Written evidence submitted by the
Polar Research and Policy Initiative (PRPI)

Authors:
Dr. Dwayne Ryan Menezes – Director
Christophe Milheres – Director
Tom Field – Associate, Geopolitics and Security
Berill Blair – Expert, Risk and Resilience
Alycia Mutual – Associate, Arts, Culture, and Heritage

Polar Research and Policy Initiative (PRPI) was launched in February 2016 as the UK’s first and only think-tank dedicated exclusively to Arctic and Antarctic issues. Based in London, PRPI seeks to facilitate within the UK and Commonwealth a sustained, high-level and high-impact dialogue between scholars, experts, explorers, policymakers, indigenous peoples, civil society, private sector firms and other stakeholders about the most important issues facing the Polar Regions. These issues range from the causes and consequences of climate change and the protection of marine and coastal environments to the socio-economic empowerment of indigenous and Northern peoples and the management of shipping routes and natural resources. In doing so, PRPI aims to raise the profile and understanding of the Polar Regions in the UK and across the Commonwealth; increase and sustain the scholarly, cultural, political and commercial engagement of the UK and relevant Commonwealth member states with the Polar Regions; and help address some of the toughest political, social, economic and environmental challenges facing polar peoples and places.

FOREWORD

The United Kingdom engages in several major Arctic research projects that represent an excellent resource to help provide future STEM training that can be applied to the Arctic or transferred to other areas. Examples of these research projects include: an EU Integrated Arctic Observing System (INTAROS), with a €15.5 million budget, involving 49 partners in 20 European and non-European countries; the ‘Advanced Prediction in Polar regions and beyond: Modelling, observing system design, and LInkages associated with a Changing Arctic climate’ (APPLICATE), 2016-2020, with a €8 million budget (and additional Russian contribution), involving 16 partners from 9 countries; Blue-Action (Arctic Impact on Weather and Climate), 2016-2021, with a €7.5 million budget, involving 116 experts from 40 organisations in 17 countries; ICE-ARC (Ice, Climate, Economics – Arctic Research on Change), 2014-2017, with a €11.5 million budget, led by the UK, involving researchers from 21 institutes from 11 European countries; and the UK-managed Changing Arctic Ocean (Implications for marine biology & biogeochemistry) Programme, 2017-2022, with a £16.5 million budget.

The UK supports these projects with significant resources, including: the ice-strengthened research vessels RRS James Clark Ross, RRS Ernest Shackleton and what is to be the RRS Sir David Attenborough; six specially-equipped NERC aircraft capable of carrying out scientific measurements and logistical support in the Arctic (four ski/wheel equipped De Havilland Twin Otter aircraft, a De Havilland Dash 7, a leased BAe-146 and a Dornier 228); a UK Arctic Research Station in Ny-Ålesund, Svalbard (Norway), funded by NERC and operated by the British Antarctic Survey; and support for European Space Agency satellites measuring the thickness of polar sea ice and changes to the Greenland ice sheet.

The UK faces several challenges in providing STEM education and training: the recruitment and retention of STEM teachers; the lack of continued subject specific training for STEM teachers in
their fields; creating national education outreach programmes; increasing the number of STEM apprenticeships; and developing other sources of income and research talent for British universities after leaving the EU. This briefing outlines existing international and domestic Arctic STEM initiatives that could be replicated or expanded within the UK to overcome these issues. The briefing addresses the potential added value of Arctic initiatives to UK STEM education for two reasons. First, as a near-Arctic state, the UK already has existing economic, political, and cultural links with Arctic states. As such, the UK is able to leverage its significant investment in Arctic research and infrastructure. Second, the integration of theory in the classroom and front-line research is essential to improving the quality and effectiveness of STEM education. Arctic research has this potential because it covers a wide array of STEM disciplines and requires substantial planning and logistical support that develops discipline-specific best practices. Such valuable field experience can encourage professional development, wide-ranging outreach programmes, instructional partnerships, and interdisciplinary collaboration across STEM subjects.

