Amelia M, Year 9

Conducting an experiment in Antarctica

I am very interested in photography and therefore, I would like to undertake a photographic study of Antarctica, returning to photograph life there at various times of the year.

I believe this would offer:

a) A chance to record science and nature in this unique territory.
b) By returning to look at how the same place changes over time, the photographs would show climate changes, pollution, presence of plastics, sea ice loss etc.
c) Although I understand that the British Antarctic Survey compares aerial photographs taken over the last 40 years to see climate changes, I would like to produce photographs that are more similar to photo-journalism that could be reproduced in magazines such as 'National Geographic'. I hope that this would not only allow for similar comparisons of change to be made (as mentioned above) but it would also spark curiosity and interest for the viewer and therefore, have more impact on the general public when published. The photos would therefore have layers of different meaning ie scientific, visual, educational and commercial.

Difficulties in conducting the research:

a) The ability to capture everything, in images where there is a lot of contrast, action or low-light considering exposure, aperture and focal length.
b) Keeping equipment working in sub-zero temperatures and difficult weather conditions.
c) Ensuring I returned to the exact same location to ensure a direct comparison could be made when looking at photographs taken at different times.
d) Ensuring that the photographs taken have a visual impact and tell a story but that they are also meaningful and useful for research ie not just 'beautiful'.

An example of a picture I would like to take and compare throughout multiple visits.

Bella A and Olivia T, Year 12

How does climate change affect snow igloos structure in Antarctica?

Igloos are built from compressed snow cut into blocks stacked up individually, spiraled around a circular terraced hole in the ground. The igloos with the best structure have walls of the same thickness and density from top to bottom, and the snow is compact and solid - therefore fresh snow isn't as good.

The average annual temperature in Northern Antarctica is 10 degrees celsius. However, as our experiment would need to be conducted in a closed circuit, we plan to imitate this environment through a snow room (e.g by TechnoAlpin) at a consistent temperature of 10 degrees celsius (independent variable). We will build 3 igloos of the same structure. Then we will increase the temperature by 1 degree daily for 10 days until it reaches 0 degrees celsius (equilibrium). After every day we will analyse the igloo's structure and any changes, additionally testing how effective the igloos are, for example through: insulation (tested through a resistivity meter that measures thermal conductivity), and reducing windchill (tested by thermal probe on the temperature of a warm body and/or the air). We could use a light source (testing with potentially different light intensities) and UV and infrared radiation emitting diodes to imitate the light, heat and radiation of the sun - as in Antarctica in the summer it is light for 24 hours a day whereas it is the opposite in the winter. Additionally, the warmer atmosphere due to climate change means more infrared light is emitted, but as igloos are approximately round the infrared emitted by people inside is absorbed and re-emitted back at the occupants reducing/stopping radiation cooling.

The results will be important as climate change is an important issue affecting us now and in the future, as surface temperatures are rising by about 0.2 °C per decade, so our experiment will imitate what could happen if temperatures keep rising. These will be beneficial to others, such as: hunters, Inuit people (although they use igloos less commonly than a few decades ago) who live in the area (who are already a minority group), animals who live in the habitat (some of which who are endangered and could become extinct in the future), scientists who are working in Antarctica, people who need emergency shelter if e.g transport failed or due to weather, and the igloo hotel industry. Our research could also help endangered animals such as penguins whose habitats are being destroyed due to climate change, such as melting polar ice. For example, architect Sajjad Navidi shared a two-part system design that uses igloos above the ground and under the water, with the upper structures providing penguins with man-made habitats for breeding/space to keep eggs warm, and the lower igloo features crater-like holes connected to a submerged swinging pendulum. As the pendulum is moved by waves, it produces electricity to cool the surrounding ice which stops the frozen sheets from melting.

However, the possible difficulties of conducting our experiment would be: the price of a snow room would be expensive (starting at $100,000), the 3 Igloos built would not be perfect replicas of each other, the experiment would not be a totally accurate replica of the Antarctic environment (e.g the weather, such as cloud coverage, or external factors such as animals which may destruct it), the type and purity of the snow, human error in the testings, the ground will absorb the scientists body heats', and the snow won't fully melt until 32 degrees celsius due to latent heat.

