A New Blue Curriculum

A toolkit for policy-makers

IOC MANUALS and GUIDES, 90

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Intergovernmental Oceanographic Commission

2021 2030 United Nations Decade of Ocean Science for Sustainable Development

Published in 2022 by the United Nations Educational,
Scientific and Cultural Organization,
7, place de Fontenoy, 75352 Paris 07 SP, France
and
UNESCO Intergovernmental Oceanographic Commission and Regional Bureau
for Science and Culture in Europe

This publication should be cited as follows: IOC-UNESCO. 2022. A New Blue Curriculum – *A toolkit for policy-makers*, Paris (IOC Manuals and Guides, 90)

More information at oceanliteracy.unesco.org

Cover photo: Shutterstock.com/Jsep
Pwani Zanzibar, Tanzania, Africa 08.25.2017 Zanzibar Kids
Graphic design: Giorgia Revelli
Cover design: Giorgia Revelli
Illustrations: Giorgia Revelli
Typeset: Giorgia Revelli
Printed by: Grafiche Veneziane

Printed in Venice, Italy

(IOC/2022/MG/90 Rev.)

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Acknowledgements

Appreciation is expressed to all contributing authors, reviewers and those who supported the development of this publication, 'A new blue curriculum: Toolkit for policy-makers'. Their experience, vision and knowledge made it possible to produce this material to support the inclusion of Ocean Literacy in school curricula worldwide. Thanks also for the support and collaborative efforts of the UNESCO International Bureau of Education (IBE-UNESCO), which were essential to concretize this publication.

This Toolkit could be developed thanks to the financial support provided by AXA XL.

IOC-UNESCO gratefully acknowledges the support and tireless engagement of all individuals who participated in the development of this material.

Publication team

Authors:
Francesca Santoro, Intergovernmental Oceanographic Commission of UNESCO
Ana Vitória Tereza de Magalhães, Intergovernmental Oceanographic Commission of UNESCO
Fiona Middleton, Intergovernmental Oceanographic Commission of UNESCO
Jamie Buchanan-Dunlop, Encounter Edu

Contributors and reviewers:
Renato Opertti, UNESCO International Bureau of Education
Hugo Labate, UNESCO International Bureau of Education
Diana Payne, Ph.D. Associate Professor & Education Coordinator, University of Connecticut & Connecticut Sea Grant
Raquel Lorenz Costa, Portuguese Ministry of the Sea
Nicola Bridge, Head of Ocean Advocacy & Engagement, Ocean Conservation Trust, UK
Daniel Kasnick, Newton College and Founder Camp D&D Peru

Foreword

**by Vladimir Ryabinin, Executive Secretary of the Intergovernmental Oceanographic Commission and Assistant Director General of UNESCO,
and Chip Cunliffe, Biodiversity Director, AXA XL**

Our planet is the planet Ocean. Home to the largest array of ecosystems on Earth, the ocean is endlessly fascinating and deeply connected to human life and culture. Its features hold diverse meanings for human practices and peoples around the world and persist as an important aspect of cultural identity and heritage. Across the planet, the ocean is a source of food for more than a billion people, covering approximately 70% of the Earth's surface. Its interconnected circulation impacts winds, currents, tides and water density, continuously transporting heat, matter and organisms across the world, and supporting livelihoods and economies. Throughout human history and into our future, all corners of the ocean hold possibilities for nutrition, medicine, tourism, mental health, ethical values, livelihood, education and sustainable solutions.

Despite the ocean's vastness and diversity, and its cornucopia of resources, we understand only a small part of it. Ocean Literacy and ocean-related educational practices are not yet widely present within school curriculum structures worldwide – but the inclusion of the ocean as an area of learning in curriculum structures offers many opportunities to engage future generations and support informed decision-making processes regarding the ocean and our planet. A greater understanding and appreciation of the importance of the ocean is key to its long-term sustainability. This Toolkit for Policy-makers moves us towards a 'new blue curriculum' and is a welcome step in bringing Ocean Literacy into classrooms, weaving it into teaching and learning through innovative and inspiring methods.

The essence of Ocean Literacy is understanding the ocean's influence on us and our influence on the ocean. In 2015, IOC-UNESCO embraced the concept of Ocean Literacy and began working to boost the global reach of the movement. The commitment 'Ocean Literacy for All', launched at the first UN Ocean Conference, marked the start of a series of activities to promote Ocean Literacy worldwide. This work included the launch of the Ocean Literacy For All Toolkit and the creation of the Ocean Literacy Portal, acting as a one-stop-shop for Ocean Literacy practitioners around the world. These initiatives have inspired the birth of a multicultural community of Ocean Literacy practitioners who are constantly promoting the concept at an international level.

In 2017, the UN General Assembly declared the United Nations Decade of Ocean Science for Sustainable Development (2021–2030), the 'Ocean Decade', where 193 countries recognized the key role of ocean science in finding innovative ocean-based solutions for the major global challenges in our rapidly changing world. This initiative requires a revolution in the way ocean science is generally used and Ocean Literacy, and its support of new educational approaches, is crucial to the success of the Ocean Decade.

For the last 10 years, AXA has also been working to support teachers in bringing the ocean into school. Using the outputs of AXA's own ocean science research and the expertise of Encounter Edu, AXA Ocean Education has developed a suite of free, publicly available classroom resources and lesson plans for teachers to use. Annual live education broadcasts with marine scientists from the Arctic, and the coral reefs of the Caribbean, help make ocean science accessible to children around the world. Recognizing the importance to grow Ocean Literacy, AXA is proud to work with IOC-UNESCO on this Ocean Literacy Toolkit for Policy-makers.

The IOC-UNESCO 'A new blue curriculum' Toolkit for Policy-makers is the result of a collaborative effort between IOC-UNESCO, AXA, and many other partners. It aims to achieve the targets proposed by the strategic vision of 'Ocean Literacy within the Decade: A Framework for Action', which establishes 'mainstreaming Ocean Literacy in education policy formulation' and 'enhancing Ocean Literacy in formal education' as a priority for the Ocean Decade. This Toolkit, and Ocean Literacy more broadly, also supports Education for Sustainable Development, which is an integral element of the UN's Agenda 2030 Sustainable Development Goals. The Agenda highlights the purposes and values that underpin education and aims to reorient all levels of education and learning to contribute to sustainable development.

The development of 'blue curricula' is occurring alongside other changes transforming the educational sector across the world, namely approaches aiming to transform educational environments, empower teachers, encourage flexibility and hybrid learning, and strengthen community cooperation. These forward-looking movements are taking place with an eye to envision global futures defined by sustainability, care and imagination. We hope this publication will inspire policy-makers, curriculum developers, education experts and stakeholders to integrate Ocean Literacy into curriculum structures with consideration of local, national and regional policies, and specific cultural and geographical aspects of the ocean within their contexts.

Throughout 2020 and 2021, education has been strongly impacted by COVID-19 pandemic measures, from closed schools to distance-learning and remote classes, reduced student contact, and countless other challenges. Looking ahead, Ocean Literacy can serve as an opportunity to implement transformational whole-school educational approaches, where access to ocean knowledge and care is not limited to students but extended to all school stakeholders and school staff. Such an approach supports inclusivity, flexibility, cooperation with the community, promotion of traditional knowledge and cross-cutting competences. Indeed, schools and authorities wishing to 'blue' their curriculum have ahead of them an exciting array of ideas and activities to put into practice, to activate the imagination of learners and work towards an ocean-literate future.

