

ATLAS Deliverable 9.4

ATLAS Outreach Educational Portfolio

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1. Summary

Objectives

The ATLAS outreach educational portfolio has been developed to facilitate the promotion of the ATLAS project and disseminate the project's objectives and findings to a variety of stakeholders and possible end-users, especially educators. It will contribute to the Atlantic Action Plan initiatives on Ocean Literacy with new exciting and dynamic outreach resources based on the project activities. The intended use of the portfolio is to encourage and support citizen focused outreach activities which ensure engagement with European Citizens. Dissemination of the portfolio to other outreach organisations will ensure maximum uptake and impact.

Rationale

The development of the ATLAS outreach educational portfolio drew on Dynamic Earth's experience as a public engagement and educational centre as well as results from a teacher survey undertaken early in the project. The survey was disseminated by ATLAS partners with respondents from the United Kingdom, Ireland, Germany, Spain and Canada helping to identify areas of the project which were of interest to teachers and their pupils and would link into school curriculums.

To showcase some of the scientific expeditions the following resources were developed or utilised: public-friendly blogs, video footage, images and a letter template for involving local schools in 'Question and Answer' exchanges with the scientists and crew.

New dynamic communication products to engage a public audience with the overall outcomes of ATLAS have been developed, with additional products planned, and will be embedded in Dynamic Earth's Ocean Gallery exhibition. A public-friendly ROV simulator has been developed and an interactive 3D model of the 'thermal vent mission' has been created, to allow the public to see a simulated ROV scene even if they are not able to visit a centre which has the full simulator. Interactive models of a cold-water coral have been created which enable visitors to examine corals which would ordinarily be inaccessible and/or too fragile to handle. The physical models are not intended for wider sharing but the commissioning process enables other centres to access copies of the models. Further planned products include an Augmented Reality app and an interactive touch-screen featuring the ATLAS Case Study areas. Where appropriate, these will be made available to ATLAS partners for wider dissemination.

The educational programme on the ATLAS theme has been created for marine educators and has been adopted by Dynamic Earth as part of their annual outreach programme, with the aim of engaging around 8,000 people in Scotland with ATLAS via participation in regional science festivals (March-September 2019). It will also run across the busy summer period at Dynamic Earth, expected to reach around 7,000 people (July-August 2019). The programme has been designed to be easily replicated by other marine educators and will be disseminated via relevant networks to ensure maximum impact. It comprises a 'reef survey' image and associated activities, sheets for public engagement activities, activity packs for educators and a script for an ATLAS 'show' aimed at primary school pupils (including a transcript for a video featuring ATLAS cruise footage). Selected resources have been translated into other EU languages and more translations may be added later in the project if deemed appropriate.

A dynamic ATLAS exhibition stand was developed for dissemination of the project at key events such as World Ocean Day. It includes six banners designed to communicate ATLAS science themes and aims to a general audience. There are also 360° videos with cardboard 'viewers' which allow ATLAS partners to share the experience of being an ATLAS scientist in a fully immersive way.

Public engagement (or 'meet the scientist') training based on Dynamic Earth's style of engagement was offered at the 4th General Assembly, on 4th April 2019 in Mallorca, so that partner scientists can engage locally with publics across partner countries.

The ATLAS website is the main tool for sharing these resources via a new Education tab (<https://www.eu-atlas.org/education/public-engagement>). The resources will also be uploaded to the ATLAS community page on Zenodo, ensuring that they will be accessible beyond the project's lifetime and increasing the ATLAS legacy (<https://zenodo.org/record/2652408#.XMarDzBKl71>). Any additional materials which are developed later in the project will be made available via these two sources. Dynamic Earth's website will be updated to link to the ATLAS education area and external organisations/groups such the [Sea Change project](#), [POGO](#), [UK Schools Ocean Resources Hub](#) and Scuttlebutt will be invited to share the link. The resources will be demonstrated at the EMSEA conference in September 2019 with an expected audience of around 100 marine education professionals. Videos produced as part of the outreach portfolio will be shared via the ATLAS YouTube channel and any new videos will be added as they become available. https://www.youtube.com/channel/UChT_uQfwZX_S9cmWHOc_DhA

Team involved in deliverable writing

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2. Introduction

The overall objective of WP9 is to ensure effective external communication, dissemination and optimal knowledge transfer of ATLAS results and applications leading to optimal exploitation of its research outputs. All project partners are involved in dissemination and exploitation in order to foster awareness and transfer results for impact, especially in their own countries and in their own communities. This includes public engagement and outreach events.

A portfolio of educational outreach resources and tools was developed to facilitate promotion and widespread awareness of the project. This is intended to help partners communicate the project and its results in a consistent and efficient manner.

The materials described here were mainly developed by Emma Paterson at Dynamic Earth with assistance from Georgios Kazanidis and Laurence de Clippele (UEDIN) and Annette Wilson (AquaTT). Other partners provided images, video footage and background information including Murray Roberts, Julia Eigheten, Alan Fox and Johanne Vad (UEDIN); Telmo Morato and Carlos Dominguez Carrió (IMAR); Covadonga Orejas (IEO) and Graham Tulloch (BGS).