Moni O, Year 12

Ross ice Shelf Investigation

When I was investigating unknown facts about Antarctica, I came across the term "singing ice" which refers to the massive Ross Ice Shelf (Antarctica's largest ice shelf) that constantly "sings" to itself. However, the frequency at which this occurs is inaudible to human ears, requiring the use of seismic sensors to detect the sound produced by the winds that constantly blow over the ice shelf, generating vibrations in the snow and ice on the surface. This produces an almost nonstop tone that changes as the conditions change, which I thought would be fascinating to study more.

The first step in my experiment would be to determine the conditions I wanted to study. Some of the conditions I'd investigate to see if they cause a change in the amount of ground motion when perturbed. This could, for example, be the difference in temperature (in terms of being high or low) which could be monitored during the day and perhaps night, or over a set period of time, such as 12 hours. Another factor to consider is whether or not there is any precipitation or wind (both low and high).
After that, I'd install at least 20 highly sensitive seismic sensors beneath the Ross Ice Shelf's snowy surface. I would record the data from the seismic sensors every hour for 12 hours. In addition, I would make sure that an overview of the conditions for that hour is recorded. Once I have a sufficient number of data, I will be able to draw conclusions about how ground motion is affected by different circumstances.

The findings may allow us to delve deeper into the impact of Antarctic conditions and the role of the Ross Ice Shelf in stabilising the Antarctic ice sheet. Despite the advantages, there may be challenges in carrying out this experiment. When travelling to the Ross Ice Shelf, you will be travelling directly south, where the storm system will be approaching, which can be hazardous when your safety is important. To collect a significant and relevant amount of data, you may need to do this over several years, which, if you don't have the funds to do so, can limit your results.

Bethany N, Year 10

Hypothesis: Does Physical fitness differ in different climates?
What conditions are the best to attain fitness levels

Possible benefits:

- Better micro-climates for professional athletes to train in
- See if overall health can improve by exercising when it reaches colder temperatures
- Can rehabilitation facilities be improved

Difficulties of conducting experiment:

- Whether it would be to cold to conduct the experiment
- Wether layers of clothing would restrict movement
- To icy/not the right terrain

Researching:

- *Lung health (respiratory)*
    - More or less efficient in cold, clearer air
- *Muscle repair*
    - How quickly and efficiently the micro tears heal in our muscles following exercise
- *Heart health*
    - Wether blood is pumped around the body at the same rate.

Steps:

- Tests taken on arrival and departure
- Comparing differences

Equipment:

- **Spirometer**; measures the amount of air you're able to breathe in and out and the time it takes you to exhale completely after you take a deep breath.
- Heart rate monitor
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My experiment aims to explore whether physical fitness and overall health can differ in different climates. And whether we can adapt from this to improve our micro-climates and rehabilitation facilities for professional athletes to train in.

The three main categories we would investigate are lung health, muscle repair and heart health. This would help scientists to understand if different weather and/or air clarity can affect the way we breathe and therefore how we can complete everyday tasks. In addition, this would also help us understand just how much we have adapted to breathe in polluted air. Following exercise, we attain several micro-tears in our muscles, these heal and eventually grow back stronger. It would be interesting to research whether the temperature of the surroundings could speed up or slow down this process.

Eleanor J, Year 9

Collecting water samples from reasonably deep in the ice to see if there are any new viruses.

I think it would be interesting to see the consequences of allowing climate change to continue to progress at the rate it does, in a different way than is already predictable: how many viruses will we be allowing into our water systems, livestock and wildlife if the icebergs melt even more.

Difficulties	solutions
Where to store the water samples	Could store them in lightweight, plastic, small containers such as those we use to covid test (see below)
How to extract them easily	If water is melted already: Use a plastic pipette to transfer sample from iceberg to plastic tube If the sample is ice: Use a pickaxe or such to break up the ice. Use tweezers (finger will be in gloves) to transfer ice from iceberg to plastic tube
How often to take samples	Anywhere between after 30 mins - 2 hours of walking, depending on how long the expedition is for - don't want to be carrying too many samples that it is ridiculously heavy
How to tell where the sample was collected	Use GPS and satellite signals to mark the position on a map and label it with a letter, corresponding to the letter labelling the plastic tube.

Sophia M, Year 12

Moss in Antarctica

Experiment:

Moss in Antarctica is built to survive harsh conditions from, the extreme lack of water, to the frighteningly low temperatures, to the long hours of sunlight in the summers. I thought it would be interesting to explore just how the moss has adapted to all of these extremes and what makes them so immune to all these conditions. The experiment would include getting samples of different species of moss (found usually on the coast) and transporting it to a lab where we can experiment on how it is adapted to survive. This moss could be one of many plant species worldwide that has adapted to extreme climates, which could also be tested to see how they are adapted. Then we could try genetically modifying existing plants to be able to adapt to harsh environments.