This publication invites education authorities and Ministries to engage with emerging trends in school curricula, and advance Education for Sustainable Development and Ocean Literacy within their formal education systems. To meet the challenges of today, numerous international trends in formal education are guiding the design and update of curricula – through which the ocean must be included as a fundamental part of our world.

We extend the warmest thanks to the International Bureau of Education (IBE), Encounter Edu, and those Member States who contributed resources and time to develop the toolkit, as part of their support for IOC-UNESCO and the Ocean Decade.

Vladimir Ryabinin
Executive Secretary of
IOC-UNESCO

Chip Cunliffe
Biodiversity
Director, AXA XL

Executive Summary

A new blue curriculum: Toolkit for policy-makers

This Toolkit aims to support policy-makers, curriculum developers and educational authorities in implementing Ocean Literacy into their national curriculum framework.

Ocean Literacy is a tool, a framework and, more broadly, a mindset that forefronts the ocean in all aspects of life on Earth. As an approach for society as a whole, Ocean Literacy catalyzes actions to protect, conserve and sustainably use the ocean.

The ocean is intrinsically connected to every part of the globe, to human livelihoods and to sociocultural practices. Understanding the ocean's influence on us and our influence on the ocean is vital to develop and practice sustainable ways of living together. With the launch of the UN Decade of Ocean Science for Sustainable Development (2021–2030), this Toolkit builds on the momentum of the global Ocean Literacy movement to support Ocean Decade Outcome 7 – 'An inspiring and engaging ocean'.

By synthesizing the latest research and case studies provided by Member States who currently are already promoting ocean literacy, this Toolkit aims to offer orientation on how to 'blue' curriculum and guidelines, in line with trends in education. Enhancing the knowledge and capacity of schools, teachers and learners about the ocean furthers society's understanding of the importance of ocean life and ocean–human interactions. In turn, this knowledge advances the need to preserve and care for ocean resources, and to support better decision-making by society as a whole.

A Theory of Change for Ocean Literacy

To advance behavioural change through the uptake of Ocean Literacy in school curricula, the Theory of Change offers a four-part matrix for designing a curriculum rich in ocean content:

Knowledge and awareness	**Nature-connectedness**	**Values and attitudes**	**Competences**
Through problem-based, action-based and wonder-based knowledge, provides a foundation for young people to engage with and debate ocean topics and issues.	Fostered by spending time and learning in nature, strengthens positive attitudes and emotional connection with the marine environment.	Towards the ocean, developed alongside peers and teachers in the school environment, guide students to make informed and sustainable choices to safeguard the marine environment, and influence others for collective change.	Enable and empower students to take sustainable action for collective well-being and sustainable development.

Educational trends and opportunities for a blue curriculum

With the continuing technological advances in and outside the classroom, and from the conditions of a post-COVID world, emerging trends in educational approaches and methods can shape a progressive blue curriculum in line with UNESCO's Education for Sustainable Development framework and the goals of Agenda 2030:

- Embracing Ocean Literacy through a **whole-school approach** promotes a holistic understanding of the ocean's importance, encouraging **student agency** to act, interact and participate as active citizens.
- **Flexible and hybrid teaching and learning methods** facilitate **inclusive ocean education** through the use of innovative tools like virtual reality, diverse materials and attention to individual student needs.
- Providing teachers with **training and ready-to-use materials** on Ocean Literacy builds networks of **confident, connected educators**.
- Extracurricular activities and field trips enhance student **well-being and provide** opportunities for **cooperation with NGOs, academic institutions and local communities** on initiatives to raise awareness and protect the marine environment.
- Understanding and valuing **local, traditional and Indigenous knowledge** about the ocean contributes to a **multi-perspective approach** to ocean content.
- Including **blue case studies and examples** helps to overcome terrestrial bias and misconceptions about the ocean, and foster Ocean Literacy in regions far from the coast.
- A blue curriculum considers the ocean **across multiple disciplines**, connecting knowledge between the sciences and humanities; and spans **local and global scales**, educating as students forward-looking global citizens.
- Raising awareness of Ocean Literacy elevates its **inclusion in policy frameworks**, highlighting its connections with national priorities and attracting **funding for initiatives**.

A Toolbox for implementation and evaluation

To successfully integrate Ocean Literacy across the scope and sequence of the curriculum, implementation must involve an array of stakeholders through a pilot testing phase.

With evaluation in mind as a constant process, policy-makers and curriculum developers are able to envisage Ocean Literacy approaches that support sustainable action for educational stakeholders and students in the long term.

To support blue curriculum development and implementation, the second part of this Manual provides a Toolbox to guide policy-makers through the process of:

- Considering approaches for developing a blue curriculum
- Implementing the Theory of Change
- Understanding the elements of a blue curriculum
- Revising the current curriculum structure
- Mapping national priorities, policies and Ocean Literacy.

Acronyms

ESD	Education for Sustainable Development
IBE	International Bureau of Education
IOC	Intergovernmental Oceanographic Commission of UNESCO
IGO	Intergovernmental organization
KPI	Key Performance Indicator
MOOC	Massive Open Online Course
NGO	Non-governmental organization
OL	Ocean Literacy
SDGs	Sustainable Development Goals
STEAM	Science, Technology, Engineering, Art and Mathematics
UN	United Nations
UNESCO	United Nations Educational, Scientific and Cultural Organization

INTRODUCTION

A blue curriculum in the context of the United Nations Decade of Ocean Science for Sustainable Development (2021–2030)

Ambition for a new blue curriculum

A Theory of Change model for Ocean Literacy

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1

Many people are unaware of the importance of the ocean and its intrinsic connection to life on Earth. The ocean provides the oxygen we breathe and absorbs carbon dioxide from the atmosphere, and is crucial for many processes in Earth systems such as food supply and climate regulation. It is also essential for humanity as it contributes to diverse aspects of our economy, well-being, politics, medicine, global trade, food, recreation, cultural heritage and many other sectors.

Ocean Literacy has grown to encompass more than educating or informing the public or marine and maritime stakeholders about the importance of the ocean. Ocean Literacy is radically evolving from its initial application in formal educational contexts into an approach for society as a whole that catalyzes actions to protect, conserve and sustainably use the ocean.

The inclusion of Ocean Literacy in the curriculum creates what is hereafter referred to as a 'blue curriculum', helping learners to understand the importance of ocean life and features (physical, chemical, geological, etc.) and ocean–human interactions, and underscoring that the ocean is part of the planet. By enhancing schools', teachers' and students' knowledge about the ocean, in turn, a blue curriculum may advance knowledge and show the need to preserve and care for ocean resources, therefore supporting better decision-making by society as a whole.

The objective of this Toolkit is to synthesize the latest research and case studies to offer orientation to policy-makers, curriculum developers and educational authorities on how to include Ocean Literacy in their curriculum framework and guidelines. A variety of case studies showcase how different curriculum authorities, NGOs, schools and educational initiatives have addressed Ocean Literacy. In addition, a Toolbox provides tools for policy-makers, curriculum developers and education experts to assess their current Ocean Literacy frameworks, and to understand how to advance towards a curriculum that considers the ocean and its complexity.

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A blue curriculum in the context of the United Nations Decade of Ocean Science for Sustainable Development (2021–2030)

The UN has declared that the Decade of Ocean Science for Sustainable Development ('the Ocean Decade') is taking place from 2021 to 2030, and the enhancement of Ocean Literacy is critical to its success. Throughout the Ocean Decade, Ocean Literacy initiatives will be developed and implemented that encompass cross-sectoral, inter- and transdisciplinary approaches. In turn, these can empower governments, businesses, the media, educators, civil society and the general public to understand the key role the ocean plays in our lives[1].