3. Showcasing ATLAS expeditions (cruises)

Resource:	Expedition/cruise blogs
Intended for:	ATLAS Partners (for the template style) & general public (for the articles themselves)
Access:	ATLAS website: https://www.eu-atlas.org/news/cruises/life-on-board-the-ccgs-amundsen ; https://www.eu-atlas.org/news/cruises/life-on-board-the-ccgs-amundsen-the-sequel
Instructions for use:	Use as examples of style of writing to suit a general public audience

The Amundsen cruise (August 2018), carried out within the framework of the ATLAS project, provided many opportunities for outreach activities with Dynamic Earth coordinating plans with other ATLAS partners BGS, AquaTT and UEDIN. Video footage and images have been used to develop 360° videos (Section 5.2) and were incorporated into the school show (Section 4.4). ATLAS partners Graham Tulloch (BGS) and Sabena Blackbird (ULIV) wrote blogs from their experiences on the cruise. Emma Paterson edited the text to ensure that it was accessible for a general audience with assistance from

Annette Wilson (AquaTT), Julia Eighteen and Laurence De Clippele (both UEDIN). The blogs are available on the ATLAS website and serve as examples of the style of writing which will suit a public audience to become engaged with science in an accessible way. The blogs also serve as exciting stories to potentially draw young people to professions related to marine science, in addition to being ‘writing style examples’.

Resource:	Invitation to ask ATLAS scientists a question
Intended for:	ATLAS partners (letter template) & primary/secondary school pupils (for the letters themselves)
Access:	Contact Annette Wilson: annette@aquatt.ie
Instructions for use:	To invite primary/secondary schools to participate in question and answer exchanges with scientists on ATLAS expeditions.

To evoke curiosity about the marine environment from a young age, ATLAS also developed and carried out a Question-and-Answer exchange session around the Amundsen expedition, inviting primary/secondary school children to actively engage with marine scientists at an ATLAS expedition. School children were encouraged to ask the ATLAS scientists any question they had on sea life in the deep Atlantic Ocean. Since the cruise took place during school holidays, the exchange was not as successful as we had hoped it to be. However, the contacts and introductory letter templates (Annex 1) will be used for the return expedition in summer 2019 and will be made available through contacts at Dynamic Earth and AquaTT for future expedition engagements, both ATLAS and others.

The concept of personally-answered questions put to the scientists on board was trialled by participants at Dynamic Earth’s Summer School in 2018 and will be repeated for the 2019 cruise due to the positive response (Figure 2). Other marine science expeditions are welcome to use and apply the same idea, see templates provided.

"I just wanted to let you know that Joshua received two postcards yesterday from the Arctic Explorer, with the answers to his questions. He was absolutely thrilled! Is there any way you can pass on our thanks to the team there? I am sure they are very busy but the time they took to write to him was definitely well spent. Is there also anywhere online we can get more info about the ship/expedition etc.? I would love to let Joshua have a further look at what they are doing, now he is really excited about this!"

Figure1. Thank you note from the parent of one of the participants in the Amundsen question and answer activities.

4. Dynamic Communication Products for the Oceans Gallery

A series of new, innovative and dynamic communication products have been developed, as outlined in detail below. These products will be embedded in Dynamic Earth's Ocean Gallery exhibition (having over 200,000 visitors per year) and most of these will be open sources for other outreach bodies to use as well.

4.1 ROV simulator 3D model scene

Resource:	ROV simulator 3D model scene
Intended for:	ATLAS Partners, educators & public engagement professionals
Access:	https://sketchfab.com/3d-models/virtual-hydrothermal-vent-exhibit-dynamic-earth-cbe103d1546245c18ab87239af5f0287
Instructions for use:	Use to introduce the concept of the ROV simulator and explore hydrothermal vents. Can be used with 360° viewers.

A ROV simulator has been commissioned by Dynamic Earth from the company MarineSimulation.com to give participants the (simplified) experience of flying or piloting an ROV with graphics based on ATLAS Case Study locations. The final product is intended for use in Dynamic Earth's Ocean Gallery exhibition which has over 200,000 visitors per year. It will also be used for Dynamic Earth's outreach programme with around 3,000 people expected to engage through science festivals from May-September 2019. On discussions with Marine Simulation it was apparent that this product could not be made 'open source' in the manner of the Educational resources as this would involve the sharing of proprietary code and would have pushed the development costs beyond the scope of the budget. To mitigate disappointment with this more limited sharing option, Dynamic Earth worked with the company to develop a 3D model of the simulator to be made available online. This allows the public to see a simulated ROV scene even if they are not able to visit a centre which has the full simulator. One selected scene from the simulator is now online as a 3D model which people can interact with (Figure 2). It can also be examined using cardboard viewers (Section 6.2). The link to the 3D 'sketchfab' model will be available from both the ATLAS website Education tab and Dynamic Earth's website.

Additionally, once the simulator is fully developed, two free licences will be made available to ATLAS partners (specific partners to be confirmed) while further ones will be available to purchase for a small percentage of the development costs (quoted at US \$1,100, April 2019). Text and designs for explanatory panels developed to accompany the simulator in the gallery will also be shared with

partners later in the project to give context to the simulator and highlight the links to the ATLAS project.

A test version of the simulator has been used successfully at three Scottish science festival family drop-in events: Strathearn (9th March 2019); Caithness (23rd March 2019) and Edinburgh (11th, 14th, 15th, 20th & 22nd April 2019), engaging with over 6,000 people.

Figure 2. The 3D model of the thermal vent scene of the ROV Simulator.



Resource:	ROV simulator and associated interpretive panels
Intended for:	ATLAS Partners, linked public engagement centres
Access:	Purchase a licence from Marine Simulation, contact Paul Unterweiser paul.unterweiser@marinesimulation.com ; text and design for panels from Natalie.walls@dynamicearth.co.uk
Instructions for use:	A video-game style simulator requiring suitable hardware (following recommendations from Marine Simulation). Panel text and design can be adapted to suit.

4.2 Interactive cold-water coral models

Resource:	Cold-water coral interactive models
Intended for:	ATLAS Partners, linked public engagement centres
Access:	Contact Natalie.walls@dynamicearth.co.uk Either request loan of smaller model or commission additional models from Glead3D.
Instructions for use:	Use at events/workshops to explain the anatomy of corals and introduce topics such as how they feed and how samples are collected.

