 6: The GPS System

But it doesn't end there. Ice radar allows the expedition members to measure ice thickness and snow accumulation. The geology of the area is further examined as well as the local flora and fauna. The Madrid Protocol (1991) (see pedagogical dossier 'Belgians in Antarctica through the centuries') cites that sufficient information needs to be collected before starting such a project so that afterwards the impact of the activities on the Antarctic flora and fauna can be determined. Within this framework different excursions are organised. Loaded with all the necessary gear, the biologist leaves station camp. He takes samples of living organisms on the rocks and underneath the ice. Skuas are flying in the air above. They are hunting for snow petrels that often hide in the alcoves of Utsteinen. You feel very small, all alone on a ridge, surrounded by an endless white sea, which is a habitat for **lichens**[11], snow petrels, Antarctic skuas and in the near future, human beings, too.

All equipment can be stored in the snow after finishing the required measurements, research and observation. This is done to prevent snow from piling up against the equipment during the strong autumn katabatic winds.

11 **Lichens** are composite organisms. A fungus and a chlorophyta or a blue-green algae live in a symbiotic relationship. These organisms form a thallus (undifferentiated vegetative tissue), which attaches to rocks or tree trunks.

Figure 7: All the equipment needs to be stored in the snow in order to prevent snow accumulation.

The expedition is a huge success. All objectives have been met. Due to the failing of the ice radar however, measuring the ice thickness became a lot more difficult. But this will be taken care of in the next expedition.

Do you know what they use for a toilet in Antarctica?

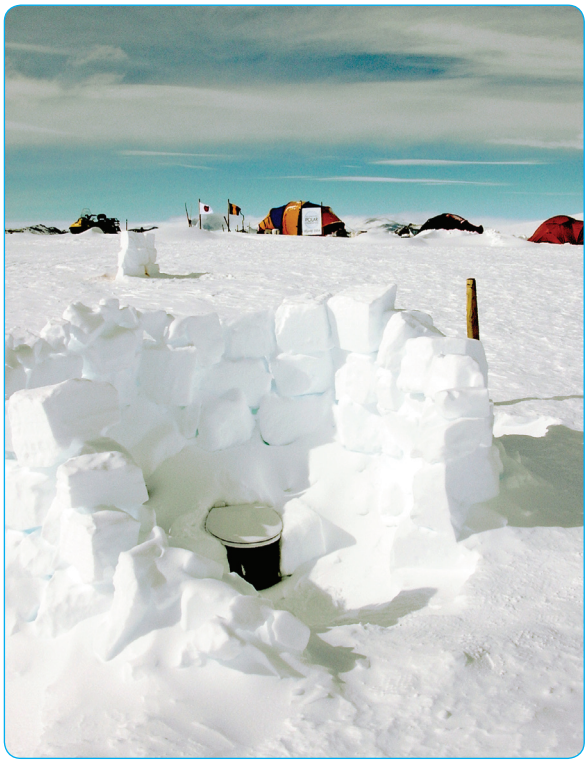


Figure 8: An improvised toilet

3) BELARE 2005 - LOGISTIC SURVEY EXPEDITION

Date: From October 27th to November 28th, 2005.
Objectives: Further exploration of the surrounding environment with additional topographic and ice thickness measurements, as well as maintenance of the Automatic Weather Station (AWS) and determining transportation routes.
Crew: Four expedition members - Alain Hubert, Johan Berte, Frank Pattyn en Maaike Van Cauwenberghe - divided into two teams, the Utsteinen team and the coastal team.

Field activities

The project manager, Johan Berte, is the first one to leave Belgium for Cape Town, where the necessary preparations for air support and logistics will be made. From there, he heads for the Norwegian research station Troll and eventually is taken to the Russian Novo Station in a Basler T67 airplane. There the second phase, the exploration by air of Breid Bay, is prepared. After an unexpected excursion to Utsteinen, Berte can see, that the AWS and the equipment from the previous year's expedition have survived the winter.

Figure 9: The skidoos have survived the winter in their shelter under the snow

On the 11th of November, the rest of the team joins Johan. The real work can finally begin!