Most of us live our lives unaware of how our day-to-day actions affect the health and sustainability of the ocean and its resources, on which we depend[2] – and Ocean Literacy is a powerful tool to increase awareness and understanding of the critical roles and values of the ocean. The societal potential of Ocean Literacy for achieving a more sustainable world is significant, as it has the ability to impact all stakeholders from awareness and understanding towards attitude change, construction of values and ultimately to desired behavioural change[3]. The Ocean Decade aims to facilitate a transition from the 'ocean we have' to the 'ocean we want' – one that supports a sustainable, equitable and healthy future for all.

[1] UNESCO-IOC. 2021. Ocean Literacy Framework for the UN Decade of Ocean Science for Sustainable Development 2021–2030. Paris, UNESCO. (IOC Ocean Decade Series, 22.)
[2] F. Santoro et al. (eds). 2017. Ocean Literacy for All - A toolkit, IOC/UNESCO & UNESCO Venice Office, Paris (IOC Manuals and Guides, 80).
[3] UNESCO-IOC. 2021. Ocean Literacy Framework for the UN Decade of Ocean Science for Sustainable Development 2021–2030. Paris, UNESCO. (IOC Ocean Decade Series, 22.)

The Ocean Decade is framed around ten challenges[4], all of which contain elements of Ocean Literacy. The final two challenges directly reflect the importance of Ocean Literacy ('9. Skills, knowledge and technology for all; 10. Change humanity's relationship with the ocean') while Outcome 7 ('an inspiring and engaging ocean') supports the aim of the Ocean Decade to showcase the ocean as a place of wonder and inspiration for future generations.

This Toolkit was developed considering the objectives of the Ocean Decade and the priority areas proposed by the publication 'Ocean Literacy within the Decade – A Framework for Action'[5] which aims to support education stakeholders in addressing Ocean Literacy through formal education.

In addition, this material aims to advise education stakeholders on the active role they can play during the UN Ocean Decade; and to reinforce the urgency to prepare the next generation of 'blue professionals' for global challenges concerning the ocean.

Additional resources

Ocean Literacy within the UN Ocean Decade of Ocean Science for Sustainable Development, A Framework for Action, Intergovernmental Oceanographic Commission of UNESCO: **https://www.oceandecade.org/resource/170/Ocean-Literacy-within-the-United-Nations-Decade-of-Ocean-Science-for-Sustainable-development-A-Framework-for-Action**

Ocean Literacy framework video: **https://youtu.be/Hcd0oDOHCZc**

Ocean Decade challenges video: **https://youtu.be/NKFhhwpsm-8**

Ambition for a new blue curriculum

A blue curriculum should support the twin goals of teaching and learning more about the ocean, and contributing to the co-design and co-delivery of solutions to the problems and threats it faces.
To achieve this ambition and fulfil the 'blue curriculum' vision, this Toolkit adopts a curriculum framework and guidelines that centre the coverage of ocean topics across subjects and phases of education, as well as a more complex approach to curricula. This approach includes four elements of a Theory of Change model, current trends in education (Section 3) and their relevance to Ocean Literacy (Section 2).

[4] https://www.oceandecade.org/challenges/
[5] UNESCO-IOC. 2021. Ocean Literacy Framework for the UN Decade of Ocean Science for Sustainable Development 2021–2030. Paris, UNESCO. (IOC Ocean Decade Series, 22).

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A Theory of Change model for Ocean Literacy

'The Theory of Change is a method that organisations and groups use to think critically about the required means to bring a desired social systemic change. It is a process designed to depict how a complex change initiative (e.g. a change of behaviour towards the ocean) will unfold over time. It creates an illustration of all the various moving parts that must operate in accordance to bring a desired outcome.'[6]

A dedicated Theory of Change model progresses the Ocean Literacy concept from learning more about the ocean to empowering young people to contribute solutions to the problems and threats it faces. The overall goal of this Toolkit is to support curriculum authorities to make appropriate decisions and progress the Theory of Change in their national frameworks.

However, this Toolkit is not proposing a one-size-fits-all approach. Crucially, different regions will have specific preferences as to the role of government in designating Ocean Literacy, alongside the roles played by civil society, individual schools and other initiatives in creating a holistic approach to Ocean Literacy for young people.

The Theory of Change model for Ocean Literacy synthesizes existing models and has four main components:

1) knowledge and awareness

2) nature-connectedness

3) values and attitudes

4) competences

[6] Theory of Change description. Adapted from: UN-Habitat, 2017.

Role of knowledge and awareness

Knowledge and awareness play multiple roles in developing Ocean Literacy. The most widely understood could be termed 'access to knowledge'. This includes basic locational knowledge, scientific and geographical vocabulary, and a grasp of concepts and processes. Access to knowledge provides a foundation for young people to engage with and debate ocean topics and issues.

Wonder-based knowledge underlines the importance of the ocean and its scale. Wonder-based knowledge exists in its own right and also contributes to a sense of nature-connectedness.

Problem-based knowledge and action-based knowledge form a pair that allows young people to take effective action on the challenges identified for the Ocean Decade.

Role of nature-connectedness

Research suggests that 'connectedness to nature encourages pro-environmental attitudes and behaviours. It is argued that when individuals feel part of nature, they are less likely to harm it, since damage to the environment would be considered as damage to themselves'[7].

A variety of interventions can contribute to nature-connectedness, including spending time in nature, virtual reality experiences, and other forms of multimedia including video and documentaries. Ongoing research is comparing the relative effectiveness of different experiences and the extent to which generic nature-connectedness initiatives foster a specific connection to the marine environment.

[7] Ibáñez-Rueda, N., Guillén-Royo, M. and Guardiola, J. 2020. Pro-Environmental Behavior, Connectedness to Nature, and Wellbeing Dimensions among Granada Students. *Sustainability*, vol. 12.

Role of values and attitudes

Values and attitudes have a role in progressing young people through the steps of a Theory of Change model by creating a predisposition to effective and sustainable action. Models for attitudes that can have a positive or negative impact on behaviour change for Ocean Literacy[8] contain four categories: egoistic, altruistic, hedonic and biospheric.

Character-based education interventions and whole-school initiatives can help to shape these attitudes and values and align them towards ocean action. Traditionally, research suggests that altruistic and biospheric values are prime contributors to positive behaviours. However, some research[9] argues that self-interested values are also viable routes to sustainable behaviour.

Role of competences

Competence frameworks provide a structure for the development of the skills which ensure that young people are able to take effective action. Competence frameworks can be included within subject-based programmes of study or in more holistic approaches, such as those described in the socio-emotional and behavioural strands of the Learning Objectives for UN Sustainable Development Goal 14: Life Below Water,[10] the Competences in Education for Sustainable Development[11] or the OECD PISA Global Competence Framework [12].The global competence framework identifies themes such as open, appropriate and effective interactions across cultures, as well as taking action for collective well-being and sustainable development.

Additional resources

Summary of the Ocean Decade Implementation Plan: **https://oceandecade.org/resource/109/Summary---Version-20-of-the-Ocean-Decade-Implementation-Plan**

Ten clues for rethinking curriculum, 2021, International Bureau of Education of UNESCO, **http://www.ibe.unesco.org/sites/default/files/resources/ten_clues_for_rethinking_curriculum_eng.pdf**

Cava, F., Schoedinger, S., Strang, C. and Tuddenham, P., 2005. Science content and standards for ocean literacy: A report on ocean literacy.