Dynamic Earth commissioned sculptor Scott Glead of Glead3D to create two interactive models of Cold-water corals for the gallery & outreach: a sectional model of a single polyp (Figure 3) and a *Lophelia Pertusa* colony complete with *E. norvegicus* worms. The colony has magnetic sections which can be ‘sampled’ as part of a ROV manipulator arm challenge (Figure 4) used at public engagement events and in the school show (Section 5.4). Due to the nature of this resource, it is not possible to share it with all partners. However, Scott Glead will retain the original moulds, allowing other centres to commission their own models if they choose to, through Dynamic Earth. Similarly, a smaller test piece of the *Lophelia pertusa* colony is available for loan and has been used by UEDIN at a public engagement event at the Scottish Parliament on 13th April 2019 alongside the floor mat (Section 5.1) and banners (Section 6.1). In addition to being used at the science festival engagements detailed in Section 4.1, both models have also been used by UEDIN scientists and students during Edinburgh Science Festival for their ‘Revealing Scotland’s Cold-Water Corals’ events on 17th and 19th April 2019 at Dynamic Earth, with 1,600 visitors across the two days.



Figure 3. A sectional model of a single polyp



Figure 4. Participant in the school show 'sampling' the coral model. Magnetic sections for sampling are marked by red tags.

4.3 Planned communication products for the Oceans Gallery and outreach

Resource:	Spectacular App and augmented reality ATLAS colouring pages
Intended for:	All
Access:	Contact Natalie.walls@dynamicearth.co.uk
Instructions for use:	Download app on a suitable device and print colouring pages.

Dynamic Earth has been working with the company 'Quiver' who have developed an app which brings colouring pages to life in augmented reality. Due to a change in Dynamic Earth's funding plans for the wider oceans gallery redevelopment, it has now been decided to commission Quiver to develop ATLAS-specific pages, using some of the budget originally planned solely for gallery redevelopment.

Approval of this budget change will allow Quiver to work on three pages with associated augmented reality animations. Planned pages will focus on different ATLAS Case Studies and include the LoVe Observatory featuring satellite monitoring equipment and bubblegum corals; a page featuring the Mingulay cold-water coral reef with depth effect (<https://www.youtube.com/watch?v=GGV3jJg-VNs&feature=youtu.be>) and hydrothermal vents in the Azores. These will be brought to life through the app 'Spectacular' which can be customised to include ATLAS branding, relevant website links, information about the project and the option to translate into European languages. The app and colouring pages will be free to download, allowing global access to this resource and increasing the impact. As and when development is complete, this will be shared with ATLAS partners and disseminated through all relevant channels mentioned previously.

Resource:	Interactive touch screen featuring ATLAS case studies
Intended for:	ATLAS Partners, linked public engagement centres
Access:	Contact Natalie.walls@dynamicearth.co.uk
Instructions for use:	Upload onto suitable touch screen.

A further resource to be included in the gallery is an interactive touch screen featuring the ATLAS case studies. Where suitable data is available, BGS will use 'Geovisionary' software to produce 'fly-through videos' using bathymetric maps of various case studies. Dynamic Earth will work with UEDIN and BGS to create an appealing interactive touch screen resource with videos and images which explain the different case study areas. This will be made available to partners to use in their own centres. Development and installation is planned for November-December 2019.

Resource:	ATLAS cruise/expedition compilation video and associated interpretive panels
Intended for:	ATLAS Partners, linked public engagement centres
Access:	Contact Natalie.walls@dynamicearth.co.uk
Instructions for use:	Video and panels to be installed as desired.

The ATLAS cruise compilation video used in the school show (Section 5.4) is also intended to be added to a porthole in Dynamic Earth's Yellow Submarine Gallery alongside interpretative panels explaining the work of ATLAS scientists. The video and a transcript are available through the [ATLAS YouTube channel](#) and the [Education section of the ATLAS website](#). The text and design of the panels will be shared with ATLAS partners for use in their own exhibitions.

5. Educational Programme and workshop

5.1 Reef Survey Activity

Resource:	Cold-water coral reef survey image, key and explanatory pack.
Intended for:	ATLAS Partners, educators & public engagement professionals
Access:	Image, key and packs available to download: https://www.eu-atlas.org/education/activity-mat ; https://zenodo.org/record/2652481#.XMbWkjBKi71
Instructions for use:	Image can either be printed on 1.5m x 3m vinyl banner material for use as a floor mat or on A3 paper for table-top activities. The key and explanatory pack can be used alongside the image. Translations in German, French and Spanish are available.

5.1.1 Reef Survey Image

This large-scale image is a composite of images from the Logachev Mounds provided by Laurence de Clippele (UEDIN) from a cruise in June 2012 and blended together by artist R.H. Stewart. The images of creatures and substrates were chosen both to be representative of the area and be appealing to the general public. The attention-grabbing image draws in people of all ages and sparks conversations about the biodiversity of deep-sea coral reefs, selected techniques which are used to assess the biodiversity and adaptations of deep-sea creatures. It is intended to be used as a floor mat (Fig 5) but can also be printed on paper for table-top activities. In this way it is suitable for both public engagement and school activities. It forms an integral part of modular drop-in activities used both at Dynamic Earth and on outreach. It has already been used successfully at science festival family drop-in events by Dynamic Earth and UEDIN as mentioned in Sections 4.1 and 4.2.



Figure 5 Reef survey image as a printed floor mat.

5.1.2 Reef Survey Key and answers

The Reef Survey Key accompanies the reef image and challenges participants to identify and count as many creatures in the image as possible by matching the pictures (Annex 2). This mimics the work of ATLAS scientists who analyse ROV images and footage to assess and identify the biodiversity of cold-water coral reefs. It also introduces participants to a range of deep-sea creatures which are often unfamiliar to them. An answer sheet is provided. The key has been translated into French, German, and Spanish. More translations are planned and will be added when available.