The following days don't bring much good news. The visibility on site is practically zero and the winds are very strong. The expedition members can't see a thing and they almost get blown away. The team succeeds in dropping off the equipment and setting up camp at Utsteinen, after which they isolate themselves in their tents. Due to the bad weather conditions, they fear that supplies will be delayed and that they will have to live for a few days on short rations. Fortunately the supply plane eventually arrives. After about two days of complete isolation the situation improves. Finally, the camp can be completed and the first field

activities can commence. In the meantime, a group of four expedition members notice that the batteries of the AWS, which were supposed to last for two years, have already died after a mere 11 months. The engineers are determined to find the problem and find a solution. And they quickly find what they are looking for. The AWS appears to take measurements once every minute instead of once every hour, which uses much more of the battery's energy. By resetting and reprogramming the AWS, the problem is solved and the empty batteries are replaced by other batteries made from **amalgam**[12] .

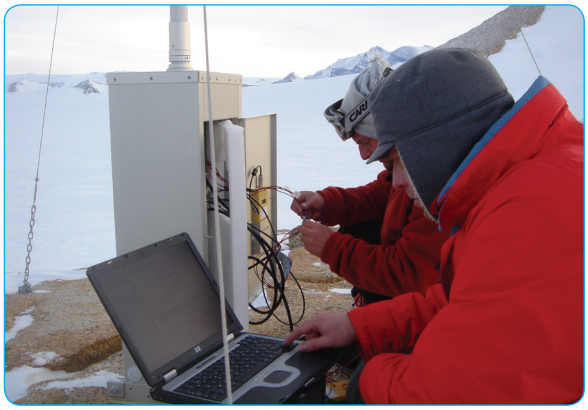


Figure 10: Looking for a way to repair the AWS

It was time for a new challenge: placing a second four-metre high wind velocity sensor, used for measuring simultaneous wind speeds. This is crucial for figuring out how to harness wind energy. Other field activities include carrying out topographical and ice measurements, doing research on snow accumulation, testing the ice drills used for determining underground features, making a three-dimensional map of the construction site, noting local meteorological and environmental conditions, and studying the flora and fauna. Quite a lot of work!

Figure 11: Lichens on the cold rocks

12 An **amalgam** is a mixture of mercury with another metal.

Coastal report

While three expedition members work on these activities, Alain Hubert sets off on an expedition across the ice sheet in order to find a possible access route from the shore to Utsteinen and to identify an offloading point where a ship could supply expedition members during subsequent expeditions. While zig-zagging through the crevasses, which were easy for his trained eye to identify, Alain sets course for Breid Bay. On the way, he stops at the Japanese Asuka base to compare the current situation to the year before. Time seems to stand still. The station looks like a ghost town from the Old West, only covered in snow.

Figure 12: The Japanese vehicles are gradually being snowed under

Alain continues his expedition. At the shore, he meets an entire colony of Weddell Seals, both mothers and pups, which are sunbathing next to openings in the ice. Once in a while, they take a cool dive and look for a nice meal. They are not afraid of this rugged man. Alain takes advantage of the opportunity to film and photograph them for two hours. A fringe benefit of the hard work of these expeditions is being able to enjoy such scenery. The pictures are a nice New Year's present for loved ones back home. After exploring the area for possible offloading points, Alain sets course for Utsteinen once again.

Figure 13: Sunbathing Weddell Seals

Once Alain has reached the station camp, the team gets ready for their return home. They break camp, store the equipment away in the snow, double-check the AWS and wait for the plane. The second BELARE-expedition ends on the 26th of November, 2005 with a flight to Cape Town, with a stop at the Novo station along the bay.

Do you know how can you brush your teeth without running water?