Ashley, M., Pahl, S., Glegg, G. and Fletcher, S., 2019. A change of mind: applying social and behavioral research methods to the assessment of the effectiveness of ocean literacy initiatives. Frontiers in Marine Science, vol. 6.

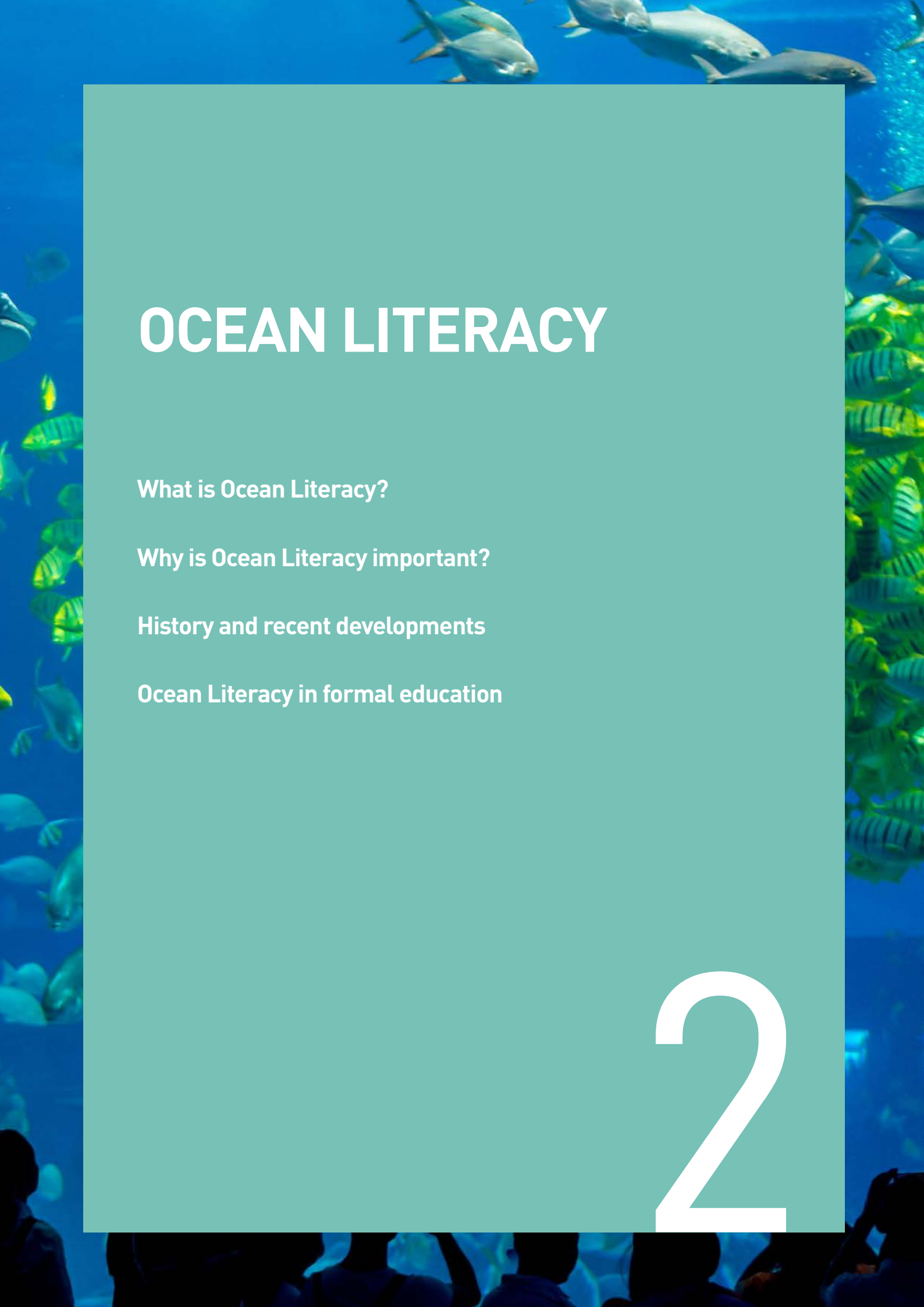
[8] Adapted from Ashley, M., Pahl, S., Glegg, G., and Fletcher, S. 2019. A Change of Mind: Applying social and behavioral research methods to the assessment of the effectiveness of ocean literacy initiatives. *Frontiers in Marine Science*, vol. 6.

[9] De Dominicis S., Schultz P.W. and Bonaiuto M. 2017. Protecting the Environment for Self-interested Reasons: Altruism Is Not the Only Pathway to Sustainability. *Frontiers in Psychology*, vol. 8.

[10] UNESCO. 2017. Education for Sustainable Development Goals: Learning objectives, https://unesdoc.unesco.org/ark:/48223/pf0000247444.page=43

[11] The Competences in Education for Sustainable Development ('Learning for the future: Competences in Education for Sustainable Development'; ECE/CEP/ AC.13/2011/6) were adopted at the sixth meeting of the United Nations Economic Commission for Europe (UNECE) Steering Committee on Education for Sustainable Development on 7 April 2011.

[12] OECD. 2018. The OECD PISA Global Competence Framework, https://www.oecd.org/education/Global-competency-for-an-inclusive-world.pdf



OCEAN LITERACY

What is Ocean Literacy?

Why is Ocean Literacy important?

History and recent developments

Ocean Literacy in formal education

2

2

This section presents the concept of Ocean Literacy, including its essential principles, history and adaptation to formal educational contexts.

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What is Ocean Literacy?

The essence of Ocean Literacy is the understanding of the ocean's influence on us and our influence on the ocean[13], defined by a set of seven principles:[14]

The Earth has one big ocean with many features	The ocean and life in the ocean shape the features of Earth	The ocean has a major influence on climate	The ocean makes the Earth habitable	The ocean supports a great diversity of life and ecosystems	The ocean and humans are inextricably interconnected	The ocean is largely unexplored
1	2	3	4	5	6	7

An ocean-literate person understands the essential principles and fundamental concepts about the ocean; can communicate about the ocean in a meaningful way; and is able to make informed and responsible decisions regarding the ocean and its resources.

Ocean Literacy can take many forms, and may be adapted to formal educational contexts within schools by way of the national curriculum. With this, schools actively engage with civil society and involve local communities in thematic activities about the ocean. Such strong networks tend to incentivize improved behaviour towards the ocean and shape mentalities for sustainable development.

[13] Cava, F., Schoedinger, S., Strang, C. and Tuddenham, P. 2005. Science content and standards for ocean literacy: A report on ocean literacy.
[14] Santoro, F. et al. (eds). 2017. Ocean Literacy for All – A toolkit, IOC-UNESCO & UNESCO Venice Office, Paris (IOC Manuals and Guides, 80).

Why is Ocean Literacy important?

The ocean covers more than 70% of the planet's surface[15], but many people are still unaware of its crucial role and vital influence that reaches far beyond the shore.

During the 2020 COVID-19 pandemic, for example, the ocean was essential for creating COVID-19 tests and vaccines. The blue blood of the horseshoe crab, an animal that lives in several habitats, including coastal waters, contains an endotoxin that is widely used for vaccine and COVID testing.[16]

In addition to producing vaccines, the ocean has great importance for the manufacture and transport of food and commercial goods. Globally, an estimated 11 billion tons of goods are transported by ship every year.[17] Despite the growing footprint of human activity in the ocean, over 80% of the ocean remains unmapped, unobserved and unexplored at high resolution.[18]

Marine ecosystems can be extremely diverse and differ according to geographical region. Coral reefs, mangroves, kelp forests, the deep sea, hydrothermal vents and many more are essential ecosystems for maintaining the balance of life on Earth. However, marine ecosystems are facing serious threats, including those of climate change.[19] To respond to these threats, learners around the world should gain an understanding of sustainable solutions and blue careers from a young age. Future generations need skills to understand the complexity of present and upcoming environmental challenges, and Ocean Literacy is an essential part of this process.