5.1.3 Reef Survey pack

The pack accompanies both the image and key and gives more information on how to run the activity including which creatures to highlight in further discussions, how the coral rubble habitat differs from the living reef and advice on printing the mat. It is intended to be used by ATLAS partners and external educators, allowing them to run the activity effectively without the need for face-to-face training. It has been translated into French, German, and Spanish. More translations are planned and will be added when available.

5.2 Public engagement sheets

Resource:	A3 sheets for public engagement on ATLAS themes
Intended for:	ATLAS Partners, educators & public engagement professionals
Access:	Available to download: https://www.eu-atlas.org/education/public-engagement
Instructions for use:	Sheets can be printed individually or as a suite to help run public engagement activities. They explain ATLAS science themes to a general public audience. Translations in German, French and Spanish are available.

The public engagement sheets are instructions which explain to a public audience how to carry out activities based on ATLAS science and concepts, or more broadly ocean exploration and research. They follow ATLAS brand guidelines including colours, font and logos and utilise various images shared by ATLAS partners. They are designed to be clear, engaging and eye-catching, allowing other partners to use them without the need for additional public engagement training (Figure 6). They have been translated into French, German, and Spanish. More translations are planned and will be added when available.

The concepts illustrated by the sheets are listed below:

- The importance of the ocean for humans and all life on Earth
- Ocean acidification
- Pressure in the Deep
- How ROVs use different sampling tools
- Technology used in deep-sea exploration including ROVs, Gliders and Landers/Moorings
- Hydrothermal vents (inspired by the discovery of new vents off the Azores by the IMAR-UAz team on an Blue Azores Expedition organised by the [Oceano Azul Foundation](#), in cooperation with the [Waite Foundation](#) and [National Geographic PRISTINE SEAS](#), and in partnership with the [Regional Government of the Azores](#)).



Figure 6 Example of a Public Engagement sheet: looking at how ROVs use different tools to sample the deep.

5.3 Activity Packs for Educators

Resource:	Educational packs covering ATLAS science themes
Intended for:	ATLAS Partners, educators & public engagement professionals
Access:	Available to download: https://www.eu-atlas.org/education/education-packs
Instructions for use:	Packs can be used to assist the running of public engagement or class activities covering ATLAS science themes. They include kit lists, instructions and background science information.

The activity packs were created with the intention of being used by both educators and ATLAS partners for running educational or public engagement activities. Some of them link to the public engagement sheets and/or demonstration and activities in the ATLAS show. The suggested time needed to prepare and run the activity, a brief introduction to the topic and a kit-list are included (Annex 3). The suggested age of pupils/participants is indicated in years and the relevant Scottish curriculum links. Including curriculum links for other European countries was deemed to be too much detail for inclusion in the packs, however the Scottish links are explained in full so that they can be transferred across to other curricula. The packs are listed below:

- Animal, vegetable, mineral: a quiz-style activity highlighting the lack of plants in the deep-sea and featuring a selection of interesting creatures found on the ATLAS MEDWAVES cruise.

- Hydrothermal vents: instructions on how to construct small clay models of vents which release CO₂ gas, inspired by the discovery in the Azores (Section 5.2).
- Ocean Importance: an introduction to the concept of ocean literacy and suggested props which highlight the importance of the oceans in our daily lives. Links to the Public Engagement sheet and the show.
- Ocean acidification: instructions for experiments which demonstrate the process of ocean acidification. Links to the Public Engagement sheet for this topic.
- Pressure in the deep: instructions for experiments which demonstrate the effect of high pressure. Links to the Public Engagement sheet and the show.
- Taxonomy challenge: developed with Georgios Kazanidis (UEDIN), an introduction to taxonomy, instructions on how to develop a classification key and a simplified identification key using images of ophiuroids from the Mingulay reef.
- Threats to coral reefs: a mapping activity which introduces some of the threats faced by cold-water coral reefs.

The packs will be shared via marine education networks mentioned previously. The offer to share resources has already generated interest in this community and encouraging feedback (Figure 7).

“...Also – your ‘pressure in the deep’ activity is brilliant – and very timely! We are doing some outreach work with local schools relating to the upcoming SoNoAT cruise on Polarstern, and we’re running a competition for each of the schools to send a decorated polystyrene cup into the deep. This activity will be perfect for helping teachers to demonstrate what will happen to the winning cups!”

Figure 7. Response from Fiona Beckman, Communications Officer at the Partnership for Observation of the Global Ocean (POGO)

5.4 ATLAS School Show

Resource:	PowerPoint presentation and pack for School Show
Intended for:	ATLAS Partners, educators & public engagement professionals
Access:	Available to download: https://www.eu-atlas.org/education/school-show and https://zenodo.org/record/2652408#.XMb32zBK71

Instructions for use:	The presentation and accompanying pack explain how to run a school show aimed at 6-12 year olds.
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The show was developed to explain the ATLAS project and the work of people involved in it. It starts with a brief introduction to how and why oceans are important, then moves on to how scientists and engineers work at sea. There are discussions around the technology used for exploration of the deep-sea and the challenges posed by deep water. It also features an introduction to cold-water corals, how they feed and how bottom trawling for fish damages them. The show finishes with information about marine protected areas and a compilation video from various ATLAS cruises. It was created initially to support Dynamic Earth's outreach programme and was successfully delivered to over 1,200 pupils in March 2019 at Strathearn and Caithness science festivals, Scotland. Feedback was gathered from teachers after their classes experienced the show (Annex 4). One teacher commented that the show would give their pupils an interest in deep sea creatures and others said that the interactive activities were a highlight.