Consequently, PRPI’s evidence can be divided into three main parts:

- **UK Schools and STEM in the Arctic**
- **UK Universities and STEM in the Arctic**
- **UK Apprenticeships, Shipbuilding, and STEM in the Arctic**

**UK SCHOOLS AND STEM IN THE ARCTIC**

**Student Engagement**

1. Student engagement with STEM subjects has been driven by a number of high-profile national media campaigns that have taken advantage of e-learning. In 2016, **Major Tim Peake** was able to answer questions on his mission at the International Space Station (ISS) to students at King’s School in Ottery St Mary. Peake also read bedtime stories from the ISS on children’s channel CBeebies and broadcast a science lesson from space in which 400,000 children took part. A further 600,000 students were involved in a project organised by the Royal Horticultural Society that compared seeds planted on earth to those grown on the ISS.

2. An educational outreach and public engagement programme is being developed for the research vessel **Sir David Attenborough** and its remotely controlled autonomous underwater vehicle **Boaty McBoatface**, with a £1 million budget set aside for this cause. The government-funded **Polar Explorer Programme** will be managed by STEM Learning. As stated on its website, “the programme aims to inspire the next generation of scientists, engineers and citizens by engaging young people with the RRS Sir David Attenborough and polar science”. RRS Sir David Attenborough will also be supported by STEM Learning’s network of Polar Ambassadors recruited to provide intensive support for 500 schools with low attainment or progression in STEM subjects with a focus on the transition from primary (key stage 2) to secondary (key stage 3). The programme will also include free online support, including resources, images and activities, available on [www.stem.org.uk](http://www.stem.org.uk) and videos from missions to inspire students. These video updates will be able to report on missions such as Boaty’s planned 2500km independent traverse of the Arctic in 2018 or 2019, building on existing media interest.
3. The UK Polar Network (UKPN), which is the UK branch of the Association of Polar Early Career Scientists (APECS) and has over 600 members, promotes the inclusion of polar research in school curricula, organises education and outreach activities for young people about the Polar Regions, and convenes career development and networking events for early-career scientists. UKPN members have frequently visited primary schools across the UK; presented workshops to six forms students using videos, presentations, and polar clothing and equipment as visual aids; and hosted events such as the FCO-funded Sea Ice, Shackleton and Science workshops organised in collaboration with the International Polar Foundation (IPF) at the Dundee Science Centre (27-29 September 2014), Birmingham Thinktank Science Centre (24-26 April 2015), and @Bristol Science Centre (30 May – 1 June 2015). UKPN has also worked with Our Spaces in organising Antarctic Day festivities by inviting young people from across the UK to send in their renditions of Antarctic flags, which are then taken by scientists and engineers down to Antarctica. Such public engagement events are particularly effective means for promoting STEM education and professions.

4. Another developing initiative is Education through Expeditions, founded in 2010 by polar explorer Antony Jinman, who communicated with students when travelling to the Arctic and Antarctic via satellite phone and email, using drone imagery to provide videos of the experience. Education through Expeditions has since expanded to offer Polar Fun Days in which polar professionals are invited to schools to host assemblies or full activity days (over 700 schools have been visited internationally), and online discussion boards via ETE Teachers, which allows teachers and their students to interact directly with polar professionals away on expeditions.

5. Actua is a Canadian charity that promotes STEM initiatives through its outreach teams and 33 partner universities and colleges across Canada. It uses a range of traditional and e-learning methods to support a range of domestic programmes that include: Codemakers, which promotes digital literacy for youth through workshops that blend technology with local culture and, in 2015-2017, will engage 100,000 youth from across Canada; Simply Science, a two-week summer camp and school program for students aged 9-13 which teaches students how to develop their own websites, apply STEM subjects to the Arctic, and learn from scientists and researchers who work in the Arctic; Science Adventures, in Yukon, which supports teachers and parents in promoting STEM courses and provides workshops that encourage girls to pursue STEM careers (Sci-Tech Girl and All Girls Science Club). The UK has shared heritage with the Arctic or Arctic nations and could replicate similar initiatives to Codemakers. Furthermore, Actua’s programmes represent a valuable case study as many of its programmes are enabled because of its collaboration with a range of regional, national, and international partner organisations.