Benefits of Result:

Climate change is a large issue and there is a huge impact on plants. There are warmer summer temperatures and an inconsistent amount of rainfall. It's stated that around ⅓ of plants and animal species could die out by 2070 due to climate change. However, what if we could genetically modify existing plants to be able to withstand some effects of climate change? Like the moss, they would be able to withstand the extremes and result in less species becoming extinct. Yes, it would be better if we tried to prevent climate change altogether but it is important to have a plan B if all else fails.

Difficulties in Conducting it:

Opening the plastic bags to place the samples in could be quite difficult. I'm assuming you would have to use scissors or something to cut a section of moss which might be quite difficult with gloves on. The experiment might not even work as the genetic modifications might not be successful on different plants or different characteristics could be added to the plant than intended.

Sofia M

Antarctica Experiment:

Extremophiles:

Extremophiles are microorganisms that live in conditions of extreme temperature, acidity, alkalinity or chemical concentration and are mainly located in the Ace Lake in Antarctica along with other soils and water surfaces.

For these organisms that do manage to adapt to the extremely cold temperatures, they are often very large in population sizes. Since they have been exposed to these conditions for prolonged periods of time, a range of adaptation have evolved; some species have adapted to live at the limits, some produce specific compounds called antifreeze, some remain viable but frozen in a state of suspended animation while others adapt their life cycle in such a way that they die when the conditions become harsh. My experiment would be to identify which organisms have certain adapted behavioural characteristics by obtaining a sample of many substances such as the soil, water, rocks and even ice from a particular location in Ace Lake or from Carezza lake near Edmonson Point. I would then be able to obtain extremophiles and cyanobacteria and hopefully collect a large population of them to test different environments and see if they can cope with them and begin to understand why they are able to cope with them, with which behavioural advantage that they genetically have. Once the samples are collected, I would ensure they would remain in the same media and incubation conditions similar to the environmental parameters to ensure my results are not skewed from a change in conditions. I will test these conditions in a lab where I am able to carefully monitor the conditions placed on them and test them for a longer period of time. To ensure I am able to replicate the conditions of Antarctica, I will note down the temperature, the pH and salinity of the Antarctic environment.

The benefits of my research would be to help us understand the evolution of life, especially since they were the first inhabitants of the earth at the origin of life. As a result, they would provide a valuable resource for exploitation in the biotechnological process. In terms of difficulties conducting the experiment, would be obtaining the samples and placing them in plastic containers, as I will have thick gloves on, so fine motor movement will be limited and as a result, I would obtain a larger piece of a sample which I will later observe finely in a lab when I am able to be more precise. Storing the samples will be another issue as I have to ensure the environment I store them replicate the conditions that they live in to ensure they do not die on the journey home or become damaged in any way. The final issue I could encounter is logging the data about the environment. I may have to write it in either a notebook big enough to handle large writing, or type it in a portable computer to ensure the data is always legible once you return back to the lab.

Abby S, Year 12

Antarctica Assignment - Friday 12th

- Marine life biodiversity

You could go to Antarctica and get in a small boat (to cause as little distrubance as possible) and stay at one ~~set~~ position which is a set distance from the coastline. For a set amount of time you would record all of the marine life that passes by your boat. You could do the same thing for different distances from the coastline and at different point along the coastline or at different times of the day or year.

The results would be beneficial as you could repeat the experiment in 10 years or so and you can see how the results have changed and then you could deduce what has caused these changes. e.g. climate change. Also, it would give us a bigger and better picture of the wildlife in Antarctica

However, there would inevitably be some difficulties when conducting this experiment such as, the sea may be too rough to make out any marine life or it may b too dark to even see anything especially at night. As we you would probably have to stay put in one position f

Eleanor J, Year 9

Measuring different levels of chemicals

My idea for the experiment is to measure the amount of different elements or chemicals in different parts of the Antarctic and to compare it to other countries, for example England. One thing we could do is measure the levels of sulphur in the sea there, in the air, and in samples of ice, then the levels of it measured in england. We could repeat this with different chemicals which might show how much pollution is in one area compared to Antarctica where there should be near to no pollution as it is uninhabited.

Certain aspects of this might be difficult, for example getting the right equipment to test it and then taking it with you halfway up a glacier. Furthermore, it would also be difficult to collect the samples and keep the equipment in usable conditions.