To protect, conserve and sustainably use marine resources, citizens of all ages need to know and understand the connection between humanity and the ocean, i.e., to be ocean literate. As such, Ocean Literacy plays a fundamental role in pursuing wider goals such as achieving the Sustainable Development Goals (SDGs) of Agenda 2030, through the integration of the ocean into all 17 SDGs (Appendix 2).

[15] https://oceanservice.noaa.gov/facts/oceanwater.html
[16] Wang, C.C. et al. 2020. Future of Asian horseshoe crab conservation under explicit baseline gaps: A global perspective. *Global Ecology and Conservation*, vol. 24.
[17] https://www.ics-shipping.org/shipping-fact/shipping-and-world-trade-driving-prosperity/
[18] https://oceanservice.noaa.gov/facts/exploration.html
[19] Hoegh-Guldberg, O. and Bruno, J.F. 2010. The impact of climate change on the world's marine ecosystems. *Science*, vol. 328.

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History and recent developments

The concept of Ocean Literacy was born in the early 2000s,[20] when US educators recognized a lack of ocean-related topics in the school curriculum and developed a comprehensive framework to encourage their inclusion. This work began the worldwide Ocean Literacy movement that has now travelled to many regions of the globe.

The Ocean Literacy concept was embraced by IOC-UNESCO in 2017, accelerating the global reach of the movement. With the launch of the 'Ocean Literacy for All' commitment in 2017 came a Toolkit [21] to introduce the principles and methods of Ocean Literacy, a platform to gather practitioners, and the first opportunities for dialogue. These initiatives have marked the birth of a multicultural community of Ocean Literacy practitioners, working to elevate the concept to an international level. An index of marine educators' networks around the world can be found in Appendix 1.

Ocean Literacy conferences, workshops, the Ocean Literacy Portal,[22] the SHOAL App[23] and online training sessions[24] have targeted educators, governments, the media and civil society to support international networking and outreach. This common ground for dialogue, planning and action is now fortified through the Framework of the Ocean Decade.[25]

[20] F. Santoro et al. (eds). 2017. Ocean Literacy for All: A Toolkit, IOC-UNESCO & UNESCO Venice Office, Paris (IOC Manuals and Guides, 80 revised in 2018).
[21] Ibid.
[22] http://oceanliteracy.unesco.org
[23] https://shoal-app.com/login
[24] https://oceanliteracy.unesco.org/training/
[25] UNESCO-IOC. 2021. Ocean Literacy Framework for the UN Decade of Ocean Science for Sustainable Development 2021–2030. Paris, UNESCO. (IOC Ocean Decade Series, 22).
[23] https://shoal-app.com/login
[24] https://oceanliteracy.unesco.org/training/
[25] UNESCO-IOC. 2021. Ocean Literacy Framework for the UN Decade of Ocean Science for Sustainable Development 2021–2030. Paris, UNESCO. (IOC Ocean Decade Series, 22).

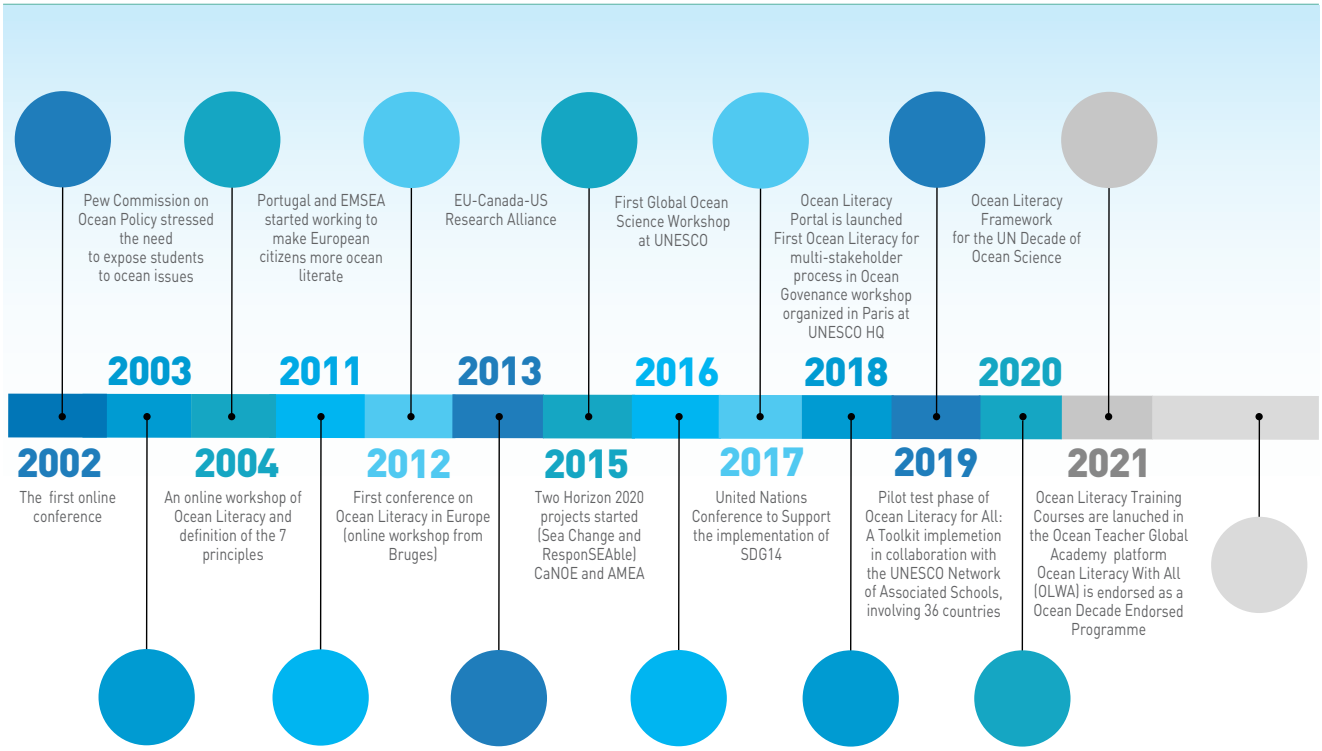

Figure 1. Ocean Literacy timeline. © UNESCO.

In recent years, many efforts to integrate Ocean Literacy into education have been developed worldwide. Associations such as the European Marine Science Educators Association (EMSEA), the Canadian Network for Ocean Education (CaNOE), the National Marine Educators Association (NMEA) of the United States, Red de Educación Latinoamericana para el Océano (RELATO), the International Pacific Marine Educators Network (IPMEN) and the Asia Marine Educators Association (AMEA), in addition to the Ocean Decade endorsed Programme Ocean Literacy with All (OLWA), are consistently promoting the inclusion of Ocean Literacy in formal and informal educational contexts. Those networks remain indispensable for the evolution of Ocean Literacy across the globe and its permeation into educational settings, while offering opportunities for the science–policy interface and conducting practical work on the ground with local communities and schools.

During the COVID-19 pandemic, Ocean Literacy has also evolved online. The organization of activities has adapted to the digital interface, therefore reaching more people and improving communication between stakeholders. New tools have started to emerge and enable initiatives such as flexible training, webinars, massive open online courses (MOOCs), summits and even virtual reality experiences that allow participants to have interactive experiences. The digital acceleration has impacted Ocean Literacy and the educational sector as a whole, now reaching a point where it is necessary to create hybrid, blended opportunities for teachers and learners.