The show was designed to be delivered by two people who select volunteers from the audience to run a series of demonstrations or activities but it can be adapted to suit different delivery styles and audiences and the script is meant to be a suggested outline which can be adapted. It is also designed to be modular so that the activities and demonstrations can be used individually to explain certain concepts (Figure 8).

A pack for educators which includes a kit-list, script and transcript for the compilation video (Annex 5) is available to download from the ATLAS Education tab alongside a PowerPoint presentation (Annex 6). The video and transcript will also be available separately via the ATLAS YouTube channel at <https://youtu.be/IFC-DVeZx1Y>



Figure 8. Example of a modular activity from the show: pupils use balancing boards to experience the challenge of carefully preserving samples on a moving ship.

6. Dynamic ATLAS exhibition stand

6.1 Banners

Resource:	Six images designed to be printed as pull-up banners
Intended for:	ATLAS Partners
Access:	Available to download: https://www.eu-atlas.org/education/public-engagement and https://zenodo.org/record/2651008#.XMb8wTBKi71
Instructions for use:	Images are designed to be printed as standard 800mm x 2000mm pull-up banners. Partners can also contact eu-atlas@ed.ac.uk for access to the original files if needed for editing purposes.

A suite of six educational banners make up the ‘dynamic ATLAS exhibition’ stand for dissemination of the project at key events (World Ocean Day, Maritime Day etc.). Five of the banners cover ATLAS science themes and aims, while the sixth one introduces the concept of ocean literacy. Dynamic Earth’s marketing department, led by Jasmine Orde, created eye-catching, clear and appealing banners. They are designed to communicate aspects of the ATLAS project to a general public audience. The banners have already been used at the CommOCEAN (December 2018, Southampton, UK) conference and events during Edinburgh Science Festival, including UEDIN public engagement events at the Scottish Parliament and at Dynamic Earth. They form an integral part of the modular drop-in activities used both at Dynamic Earth and on outreach (detailed in Sections 4.1 and 4.2). They will also be used during ATLAS-themed drop-in activities at Dynamic Earth over the summer holidays, expected to reach an audience of around 20,000 people. To increase their impact, they are also available as PDFs for partners to download from the ATLAS website. Partners can then print these to use at their own conferences and events.

The ‘ATLAS Overview’ banner serves as an introduction to the work of the project; ‘How Deep’ looks at the depths which the ATLAS project is focusing on and relates them land-based features and ‘Case Studies’ explains the role of the ATLAS case studies and their link to the major Atlantic current pathways. The ‘Creature close-ups’ (Figure 9) banner was developed with assistance from Georgios Kazandis (UEDIN) and challenges participants to identify creatures collected from the Mingulay Reef from close-up images, similar to how ATLAS taxonomy scientists work. ‘Exploring with technology’ (Figure 10) highlights the use of technology for ATLAS research, focusing on ROVs, autonomous ‘gliders’ and computer modelling. The ‘Ocean Literacy’ banner was developed to increase public

knowledge of the concept of ocean literacy and to link it to the work of ATLAS scientists. It explains the concept of ocean literacy and lists the seven core principles (Figure 11).



Figure 9. Creature Close-ups banner



Figure 10. Exploring with Technology banner

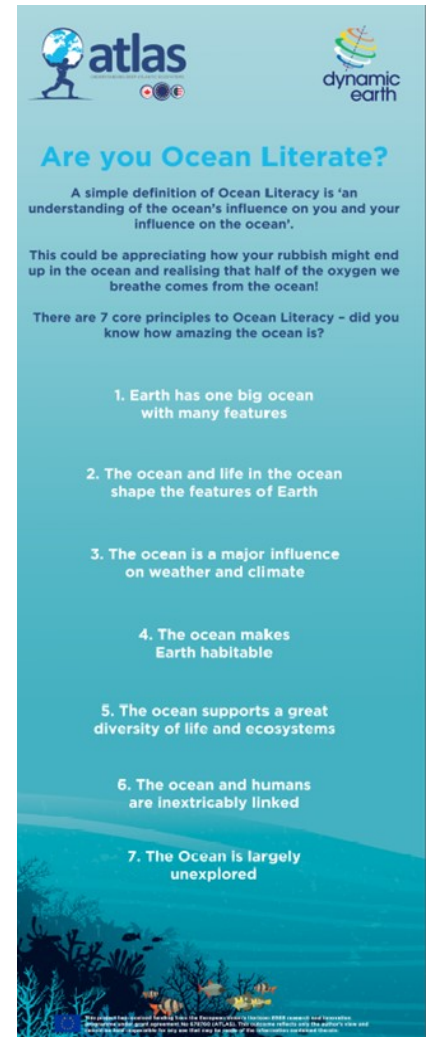


Figure 11. Ocean Literacy banner

6.2 Cardboard viewers and 360° videos

Resource:	ATLAS branded cardboard viewers and 360° videos
Intended for:	ATLAS Partners
Access:	Branded cardboard viewers for partners can be requested from Natalie.walls@dynamicearth.co.uk (approx. 60 still available, April 2019). The videos are on the ATLAS YouTube channel (https://www.youtube.com/watch?v=z47I2ZD5So). Viewers were purchased from http://www.brandedvr.com/

	Unbranded viewers are widely available for purchase online at very low cost.
Instructions for use:	ATLAS partners can use phones or similar devices in the viewers at public engagement events.