Figure 14: Making use of a rubber fingertip toothbrush

4) BELARE 2006-2007 - SITE PREPARATION EXPEDITION

Date: From October 28th, 2006 to February 4th, 2007.
Objective: Testing the transportation route across the ice sheet using the first ship transport and preparing the station site for the construction of the Princess Elisabeth station.
Crew: 15 expedition members, - Alain Hubert, Johan Berte, Nighat Amin, Jos Van Hemelryck and Joris Vermost. Dieter Dedecker, the cameraman of the VRT (the Flemish public broadcasting organization), Benjamin Luypaert of the RTBF (the Walloon public broadcasting organization), Bernard Bleeckx, Vincent Piret (both of Aeriane[13]), Damien Ertz (National Botanic Garden of Belgium) and Philippe Herman, Dieter Callaert, Philippe Van Den Broeck, Frank Vercouillie and Vaska Vanbeneden (Defense) – divided into 2 teams, the Utsteinen team and the Coastal team.

After 'freezing' the design, the engineers are able to work out the design in greater detail. During the period from July 2006 to June 2007, the different parts are manufactured. In the meantime, the third of four BELARE expeditions is launched.

The Ivan Papanin

On the 28th of October, 2006, the Ivan Papanin, a Russian ice class 1A transport ship departs from Oslo to the white continent, where it is supposed to arrive 70 days later near Breid Bay with a cargo including logistical equipment, building material for the garage, eight wind mills, and more. Two of the fifteen expedition members are aboard. They make two intermediate stops for offloading equipment, first at the Norwegian station and then at the Finnish-Swedish station. After this, the Ivan Papanin sails to Breid Bay where it arrives on the 3rd of January.

The expedition encounters serious difficulties along the way!

On the 5th of January, 2007, the rest of the team flies from Brussels to Cape Town. There, they purchase the necessary gear and make the last arrangements for their next adventure in "the land of eternal snow". Civilisation is left behind for a more harsh wilderness where you need your wits about you to survive. In the meantime, the ship gets stuck in the pack ice and the expedition members have to deal with stormy weather near Novo where they were previously dropped after an intermediate stop at the Norwegian Troll station. To make matters worse, strong gusts of wind blow away the ice around the ship. Due to this, the icebreaker starts approaching the shoreline. In the meantime, on the 11th of January all Belgians have reached their final destination Utsteinen where they unload tools and their personal equipment. The group is divided into two teams: the Utsteinen team and the Coastal team. The camp is set up, and after testing the transportation route they organise for the third year in a row

Figure 15: The station camp at the foot of Utsteinen

a trip to the abandoned Asuka station in order to pick up up two bulldozers and a sledge. At 10pm all team members are back at Utsteinen. There is still daylight. The coastal team wishes the rest of the team good luck and returns to the coast on the plane that dropped them earlier that day. The plane disappears from sight, although for a long time afterwards you could continue to hear the humming of the engine in the complete silence of Antarctica.

Once on site, the expedition members start pitching their tents at the shore and start looking for the ideal offloading point for the Ivan Papanin. At 19 m, the chosen cliff is two meters too high. The ship's cranes can't reach so high, which makes it impossible to place the containers on top of the cliff. Because the weather conditions keep getting worse, the ship is forced to retreat. The only other option is to look for a new location.

13 Aeriane is a company specialised in manufacturing composite synthetic materials.

In the meantime, the camp at Utsteinen has a few problems. The stove, which is very important for converting the ice into drinking-water, isn't working any more and also the toilet malfunctions. But this is nothing compared to the situation of the coastal camp. The Papanin continues on its course, looking for a suitable offloading point. With the help of the Adelie Penguins, Alain finds a natural slope which leads the team from the high ice sheet to a lower-lying ice shelf. Alain decides to unload the equipment on the ice shelf. He thinks it's strong enough. A perilous undertaking then begins. The first container and snow tractor are unloaded.