Ocean Literacy in formal education

In recent decades, government authorities have initiated the process of including the ocean in their national educational strategies. This is a major step to advance widespread knowledge of the marine environment and encourage young people to pursue blue careers. For example, in Japan through the Ocean Education Pioneer School Program[26] schools and teachers are able to encourage children to learn about the ocean while incentivizing future learning and promoting blue careers.

In Portugal, the Blue Schools network[27] – an initiative born in response to the above need, to prepare ocean-literate citizens and support the development of the blue economy,[28] launched by the Portuguese Ministry of the Sea and developed by the Directorate-General for Maritime Policy – is a clear example of how Ocean Literacy can be included in the formal school curriculum. Portugal was among the earliest countries to implement formal 'blue' educational projects,[29] with a network involving schools, local communities, industry, NGOs, municipalities and the ocean sector in educational Ocean Literacy initiatives. The European Union, through its Directorate-General for Maritime Affairs and Fisheries (DG MARE) is currently promoting the development of a European Network of Blue Schools[30] and an All-Atlantic Blue Schools network[31] is also being developed in the framework of the All-Atlantic Ocean Research Alliance.

Ocean Literacy also provides opportunities to promote a whole-school approach that considers inclusivity, Education for Sustainable Development (ESD) activities, education for climate action,[32] inclusivity, competences, citizenship education, and many other frameworks that may support and interact with ocean components.

The inclusion of Ocean Literacy in formal education will support the integrated conduct of educational policy, actions and affairs regarding the ocean. Systemic change will require relevant, context-specific, coherent policies and multi-stakeholder engagement, including but not limited to policy-makers, educational authorities, curriculum developers, teachers, parents, families and school staff. To achieve this vision, Ocean Literacy must be integrated into blue curricula through a single coherent framework that influences local, national, regional and global educational policy.

[26] https://oceanpolicy.jp/decade/docs/20210610_JapanInitiatives_v2.pdf

[27] http://escolaazul.pt

[28] Costa, R. L., Mata, B., Silva, F., Conceição, P., and Guimarães, L. 2021. Fostering Ocean-Literate Generations: The Portuguese Blue School. In Koutsopoulos K.C. and Stel J.H. (eds), *Ocean Literacy: Understanding the Ocean*. Springer, Cham, pp. 241-273.

[29] Barracosa, H., de los Santos, C. B., Martins, M., Freitas, C. and Santos, R. 2019. Ocean literacy to mainstream ecosystem services concept in formal and informal education: the example of coastal ecosystems of Southern Portugal. Frontiers in Marine Science, Vol. 6.

[30] https://webgate.ec.europa.eu/maritimeforum/en/frontpage/1485

[31] https://allatlanticblueschools.com/en/home-english/

[32] https://en.unesco.org/themes/education-sustainable-development/cce

In Sections 5 (scope and sequence), 6 (case studies) and 7 (curriculum implementation and evaluation) of the Toolkit, the reader will find diverse examples of how such activities can take place within various contexts. The Toolbox section provides ready-to-use tools to assess current Ocean Literacy needs and possibilities as part of a blue curriculum.

TRENDS IN CURRICULUM DEVELOPMENT AND PLANNING

Overview of current trends in formal education

Educational trends for a blue curriculum

Education in a post-COVID world

Methodologies and innovations

History and recent developments

3

3

The inclusion of Ocean Literacy in formal education is proceeding alongside emerging trends in curricula worldwide, presented in this section. First of all, it is necessary to understand what a 'curriculum' is. In the simplest terms, a curriculum is a description of what, why and how well students should learn in a systematic and intentional way. The curriculum is not an end in itself but rather a means to foster quality learning. [33]

The term 'curriculum' has many definitions, ranging from a planned 'course of study' (derived from Latin) to an all-embracing view that includes all the learning experiences for which the school is responsible (e.g. 'the curriculum is the totality of experiences which are planned for children and young people through their education, wherever they are being educated'). [34] A curriculum may take different forms depending on the culture and context.

A curriculum framework and guidelines are usually a single document, supplemented by other materials to guide the implementation of specific parts of the plan. Specificity or guidance may be offered per individual year, subject or learning area, to address the requirements of the school system as well as individual schools. The curriculum documents may include syllabuses, programmes of study, year plans and lesson plans. These may be developed centrally, locally or by individual teachers, and may have the status of support materials or official documents that must be used. Regardless of their content or status, they should be consistent with the provisions delineated in the curriculum framework.

The process of designing a quality national, local or school curriculum should be planned and systematic. It should value the input of stakeholders and also cater for sustainability and long-term impact. In contemporary educational practice, curriculum development is seen as a comprehensive cycle of development, implementation, evaluation and revision to ensure that the curriculum is up-to-date and relevant. [35]

The vision for a blue curriculum presented in this framework offers an opportunity for education ministries, education experts and stakeholders to engage with progressive concepts in education and advance Ocean Literacy.

[33] Adapted from: UNESCO IBE 2011
http://www.ibe.unesco.org/en/glossary-curriculum-terminology/c/curriculum-plural-curricula
[34] Scottish Government. 2009. Curriculum for Excellence. Building the curriculum 4. Skills for learning, skills for life and skills for work. Edinburgh.
[35] Adapted from: UNESCO IBE 2011

Overview of current trends in formal education

International trends in formal education are guiding the design and update of Ocean Literacy activities and school curricula to meet the challenges of a rapidly changing world. Education for Sustainable Development (ESD) is an integral element of Agenda 2030, as set out by UNESCO's ESD for 2030 framework.[36] The framework reviews the purposes and values that underpin education, and aims to reorient all levels of education and learning to contribute to sustainable development.

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[36] UNESCO. 2020. *Education for Sustainable Development: A roadmap.* https://unesdoc.unesco.org/ark:/48223/pf0000374802

The main trends summarized below were identified by IBE-UNESCO,[37] and many were reiterated as vital following the COVID-19 pandemic:[38]

- **Transforming educational spaces:** Schools and other educational environments are constructed on principles of inclusivity, well-being and openness. Cultural diversity is respected and celebrated as richness. A whole-school approach is adopted and promotes sustainable behaviours and a holistic approach to living.

- **Empowering educators:** Educators have autonomy and freedom and are empowered as decision-makers, leaders and guides. They are offered knowledge, tools and skills through continuous training. Teachers have responsibility for selecting, producing, using and disseminating educational materials.

- **Flexibility and hybridity:** The curriculum is open to effectively make use of technological developments to combine in-person, digital and virtual modes of teaching, learning and assessment. This is done in a way that enables freedom and ways to engage with actors in environments beyond the classroom. A flexible framework can adjust to individual student circumstances and needs.

- **Student agency:** Students are respected as central actors in learning, and positioned as the protagonists and creators of their own future. They are supported as active citizens with a right to education, able to interact respectfully, exercise their agency, and participate in an interconnected world. This is achieved through a focus on their individual needs and strengths, and the use of student-centred pedagogic methods.

- **Cooperation with community:** Schools and teachers are encouraged to reach out to communities through formal and non-formal education. Students engage with local institutions, communities and experts. Cross-generational interactions enable cooperation and knowledge exchange.

- **Cross-cutting competences:** Students develop the competence to act by mobilizing knowledge, skills and values from across disciplines and educational levels. Dialogues between different subjects such as humanities and sciences can be underpinned by ethics.