The 360° videos and cardboard viewers allow ATLAS partners to share the experience of being an ATLAS scientist in a fully immersive way. The cardboard viewers are designed to hold a smartphone or similar device on which participants can watch videos in 360° (Figure 12). The cardboard viewers can also be used to examine the 3D model of the ROV simulator scene (Section 4.1). ATLAS partners can use the viewers at conferences and public engagement events as the videos are designed for a general public audience. Laurence De Clippele (UEDIN) provided the design of a cold-water coral reef, ATLAS logo and link to the ATLAS YouTube channel. Dynamic Earth purchased 80 viewers to distribute to partners, with 20 being distributed at the 4th General Assembly and additional ones to follow later. A 360° camera was purchased by UEDIN and footage was collected by Graham Tulloch (BGS) during the cruise on CCGS Amundsen. From this footage, an educational 360° video for a family audience with explanatory text was produced, making the audience feel like they are on the research ship in the Canadian Arctic. The video is available on the ATLAS YouTube channel and can also be viewed without the cardboard viewers (Figure 13). It has been used extensively at conferences and events for ATLAS since December 2018. More 360° videos will be filmed and added to the ATLAS YouTube channel later in the project.



Figure 12. Participant using a cardboard viewer to watch a video.

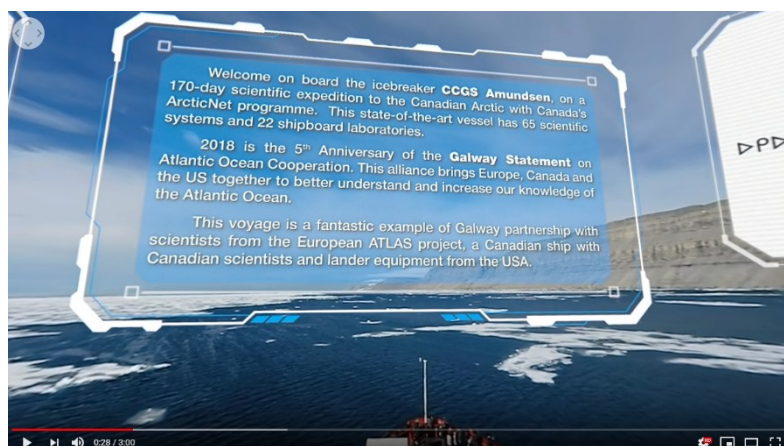


Figure 13. Screen-shot of 360° educational video from the Amundsen cruise, accessed via the ATLAS YouTube channel.

7. 'Meet-the-scientists' outreach training

7.1 Training workshop at ATLAS 4th General Assembly

To facilitate a better understanding of adapting language/vocabulary to your audience, Emma Paterson (DE) and Laurence De Clippele (UEDIN) ran a public engagement training workshop at the 4th General Assembly, Mallorca, on 4th April 2019. The workshop also involved an interactive activity with Lego and play-dough which allowed researchers to view their science field from a different angle and consider novel ways of making it accessible. The session was attended by 20 academics and was very well received (Figure 14.).



Figure 14. Tweet posted after attending the public engagement workshop at the 4th General Assembly.

7.2 Further training for proposed 'meet-the-scientist' event, February 2020

Further 'meet-the-scientist' events are planned to run either alongside final ATLAS General Assembly in Edinburgh or as pre/post activities with Dynamic Earth as a venue during the Scottish school holidays in February 2020. Dynamic Earth's Science Engagement Officer, Natalie Walls, will work with selected ATLAS partners to develop exciting new activities which showcase the latest findings of the project and offer relevant training for those who wish to take part.

8. Partners involved in the work

This educational outreach portfolio is intended to help partners communicate the project and its results in consistent and efficient manner. The materials described here were mainly developed by Emma Paterson at Dynamic Earth with assistance from Georgios Kazanidis and Laurence de Clippele (UEDIN) and Annette Wilson (AquaTT). Other partners provided images, video footage and background information including Murray Roberts, Julia Eighteen, Alan Fox and Johanne Vad (UEDIN); Telmo Morato and Carlos Dominguez Carrió (IMAR-UAz); Covadonga Orejas (IEO) and Graham Tulloch (BGS). We also wish to thank the following people for their help with translating selected resources: Laura Duran, Georgios Kazanidis, Adriana Ressurreição, Stephanie Leifmann, Wolf Isbert, Covadonga Orejas and Alex Ingle, Dick van Oevelen and Christian Mohn.

The outreach portfolio will be updated later in the project if deemed appropriate with the creation of additional materials, videos and/or translations.

9. Appendix: Document Information

EU Project N°	678760	Acronym	ATLAS
Full Title	A trans-Atlantic assessment and deep-water ecosystem-based spatial management plan for Europe		
Project website	www.eu-atlas.org		

Deliverable	N°	9.4	Title	ATLAS Educational Outreach Portfolio
Work Package	N°	9	Title	Dissemination, Knowledge Transfer and Outreach

Date of delivery	Contractual
Dissemination level	Public

Authors (Partner)	DE			
Responsible Authors	Name	Emma Paterson	Email	Emma.paterson@dynamicearth.co.uk

Version log			
Issue Date	Revision N°	Author	Change

10. Annexes

Annex 1 - Cruise engagement letter



Would your students like to ask our scientists on-board a Canadian ice-breaker a question?

Dear Teachers,

Thank you for your interest in the EU Horizon 2020-funded project [ATLAS](#). I am writing to tell you about a fun end-of-term project that you and your pupils might be interested in!

This summer, ATLAS scientists will be working on an exciting research cruise in the Canadian Arctic. We would like to invite your pupils to take part in a question-and-answer exchange with our marine scientists on-board!

The cruise is linked into our work with the ATLAS project, looking at sea life in the deep Atlantic Ocean. ATLAS scientists will be on board the Canadian research ice-breaker, [CCGS Amundsen](#), from 24 July to 16 August 2018. The scientific team from Canada, America and Europe will be using underwater robots (or Remote Operated underwater Vehicles (ROVs)) and putting equipment on the sea floor to look at the fascinating, possibly not yet-discovered creatures found there. They will also measure things such as water temperature, currents and the amount of food in the water.