Figure 16: The first attempt to unload the equipment on the pack ice

Howevert due to the swelling of the sea, the ship repeatedly pulls the mooring points. The ice cracks. The captain decides to retreat. Then suddenly a huge crack in the ice forms. A fragment of ice which had the team and its equipment on it, starts floating into the open ocean. Because of the warmth of the metal container, the ice underneath it is slowly melting away. They risk losing everything. An SOS is sent to the Russian ship, which pushes back the fragment of the ice shelf with great precision. The team jumps over the fissure onto stable ice. They are safe now. But what about the equipment? Alain, who has already experienced many problems in polar regions, knows what to do. He jumps behind the wheel of the snow tractor the container is connected to and drives it at full speed over the fissure. Now the equipment is safe, too. However now they have to start their mission to look for a good offloading point all over again. The members of the coastal team are slowly but surely getting exhausted. They haven't slept for two and a half days. The ship has to keep a tight schedule. It's January the 15th and the Papanin should have already started sailing northward a couple of days ago. But the captain doesn't give up. With one controlled movement he sails towards the wall of ice of at least 17 metres high and drops a second load. It's a close call. He has no more than a 50 cm margin of error. However the strong winds push the ship seaward, so they must wait another day before finally catching a break. The wind drops, so it's now or never. The captain of the Russian ship performs a difficult manoeuvre, one that only an experienced seaman can pull off. He very gently lists the ship to one side. This way the distance between the ship and the ice cap is bridged and the landing can be completed. In two hours' time all the equipment is on the ice shelf.

Figure 17: Second and final attempt to unload the equipment on to the ice cap

And now it's time to test the reliability of the transportation route that was trailblazed during the previous expedition (BELARE 2005). A 20 to 30 km-long trip in an area full of hidden crevasses awaits them. Metre after metre, kilometre after kilometre, for a total of 190 kilometres, they continue down this trail for five days before finally reaching the other members of the station camp at Utsteinen. While their companions were away, the station team spent their time making a kind of icebox where food can be stored for over a year; a biologist counted the snow petrel population and identified lichens; GPS measurements were carried out. But upon arrival of the containers their routine work is terminated: the checking and unloading of the equipment in the containers can begin.

On January 22nd, 2007 Alain Hubert's group leaves for the coast again to pick up the leftover containers, including the windmills. They need six full days to get all the equipment to Utsteinen.

Figure 18: Arrival of the second convoy at Utsteinen

The next few days a huge amount of work is getting done: the first anchor points are put out in front of the station. In order to minimize the impact on the Antarctic environment, engineers have chosen for a combination of both solar and wind energy. In light of this, the very first windmill is installed by the team. The very first stationary construction of the Princess Elisabeth Station is a fact! A milestone! They also start the construction of the garage. Unfortunately, the

roof collapses under the weight of the snow and with winter approaching the members of the expedition are preparing to return home, so the construction of the garage will have to wait.

Figure 19: The collapsed garage roof

Again the camp is dismantled and all the equipment is stored away in the snow. On February 4th, everyone will receive a warm welcome at Brussels Airport.

Did you know that there are «road signs» in Antarctica?

Figure 20: Signs showing how many kilometres to the South Pole, Bruges...

5) BELARE 2007-2008 – STATION CONSTRUCTION EXPEDITION

Date: From November 2nd, 2007 until March 10th, 2008.
Objective: First building phase of the Princess Elisabeth Antarctic station: construction of the garages, the struts, the inside and outside walls, and the windmills. The internal systems such as water treatment plants, the electricity grid, etc. will be installed during the next expedition.
Crew: 57 members of the expedition[14], including Alain Hubert, Johan Berte, and Nighat Amin, arrived in nine different stages during the entire expedition.

After all the preparations of the previous expeditions, the time has finally come to build the station. 57 people will be working on it, including engineers, scientists and skilled labourers, many of which are volunteers. But it's a long way from Brussels to Utsteinen. To get there, the members of the expedition have to travel by air or by sea. They come and go as they are needed in nine different "stages". Alain Hubert is the first one to arrive on the white continent. At approximately the same time, the Ivan Papanin leaves Antwerp Harbour, loaded with 120 containers that are filled with for the different parts of the Princess Elisabeth station. The fun begins.

First team and first phase

The first phase of the expedition has three main objectives: 1) drilling the anchor points for the windmills and the station, 2) setting up the station camp and 3) constructing the garages. Meanwhile the Ivan Papanin continues on its course towards Antarctica.