- **'Glocal' futures:** Curricula work across scales, from local conditions through to global issues. Students are educated as forward-looking global citizens, equipped with personal, cultural and political awareness, and the ability to understand conditions beyond their immediate environment. They are locally grounded yet open to the world.

[37] IBE-UNESCO. 2021. *Ten clues for rethinking curriculum*. http://www.ibe.unesco.org/sites/default/files/resources/ten_clues_for_rethinking_curriculum_eng.pdf
[38] IBE-UNESCO. 2021. *Education in a post-COVID world: Additional considerations.* http://www.ibe.unesco.org/sites/default/files/resources/education_in_a_post-covid_world_additional_considerations_eng.pdf

- **Student well-being:** Ocean Literacy activities contribute to learners' physical and mental health and are strongly connected to students' well-being in the learning environment. Ocean Literacy may support positive attitudes and emotions towards the ocean, but these are also present towards the school, teachers and colleagues, fostering self-confidence and the absence of social problems in school (e.g. bullying, exclusion, discrimination, etc.).

- **Inclusivity:** Inclusivity is an important concept underpinning educational values and trends, and is vital to integrate across all parts of a blue curriculum. Striving for inclusion can be viewed as an ongoing process adopted by schools to support groups of learners who may be at risk of marginalization, exclusion and underachievement. Concepts, policy, structures and systems, and practices must be brought together to realize inclusivity, with inclusive classrooms using accessible materials and nurturing a supportive, respectful culture.[39]

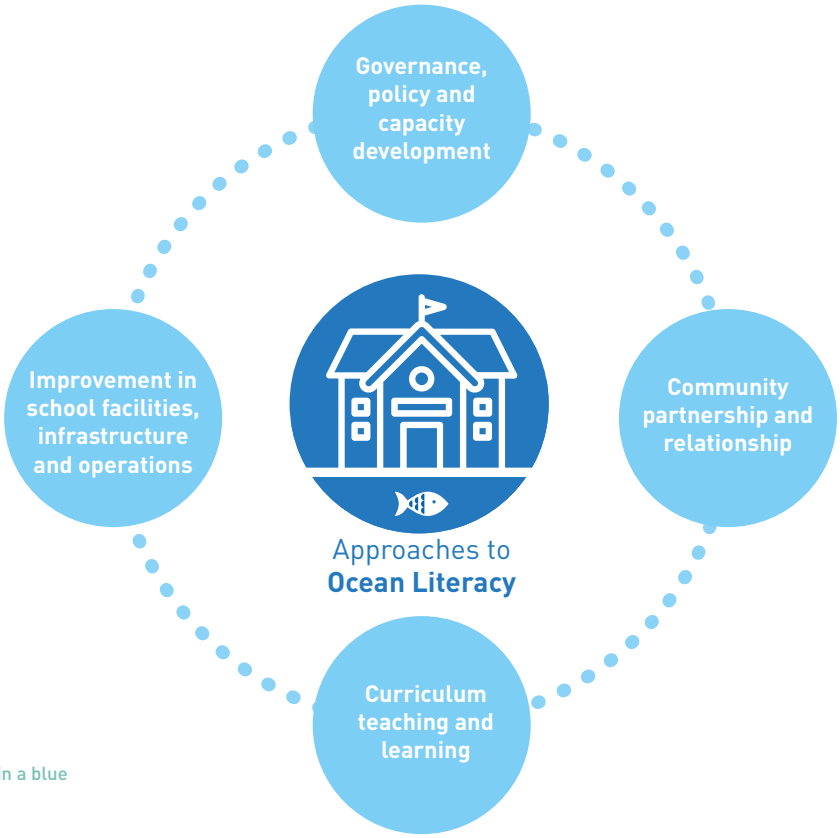

Figure 2. Aspects of the whole-school approach involved in a blue curriculum. Adapted from IBE-UNESCO. © UNESCO

[39] IBE-UNESCO. 2016. 'Training Tools for Curriculum Development – Reaching Out to All Learners: a Resource Pack for Supporting Inclusive Education',at: http://www.ibe.unesco.org/en/document/training-tools-curriculum-development-reaching-out-all-learners-resource-pack-supporting

Educational trends for a blue curriculum

Educational trend	Opportunities and examples for a blue curriculum Transforming educational spaces
Transforming educational spaces	Schools and teachers are equipped with materials about the ocean aligned with curriculum scope and sequence (e.g. lesson plans, syllabuses, textbooks) and concern for the ocean is reflected in every part of the school; from staff awareness to the food provided in the canteen (e.g. certified fish) to sports activities (e.g. snorkelling). Ocean-friendly infrastructure can support students to develop sustainable habits (e.g. recycling bins, energy and water economy systems, community gardens, bicycle parking, reduced plastic use in school environment, etc.). Water sports education is integrated with Ocean Literacy through swimming, sailing, snorkelling and experiencing contact with the ocean as part of the learning process. Partnerships are developed between schools and scientific vessels, sailing boats, aquaria, universities, research centres, and natural history museums. These partnerships extend educational spaces beyond the school through special classes for students to introduce ocean science, blue careers, etc. Students have access to plentiful and diverse resources about the ocean (online and physical) such as books and websites. The school provides library facilities dedicated to the ocean. Schools can create an 'ocean room', lab or club where they can carry out learning activities and recreational activities with ocean-based examples. Schools are equipped with 'blue' infrastructure, playgrounds and educational spaces (e.g. classrooms) that consider nature-connectedness through biophilic design and contact with water and nature.
Empowered educators	Teachers are ocean literate. They feel confident to teach and explain the ocean to students, and propose Ocean Literacy as a teaching tool connected to other disciplines. Teachers are able to explain the ocean in a meaningful way to learners through access to up-to-date resources, data and materials. Teachers are interested in the ocean and seek to develop projects and partnerships with other ocean stakeholders to enhance Ocean Literacy. Teachers from all disciplines are interested in developing partnerships within the school to promote Ocean Literacy. They are able to provide the space, time and resources to do so, and co-create materials about the ocean (e.g. a geography teacher and art teacher together develop classes on ocean models and their representation).

Educational trend	Opportunities and examples for a blue curriculum Transforming educational spaces
Empowered educators	Teachers are interested in implementing project-based learning activities with ocean examples.e.g. Instead of only presenting terrestrial examples, teachers may refer to e.g. chemosynthesis, ocean relief or phytoplankton to explain scientific or geographic principles. Teachers understand the importance of the ocean and enjoy teaching about the ocean as the reaction from their students is positive.
Flexibility and hybridity	The blue curriculum specifies adapted and updated resources (e.g. textbooks, lesson plans and syllabuses) about the ocean for teachers and students to use. They include videos, documentaries, virtual reality, artificial and augmented reality, e-books and training. A range of online and physical pedagogic methods and materials facilitate Ocean Literacy, including field trips, tools (e.g. toolkits and books) and virtual lessons. Flexible and hybrid learning enables teaching and learning approaches tailored to individual student needs. Teachers have the freedom to implement Ocean Literacy initiatives within the school structure (building, disciplines, common areas, etc.) and are able to teach Ocean Literacy in a hybrid way, regardless of their geographical location (e.g. through distance learning). Teachers and students participate in online events about the ocean (e.g. international conferences, seminars, workshops, webinars) and are able to bring these discussions into the classroom.
Student agency	Ocean Literacy empowers students to propose projects, construct values, and develop ocean citizenship inside and outside the school structure. Students have an active role inside the school system and are able to propose innovative ideas to ocean challenges supporting local communities by imagining and developing solutions to ocean issues. In addition, teachers and students have their voices included in the curriculum, on campus, and within their community regarding Ocean Literacy.
Cooperation with community	Academic, social and commercial institutions collaborate in teaching Ocean Literacy. Activities take place in the community to raise awareness and encourage action. Ocean Literacy provides an opportunity to strengthen culture, festivities and heritage practices related to the ocean. National, regional and local dates about the ocean are celebrated (e.g. International Days, National Ocean Day, Fishers Day) to strengthen Ocean Literacy initiatives and gain recognition from local communities. Ocean Literacy supports the dissemination of Indigenous knowledge and wisdom related to the ocean across education. The school is a focal point to disseminate Ocean Literacy principles and knowledge within the local community.