6. The Arctic is well placed to be a part of outreach campaigns like those above because of the range of STEM research undertaken in the region and the ease and low cost of replicating or expanding online platforms. Though programmes such as Teach First and Teach Now have recruited a growing number of experienced professionals into teaching, e-learning platforms have the particular advantage of allowing STEM professionals to contribute to lessons on a casual basis, even when on research expeditions. As many lessons are now outsourced to external professionals, e.g. sex education and other citizenship-based lessons, e-learning platforms would allow Arctic STEM professionals to engage students and alleviate the heavy workloads that have been highlighted as a significant issue by the teaching profession.
Teacher Training

7. Further subject-specific training should be encouraged during teacher training, whether a Post Graduate Certificate of Education (PGCE) or on the job training from schemes such as Teach First. Findings provided in 2013 by the National Science Foundation-funded IMPPACT Project, a study investigating the impact of pre-service professional training on teacher’s future practices, revealed that graduates developed high-quality STEM teaching practices if required during training to apply science to everyday problems and develop peer-learning networks. The UK is well placed to encourage such pre-service training in Arctic STEM fields for two reasons. First, the number of projects the UK is engaged with offers a wide range of potential secondment opportunities for trainee teachers. Second, large teaching recruitment programmes such as Teach First place a great emphasis on its links to industry and the benefits this can bring applicants. Police Now, a graduate scheme based on the Teach First model, has gone as far as to allow its graduates to engage in four-week industry internships, which may be replicable amongst universities providing PGCEs and Teach First.

8. Continued Professional Development (CPD) that fails to engage teachers in real-life developments in their field has been highlighted as an issue by organisations including STEM Learning and the Royal Academy of Engineering. Ensuring teachers are familiar with current developments in their fields is vital for two reasons. First, it allows students to appreciate the relation of theory to practice and develop practical skills. Second, it allows teachers to provide guidance on effective entry routes into STEM fields, helping to mitigate concerns over the sporadic quality of careers advice highlighted in Ofsted’s November 2016 report Getting Ready for Work. A number of international, national, and regional organisations have provided such training through e-learning platforms, which are relatively inexpensive, require shorter time commitments from STEM professionals, and have the ability to reach a larger audience than traditional training methods.

9. Edu-Arctic is a EU-funded e-learning platform that specialises in providing online lessons broadcast from Arctic research stations. It also offers support to teachers on how to develop STEM syllabi with real-life examples. Edu-Arctic provides detailed teacher training on how to teach about the Arctic region and lesson materials such as an environmental monitoring exercise where students learn about monitoring the Arctic region and how to apply this to monitoring the environment surrounding their school.

10. University of the Arctic (UArctic) is a cooperative network of universities and research institutions that has created Arctic-based learning programmes, including a catalogue of Massive Open Online Courses (MOOCs). UArctic has also created a web-based online directory of Arctic-wide research institutions, researchers, projects, publications, and research trends to foster international research and education collaboration. Though these resources are available to anyone, increasing the number of UK university members of UArctic (outlined in the subsequent section) should help bring greater attention to such courses amongst teachers.

11. The National Science Foundation and the University of Massachusetts Amherst partnered during the summer of 2010 to offer STEM Polar Connections, a one-week summer camp followed by a year of online discussion forums to train middle and high
school teachers and help them to include science research in the Arctic in their curricula. UK schools are increasingly developing links with local universities (e.g. King’s College London sponsored King’s College London Mathematics School, a free school sixth form based in Lambeth) and industry (e.g. London Academy of Excellence and HSBC). As such, similar partnerships could be developed in the UK between schools and organisations involved in Arctic research.

12. The initiatives outlined above are largely reliant on further developing partnerships between schools, universities and research bodies, industry, and international fora in the Arctic. Building and maintaining these curricular, instructional and research partnerships are paramount if the Arctic is to support UK STEM education. The above initiatives would be most effectively replicated or joined by fostering international networks via the upcoming International Arctic STEM Education Summit, planned to take place during the upcoming Finnish Chairmanship of the Arctic Council. The Summit will bring together senior government officials, students, educators, researchers, technologists and other experts to share best practices and develop new educational partnerships that enhance STEM education. It will facilitate information and resource sharing, foster new education networks, and promote a legacy of formal and informal STEM education and lifelong learning both inside and outside the Arctic. Developing relations in this Summit should be a key focus of government attempts to effectively use the Arctic in UK STEM education initiatives.