The Ivan Papanin's first stop after its departure from Antwerp is Cape Town, where it purchases fuel and food for the expedition and its 18 members, of which eight are soldiers in the Belgian Army. Its voyage to the South starts with a sunny sky, but once it passes the '**roaring forties**'[15] , the ship faces waves of over nine meters high. By mid-December, the first icebergs are in sight. The Papanin can finally serve its purpose. The ship creaks anxiously as if its hull would be breached by the sea ice at any moment. Roaring sounds echo throughout the shipl. The more south they go, the colder it becomes. A few days later the pack ice demonstrates its devastating force and the Ivan Papanin find itself trapped in the sea ice. After several attempts, the ship manages to break loose from the pack ice. But not all obstacles have been conquered. Engine trouble causes sets them behind more than four hours for repairs before they can continue their journey over the Antarctic Circle. Nonetheless, they are nearing Antarctica. Dark nights are gradually replaced by round the clock sunlight. On December 14th at 7pm they finally arrive at Crown Bay, named after a huge crown-shaped iceberg nearby. They can now start unloading.

14 The profiles of all members of the expedition can be found on http://www.antarcticstation.org/index.php?/fotos_en_videos/fotogalerijen/wie_wie_belare_20072008/&s=28&rs=29&uid=165&lg=en

15 The stormy area between 40° and 50° South latitude near the Antarctic Convergence Zone.

Figure 21: The station camp is taking shape

In the meantime, the crew hasn't stopped working on the granite ridge at Utsteinen. Upon the arrival of the first team, the members organise the station camp. First the accommodation and food tents go up. The sleeping tents are next, as well as the bathroom, an infirmary and an office tent. While one group continues with the organisational aspect of the station camp, the other group leaves for the coastal area to pick up containers with equipment, fuel and wood for the garages that were left behind during the previous expedition. Other useable equipment will later be retrieved from the closed Asuka station. A piece of cake, one would think. But the truth is quite the opposite. On the way to the coastal area, the hoisting-crane, which is used to lift the containers onto the sledges, gets stuck in a crevasse. It is not until the next day that they succeeded in rescuing the crane from the depth of the crevasse.

Figure 22: The hoisting-crane in the crevasse

Once the equipment arrives, they can start drilling the anchor points. This is not an easy task. First the loose stones need to be removed manually. Next they need to determine all the precise location of all the anchoring points. The topographers on duty use the highest point on the ridge as a reference point, using it to determine all the other points on the ridge. The granite surface isn't quite as stable as they had assumed; the surface consists of separate blocks, bound together by frozen water. If the ice were to melt, the stability of the station could be jeopardised. But even on Antarctica every problem has a solution. Huge bars are put in the rocks sideways to hold the rocks together if the ice should ever melt.

Finally they start constructing the garages, using the equipment that was left behind by the previous expedition. First the snow is taken off of the ridge's surface and then levelled out. After this, the wooden structure is gradually put up. But still they have to wait for the 120 containers to arrive before work on the garages can continue.

Figure 23: At the foot of the ridge the wooden structure is being hoisted. On the ridge the anchoring points are determined and then drilled.

Second phase

Once the Ivan Papanin offloads all the containers on the ice, the traverses can begin. To get all the containers to the station camp they need to do 18 traverses of about 40 hours each, at an average speed of 10 km/h. The total distance is 360 km. During each journey, three tractors pull three sledges each, making a total of nine sledges. It's quite an operation! The traverse team can't rest until all the containers have reached their final destination. This isn't an easy task. The katabatic winds are tough opponents. The traverse has to be halted a few times. Each time everything is left behind and the members have to return to station camp to recoup. The storm alters the landscape. Now and then they also encounter mechanical problems. Fortunately the mechanics always know what to do and are helped at a distance by the members at station camp. In January they manage to pick up the pace so that a constant stream of materiel and equipment is ensured.

Figure 24: The Ivan Papanin offloads all the containers onto the ice. From here the tractors will transport them across the ice sheet.

In December, the finishing touch is put on the foundations of the station and the last of the windmills are erected.