If you can spare 10 minutes to tell your classes about this opportunity and let them come up with some questions, we'd love to pass them on to the scientists on board. The most interesting questions will be rewarded with a hand-written postcard from one of the scientists on-board, personally addressed to the student who asked the question. We will also endeavour to answer as many questions as possible via email or social media (follow us on twitter [@Eu_ATLAS](#)).

As the cruise will take place over the summer holidays, we think this will be a great surprise to come back to in the next school year!

Please send any questions and comments from your class to; emma.paterson@dynamicearth.co.uk with your school's address, the pupils' first name and first letter of their family name, for example:

School Name: 'Dynamic Earth School'
School Address: Halyrood Road, Edinburgh
Pupil's Name: Emma P

We will use this information only for the purposes stated herein and we do not distribute any contact details to third parties.

If you have any questions, please do not hesitate to contact me! Please feel free to share this email with other teachers in your schools and network. We would love to hear from as many pupils as possible.


Best wishes,

Annette
 ATLAS Communication Officer
















P.S. You can follow the cruise via <https://data.amundsen.ulaval.ca/> and find out exactly where the ship is in real time!


Annex 2 – Reef Survey Key

Explore a Cold-Water Coral Reef




Just like their tropical cousins, cold-water coral reefs provide a habitat for many different creatures, which find shelter, food and even a safe a place to lay their eggs amongst the coral. The coral reef is made up of living coral and dead coral 'rubble' - can you work out where most of the creatures like to stay? This reef is part of the ~~Logachy~~ Logachy Mounds on Rockall Bank, a large underwater landscape to the west of the UK around 600-1000m deep. Different scientists will look at hundreds of photos and videos to work out what lives around the reef. What can you find?!

		Tick	How many did you find?
	Crab	<input type="checkbox"/>	<input type="text"/>
	Carrier Crab	<input type="checkbox"/>	<input type="text"/>
	Long-spine slate pen/pencil sea urchin	<input type="checkbox"/>	<input type="text"/>
	Brown Urchin	<input type="checkbox"/>	<input type="text"/>
	Black Coral with Skate eggs	<input type="checkbox"/>	<input type="text"/>
	Black Coral (<u>Leipathes sp</u>)	<input type="checkbox"/>	<input type="text"/>
	Basket star	<input type="checkbox"/>	<input type="text"/>
	Octopus	<input type="checkbox"/>	<input type="text"/>
	Oreo	<input type="checkbox"/>	<input type="text"/>
	Ghost Shark/Rabbitfish	<input type="checkbox"/>	<input type="text"/>
	Pink Red Rockling	<input type="checkbox"/>	<input type="text"/>
	<u>Blackbelly</u> Rosefish	<input type="checkbox"/>	<input type="text"/>
	Shrimp	<input type="checkbox"/>	<input type="text"/>
	<u>Zoanthids</u>	<input type="checkbox"/>	<input type="text"/>
	Red Scorpionfish	<input type="checkbox"/>	<input type="text"/>



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 672750 (ATLAS). This outcome reflects only the author's view and cannot be held responsible for any use that may be made of the information contained therein.



Annex 3 - Example pack for educators (Ocean acidification)



Ocean Acidification



Recommended style of activity	
Public engagement: Family drop-in activity, group demonstration	Schools: Teacher demonstration followed by class activity
Suggested age range: 8-15 years	
Approximate time : 5 minutes demonstration; 5-10 minutes class/group activity	

Background Science

The ocean soaks up carbon dioxide (CO₂) gas from the air as part of the natural carbon cycle. As CO₂ is absorbed in water it forms an acid called carbonic acid. Human activities are adding more CO₂ to our atmosphere, which means that more is being absorbed by the ocean and the oceans are getting slightly more acidic. While this change is not enough for humans to notice, it will have a big impact on creatures with skeletons or shells made of calcium carbonate (chalk).

The changing chemistry will make it harder for these creatures, including cold-water corals, to get the ingredients they need to build their skeletons or shells from the water. This might make them more likely to become diseased or mean they grow more slowly. While the creatures are alive, they are mostly protected from the corrosive effects of a more acidic ocean but this is not the case once they have died. A lot of creatures make their home in dead coral 'rubble' and many reefs are built up on the rubble of previous colonies. In a more acidic ocean, the rubble could be in danger of collapsing, causing many creatures to lose their homes or even damaging the whole reef.

Ocean acidification is a developing area of research and scientists are running long-term experiments to help us determine the effects of a more acidic ocean as well as attempting to understand how this acidification might vary through the oceans.

In this series of experiments you can use indicators to prove that absorbing CO₂ gas makes water more acidic. These pH indicators change colour when mixed with acid or alkali liquids—some are manufactured chemicals but you can also make your own using kitchen ingredients.

As a follow-up activity, you can use household acids such as vinegar or lemon juice to demonstrate the corrosive effect of an acid on calcium carbonate shells.

I can identify and classify examples of living things, past and present, to help me appreciate their diversity. I can relate physical and behavioural characteristics to their survival or extinction. **SCN 2-01a**

By contributing to investigations into familiar changes in substances to produce other substances, I can describe how their characteristics have changed. **SCN 2-15a**

I can explain some of the processes which contribute to climate change and discuss the possible impact of atmospheric change on the survival of living things. **SCN 3-05b**

I can discuss the environmental impact of human activity and suggest ways in which we can live in a more environmentally responsible way. **SOC 2-08a**

Kit List:

Note: Bromothymol Blue is an indicator which you can get from suppliers which provide chemicals for schools or education centres. If you cannot obtain this, or are not comfortable using it (for example with younger children) you can make red cabbage indicator instead.