UK UNIVERSITIES AND STEM IN THE ARCTIC

13. Though the exact implications of leaving the EU on UK universities are uncertain, developing deeper partnerships with bi- and multilateral Arctic organisations and university fora should help mitigate concerns over losing EU STEM funding, as well as the recruitment of EU academic staff and students. UK universities could communicate their interests through a number of avenues to ensure their future engagement in Arctic research.

14. The Arctic Council’s Arctic STEM Education Summit is the key upcoming event in 2017, which UK universities could engage with through two avenues. First, representatives from the Foreign and Commonwealth Office could work alongside UK university fora such as the Russell Group to communicate relevant interests through the UK representative at the Arctic Council. Second, universities and university fora could engage with the Arctic Office, the body which is responsible for coordinating Arctic scientific research and is funded by the NERC and hosted by the British Antarctic Survey.

15. UArctic membership is another key forum through which to develop partnerships. Currently, the University of the Highlands and Islands, the University of Aberdeen, and Durham University are the only UArctic member institutions based in the UK. UArctic offers student exchanges through its North2North program, online post-secondary courses (Bachelor of Circumpolar Studies) as well as field studies across the Arctic, and has 38 Thematic Networks in which member institutions collaborate on research and share knowledge. An initiative that could help increase the number of UK university memberships of UArctic is Norway’s support for developing a UArctic ‘One Stop Shop for Arctic Knowledge’ that would unite more than 170 research-focused universities, colleges, and institutes amongst Arctic states and Arctic Council observer states.
16. Developing partnerships with industry should also be considered. In Siberia, ExxonMobil partnered with Sakhalin State University to support higher education on Sakhalin Island. Many students were leaving the region to study, creating a talent gap on the island within STEM professions. ExxonMobil funding of over $15 million since 2001 has enabled Sakhalin State University to open a new campus on the island, build STEM-related laboratories, and open an educational center that includes an intensive English language program. Funding also allowed the university’s academics to visit universities in Canada and the United States for curriculum development.

**UK Apprenticeships, Shipbuilding, and STEM in the Arctic**

17. In December 2015, the UK Government published its 2020 Vision report, which aims to introduce 3 million apprenticeships by 2020, building on an announcement in March 2015 to introduce nine new flagship industry-designed degree apprenticeships. Developing the capacities of industries engaging with the Arctic region represents an excellent opportunity to meet government objectives for increasing the number and quality of apprenticeships.

18. Scotland is home to some of the most advanced shipbuilding sites in the UK. In An Independent Report to Inform the UK National Shipbuilding Strategy, Sir John Parker highlighted how BAE Systems’ “Govan and Scotstoun sites are the only UK shipyards currently used to design, build and commission a sophisticated naval warship.” The shipyards received a £100 million investment from BAE in 2015, have produced parts of the two Royal Navy’s Queen Elizabeth aircraft carriers, and is preparing to build the Royal Navy’s new Type 26 Frigates.

Therefore, Scotland is well placed to take advantage of the recommendations of the November 2016 report from the House of Commons Defence Committee Restoring the Fleet: Naval Procurement and the National Shipbuilding Strategy. The report commented on the need to “help maintain jobs, provide new apprenticeships, and develop advanced engineering skills” to “ensure that the Navy continues to have the capability it needs to protect our nation’s interests and ensure continued investment in UK warship production” and also help “the [National Shipbuilding] Strategy…set out the criteria against which the expansion of the UK’s share of the export market in warships will be judged”. These objectives offer an excellent opportunity for STEM apprentices to benefit from complex military shipbuilding projects commissioned for the Arctic region.

19. Contracts could be acquired in the short term from Arctic states concerned over Russian militarisation of the Arctic. A similar international contract, won by Babcock in June 2016, provided a new Offshore Patrol Vessel to the Irish Naval Service, securing 280 jobs over two years in the Appledore shipbuilding facility in North Devon. Longer-term contracts could be acquired by diversifying shipbuilding to meet growing demand for complex non-military shipbuilding projects, specifically icebreakers and scientific research vessels. Cammell Laird’s successful bid against international competition for the NERC Arctic research ship **RSS Sir David Attenborough** highlights the competitiveness of UK shipbuilding in this area.

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