Figure 25: Drilling the anchoring points

Third and final phase

All the anchoring points have been drilled, the containers have been offloaded and the traverse team has started bringing in new materials and equipment regularly while taking empty containers back. First the building team starts assembling the steel support structure for the station: the struts (see also the pedagogical dossier 'The station: from the inside out!'). They only have three days to place the support structure with an accuracy of less then 4 mm of precision. Subsequently the wooden skeleton of the station is installed along with the floor. The team is making good progress. This will be even more obvious when the building team starts putting the outer wall in place. The Princess Elisabeth station is taking form. However eventually they encounter some problems. The cranes that are being used to place each module of the outer wall are designed to handle a load of 700 kg maximum. Some modules seem to be heavier than expected, which at times causes the cranes to lose their balance. Yet in spite of this issue the team manages to assemble the outer walls in two days. The end is in sight. Days are getting shorter while the nights are getting longer; temperatures are dropping to a cool -26°C. The towers, the rooftop and the inner wall insulation are the final elements to be added. They also perform a few tests that are important in determining how the different systems that are going to be installed in the station during the next expedition will work.

In order to comply with the Antarctic Treaty (see also the pedagogical dossier 'Belgians in Antarctica through the centuries') the expedition members need to restore the station to its 'original state' before leaving. This means that the entire station camp needs to be shut down and all the preparations for overwintering must be made. No waste or rubbish can be left behind. The tents are put back into the containers a week before the departure, which means that for the last seven days of the expedition the members of the team can only use the station for shelter, making them the very first inhabitants of the station. The scaffoldings are taken down and the containers that will remain on Antarctica with equipment for the next expedition are stored in a safe place. The vehicles are stored in the garages. The landscape is unchanged, except for the presence of the new station.

Figure 26: The outer walls are placed inside the wooden skeleton, which is supported by the struts

The BELARE team finishes the job a week sooner than expected. On March 10th, 2008 the last members of the expedition arrive at Brussels airport. They are tired but satisfied. They accomplished the first phase of constructing the Princess Elisabeth Antarctica station!

Figure 27: The Princess Elisabeth station is a reality!

Have you ever seen a Nepalese Sherpa in Antarctica?

Figure 28: Sherpa Man Ram from Nepal was thé waterman. Every day many kilos of snow had to be melted in order to provide drinking water.

6) BELARE 2008-2009 – FIRST SCIENTIFIC EXPEDITION

Even before the station is fully operational, the first scientific expeditions will be undertaken in the austral summer of 2008-2009. At the same time the finishing touches will be added to the station. First and foremost the station needs to be thoroughly inspected and, if necessary, a solution will have to be found to any problem encountered during the inspection. Mathematical calculations will need to be double-checked, as will the design. The energy streams and sources supplying the station will be integrated. The electricity and water purification systems, the scientific tools and the internal supplies will also be installed. The systems' capacities will be fine-tuned while any operational weaknesses will be found and dealt with.

Two scientific expeditions have already been planned:

1. In November and December of 2008, Dr. Frank Pattyn, glaciologist at the Université Libre de Bruxelles (ULB), will lead an expedition to investigate the mass balance of the Antarctic ice sheet in light of recent climate change.
2. In January and February of 2009, Dr. Annick Wilmotte, microbiologist at the Université de Liège (Ulg) will lead an expedition to map the biodiversity of the microorganisms living in the crevasses and on the gravel in the Utsteinen area.

Any other scientific expeditions and will be managed and organised by the Belgian Science Policy (BELSPO). More on this can be found in the pedagogical dossier 'Putting Polar Sciences to the Test'.

EDUCATIONAL NOTE

1) NOTE FOR THE TEACHER

The pedagogical dossier 'BELARE: the station was not built in a day' is a good preface to 'The station: from the inside out!' and 'The technical side of the Princess Elisabeth station'.

2) OBJECTIVES[16]

Material from several subjects (geography, foreign languages, natural sciences and history) at the first grade level have been taken into consideration during the proposed activities.

Geography

The students can describe the landscape and its physical features in basic geographical terms and indicate them on an accompanying map. In addition, effects on the environment can be connected to the natural landscape, like those in the Polar Regions.