If running this as a Public Engagement Activity, you can also use the A3 explanatory activity sheets—available online in the ATLAS Education section.

For experiments using Bromothymol Blue:

- Bromothymol blue, diluted as suggested in the supplier guidelines or to about 1 part Bromothymol blue to 4 parts water.
- Jar or container with a loose-fitting cover (e.g. a beaker with a petri-dish on top)
- Smaller container which can be fixed to the inside of the larger one using tape.
- Bicarbonate of soda
- Vinegar/lemon juice
- (Optional extras: clear cup with a lid which has a hole for a drinking straw)

For experiments using Red Cabbage:

- Chopped red cabbage
- Hot water
- Vinegar/lemon juice
- Fizzing tablets (e.g. alka seltzer)
- Plasticene/modelling clay
- Plastic drinking straw
- Plastic bottle top

Annex 4 – Feedback from a Primary school



**TEACHERS
TELL US WHAT YOU
THINK**



We want to know what you thought of your experience with us today. We'll use this information to help improve our outreach programme in the future.

School name - *COMBE* Pupil Year - *P4*

What were the best bits about the show?
Lots of fun interactive activities. They especially enjoyed the wobble boards and the bottom brawling.

What could we do to make the show even better?
Something for pupils to take away to help them remember the workshop.

Overall, how would you describe your 'Atlantic Adventures with ATLAS Show' experience?
 Excellent Very Good Average Bad Very Bad

What impact do you think the show has had/will have on your pupils?
Hopefully an idea of what jobs a scientist might do.

Please turn over...

Annex 5 – Atlas show pack





Recommended style of activity: interactive show delivered by trained staff.
Suggested age range: 6-12 years
Approximate time : 45 minutes

Background:

This show was developed to explain the ATLAS project and the work of people involved in it. It starts with a brief introduction to how and why oceans are important, then moves on to how scientists and engineers work at sea. There are discussions around the technology used for exploration of the deep-sea and the challenges posed by deep water. It also features an introduction to cold-water corals, how they feed and how bottom trawling for fish damages them. The show finishes with information about marine protected areas and a compilation video from various ATLAS cruises (expeditions).

The show was designed to be delivered by two people who select volunteers from the audience to run a series of demonstrations or activities but it can be adapted to suit different delivery styles and audiences and the script is meant to be a suggested outline which can be adapted as well.

It is also designed to be modular so that the activities and demonstrations can be used individually to explain certain concepts. Some of these have also been made available with explanatory packs and sheets on the ATLAS website. They are as follows:

- Ocean Importance (Explanatory pack and A3 public engagement sheets)
- Pressure in the Deep (Explanatory pack and A3 public engagement sheets)
- Robot Challenge (A3 public engagement sheets)

Kit List:

For delivery as the full show:

- 'Atlantic Adventures with ATLAS' powerpoint presentation
- Atlas compilation video
- Kit for demonstrations & activities (listed overleaf)

These resources are available at <https://www.eu-atlas.org/Education>



Script for show, page 2:

[ATLAS covering slide – deep sea images/marine scientists]

Scientist 1: Hello! My name is ... and I'm a marine scientist, my job involves trying to answer some big questions about the ocean.

Scientist 2: And I'm ... We're here today to find out more about the oceans! So, who wants to find out more about the oceans? Give me a cheer!

(Wait for cheer, encourage group to be noisy if they aren't already!)

Scientist 1: Great, we'll do our best to help. I'd also like to talk about some of the scientists, engineers, and mathematicians who help us discover and appreciate all that goes on in our amazing seas.

Scientist 2: Well I have a question already then: if we're finding out more about the ocean, I want to know how it's important to me! Do we need the ocean?

Scientist 1: Well why don't we ask these lovely people and see what they think? Do you appreciate the ocean? Do you use the ocean for anything? Can you think why we might need an ocean on Planet Earth? Have a chat to the person next to you and see if you can come up with some answers. We have some items which might help you out...

(Throw or hand out the 'Ocean Importance' props to start discussions.)

Scientist 2: Wow, that's a lot of great ideas there – it's certainly sounding like the ocean is hugely important to all life on Earth, including humans. We've talked about food, medicines, energy and fun but what does [the oxygen from the ocean prop] represent?

Scientist 1: It's because of all the Oxygen! Just like plants on land take in CO₂ and give out Oxygen, so do things that live in the sea.

[New slide – phytoplankton]

These tiny creatures are called phytoplankton and there are so many in the ocean that they actually produce half of the oxygen that we breathe in! They're also very important as lots of other creatures in the ocean eat them – they're the base of a lot of marine food chains.

Scientist 2: Wow! So you're saying that when I breathe in, that's equivalent to the oxygen in every second breath being made by those tiny things?! That's amazing!

Scientist 1: Yep, awesome isn't it! Another vital thing that the ocean does is the movement of heat – that's what this globe shows you *(hold up currents globe)*.

[New slide – ocean current animation]

The ocean is always moving. Huge currents carry warm water from the equator towards the poles. Cold water sinking at the poles carries the cold away. This spreads heat out, making Earth a better place to live. Ocean currents also have a big effect on our weather.

Scientist 2: I'm curious, I've heard that the oceans is mostly unexplored. We've just talked about how important the ocean is for all life on Earth. Why haven't we explored more of it?

Scientist 1: Good question! I suspect it's because the ocean is quite a difficult place to work, but don't worry there are many people trying to explore more! This includes scientists working on the 'ATLAS' project.

[New slide – ATLAS case study map]






Annex 6 – Example slides from Show PowerPoint presentation



Atlantic adventures
with ATLAS



Atlantic Adventures
with ATLAS



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