Foreign Languages & History

The four aspects required to efficiently learn a foreign language can be tested: listening, speaking, reading and writing.
Definitions taught in primary education are repeated and developed in greater depth: nature, climate, environment, land, continent, border, state, government, power, international organisations, the EU, duties and obligations, legislation, etc. - all with respect to Antarctica. Antarctica can be connected to nearly every part of history, from the prehistoric age to the present day. It also has a global and international dimension to it. The students can look up information about the present and the past stations in their assignments. It helps them learn to be meticulous when collecting, organising, analysing and interpreting historical data.

Cross-subject final attainment levels

The students can use **ICT** during their assignments to find, process and save digitalised information, which helps them in their learning process.

In addition, different aspects of '**learning how to study**' will be dealt with.

Environmental education: climate change is discussed and students are able to give examples of causes of and solutions to this problem. The students can also link biodiversity and the structure of the landscape to how humans use the environment.

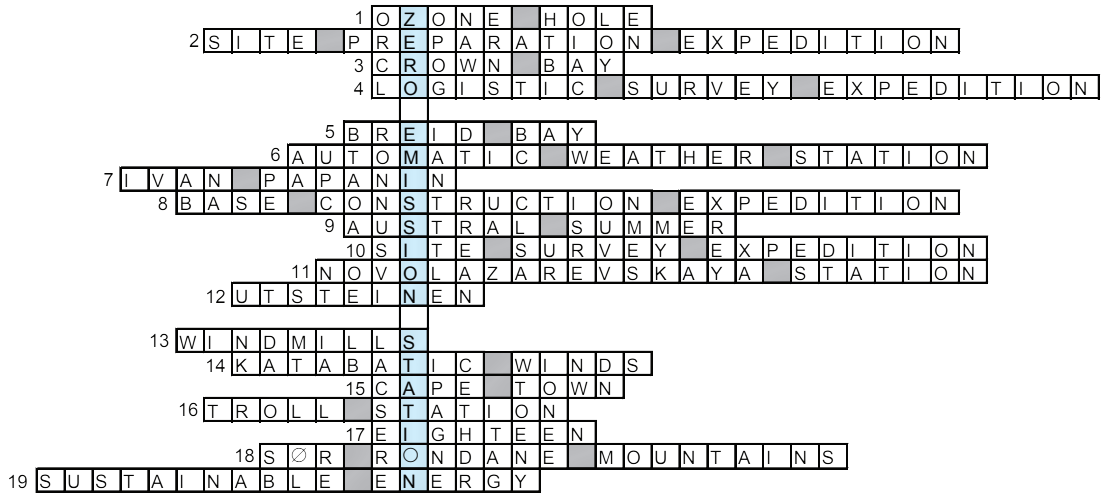
16 Bron: http://www.ond.vlaanderen.be/DVO/secundair/index.htm

3) SUGGESTED ACTIVITIES

(ALSO SEE THE WORK SHEETS FOR PUPILS)

1) Crossword puzzle and related essay

Length: 1 to 2 class periods
Target group: High school
Subject: Foreign languages, geography, history
Objective: The students can research, consult and select useable information and learn to analyse and summarise this information in a written text.



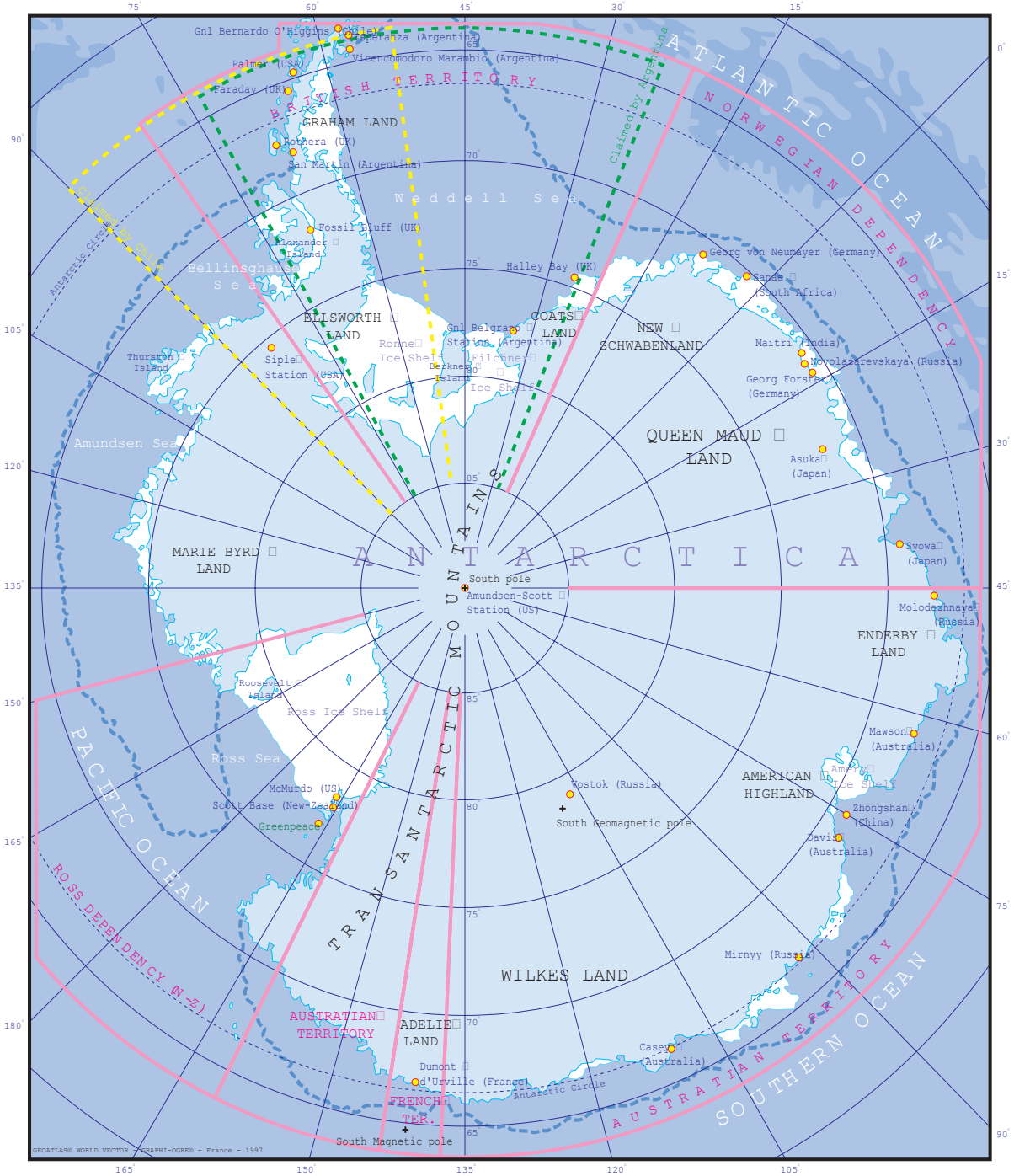
This assignment is also available in English and French. For these versions, please consult the pedagogical dossier of the same name on the French and English pages of our website. Note: this document can also be downloaded by students.

2) Other

- Show a documentary about the BELARE expeditions as an introduction (see sources).
- Write a short story about a polar expedition.
- Put together a press dossier.

ATTACHMENTS

ATTACHMENT 1: MAP OF ANTARCTICA



SOURCES

WEBSITES

http://www.antarcticstation.org
http://www.polarfoundation.org
http://www.belspo.be
http://www.mil.be
http://www.ipy.org

BIBLIOGRAPHY

So far no books have been published about the BELARE expeditions.

OTHER

The 5-part series 'Antarctica' follows the construction of the Belgian scientific station on Antarctica, the Princess Elisabeth station; VRT-Canvas; Jos Vanhemelryck (NL).
Matière Grise – Expédition en Antarctique; RTBF – La Une; Tristan Bourlard (FR).