Educational trend	Opportunities and examples for a blue curriculum Transforming educational spaces
Glocal' futures	Multidisciplinary, interdisciplinary and transdisciplinary Ocean Literacy projects and case studies are used in multiple subjects and encourage students to develop varied competences.
	Transdisciplinary subjects encourage students to think out of the box (e.g. through systems thinking) and understand the ocean as an interconnected system.
	Knowledge and practical skills enter into dialogue across the broader curriculum, especially between humanities, arts and sciences.
	Ocean Literacy is connected to other subjects such as climate, biodiversity, Education for Sustainable Development (ESD) and science, technology, engineering, art and mathematics (STEAM).
	Ocean Literacy is connected to non-environmental subjects, such as history of arts, sports, social sciences, etc., and used to tell the story of human development and as creative inspiration.
	Ocean Literacy elements are connected across spatial and temporal scales. Topics such as climate change, overfishing, and plastic pollution are recognized by students as locally and globally relevant.
	Students are aware of their local role as young citizens and promote changes within the community (e.g. reduction of plastic bag use, making informed decisions while buying food or household items).
	Ocean Literacy is recognized as intrinsically connected to planetary histories and futures.
Student well-being	Images and sounds of the ocean are proven to have a restorative effect on mental well-being (the 'blue-gym' effect: being close to the ocean can have a positive effect on human health, reducing stress and even the risk of cardiovascular diseases).[40]
	Physical access to the shoreline, for those that are able, has positive impacts on physical and mental well-being.
	Learning about the ocean and understanding how students can make a positive impact can help students to feel empowered and grounded with a sense of self-efficacy.
	Many students have an automatic fascination with the ocean and wish to spend more time close to the ocean.
	Ocean Literacy can provide a gateway to support students with additional needs due to the highly visual and sensory nature of the ocean.
Inclusivity	Students of all ages are able to engage in Ocean Literacy activities, regardless of their gender, ethnicity, refugee status, language, disability, economic and religious background.
	Ocean Literacy is accessible to all students and promotes an inclusive environment for those that are vulnerable
	Ocean Literacy supports equality, human rights, the right to inclusion, and non-discriminatory practices in the school environment. It supports the development of values such as ethics, tolerance and empathy among students.

[36] UNESCO. 2020. *Education for Sustainable Development: A roadmap.* https://unesdoc.unesco.org/ark:/48223/pf0000374802

Education in a post-COVID world

The international COVID-19 pandemic has strongly affected educational systems since 2020, as teachers and students have had to quickly adapt to new learning processes. The pandemic highlights the need to strengthen trust and collaboration among regions and countries as a key factor in the search for collective responses to shared global challenges. Moreover, it is becoming clearer that sustainable responses which enhance the well-being of individuals and societies cannot be based on isolationist views that reject the sharing of expertise between scientific communities.[41]

The COVID-19 pandemic has also shown the need to envision future and emerging landscapes, in order to develop policies based on a progressive, transformational perspective.[42] In this sense, including Ocean Literacy in the curriculum requires flexibility and adaptation to diverse formats. Virtual tools that support the visualization of ocean features may aid student learning. However, social contact and a deep relationship with the ocean are also necessary to improve mental health, solidify values and competencies and foster sustainable behaviours.[43]

Resources for policy-makers

Education in a post-COVID world: Additional considerations, International Bureau of Education of UNESCO

Methodologies and innovations

Education is also impacted by the rapid ongoing changes in technology, which require policy-makers and teachers to respond creatively to the new conditions of learning in a dynamic environment. The tools listed below may be considered by policy-makers as methods to support teachers in applying a blue curriculum:

- **Lesson plans, textbooks and syllabuses:** A blue curriculum should include up-to-date resources and ready-to-use materials about the ocean for teachers to present content in the classroom. Lesson plans benefit teachers when they provide the tools needed for activities and contribute information to present to students. Lesson plans that integrate Ocean Literacy can be developed for all disciplines. These may consider the Theory of Change approach, which suggests innovative approaches involving close contact with the ocean. The translation of such resources into national languages is crucial.

- **Documentaries, media and audiovisual materials:** The ocean has been featured in various documentaries and movies that translate the latest science into video, audio and images. Lessons can be complemented by playing and sharing audio and video, or by holding a movie screening, for example. Students may also be inspired by non-conventional ocean professions such as journalism or film-making, which provide examples and role-models for future careers. Virtual reality tools and paper microscopes may also complement this interactive approach, particularly for schools located far from the ocean.

[41] *2021. Education in a post-COVID world: Additional considerations.* In-Progress Reflection No. 43 on Current and Critical Issues in Curriculum, Learning and Assessment.
[42] Ibid.
[43] https://www.frontiersin.org/research-topics/19079/pedagogical-methods-and-technological-resources-in-education-in-times-of-pandemic

- **Field trips, excursions and immersive experiences:** Visiting, touching and experiencing the marine environment can be a unique and memorable opportunity for students and teachers. Ocean Literacy in the field spans multiple disciplines, including geography, biology, sports and other subjects, and allows students to understand concepts in context and their real-world application. Excursions can also be organized to institutions to explore ocean-related career paths such as oceanography, biology, ocean law, etc. Such activities may also support a sense of social responsibility and ocean citizenship.

- **Digital tools:** Due to conditions imposed by COVID-19, many aquaria and other shoreline facilities have invested in technology to deliver live lessons or virtual tours of exhibits or the rocky shore. In an evaluation by the National Marine Aquarium in Plymouth, UK, participants scored their virtual aquarium tour highly for gaining increased knowledge and understanding of marine species and having a positive impact on student well-being. Digital tools, virtual reality and augmented reality in this sense may offer students greater access to ocean knowledge from within the school space, with great potential benefits for landlocked regions.

- **Experiments:** Experimental work is fundamental in disciplines such as chemistry or biology, and represents an opportunity to introduce science-based ocean processes to students. Students may develop an experiment and carry out complementary activities in other disciplines to describe the experiment, e.g. through writing text or creative pursuits. Simple hands-on activities with plankton, shells or water pH are an interactive way to bring the ocean into the classroom.

- **Sports:** Sports often strengthen the sense of collaboration and responsibility between students and teachers. Nautical activities and water sports can support the development of ocean citizenship by creating a sense of belonging in the natural environment and encouraging contact with nature. Sports also reinforce teamwork skills, and individual and collective responsibility. In turn, these can support values crucial to ocean conservation, cooperation and resilience.

- **Games and roleplay:** Students can learn by playing or creating serious games (e.g. board games, online games and simulators, role playing, etc.) supported by teachers in school contexts. Games might be scientific or technological quests, like mapping an ocean region, or assigning the roles of ocean stakeholders in a policy or planning simulation, for example.

- **Arts and theatre:** Artistic activities in the school environment support students to improve cognitive skills and motor coordination, encourage imagination and speculation, and enhance visions and understanding of the importance of the ocean culturally and artistically.

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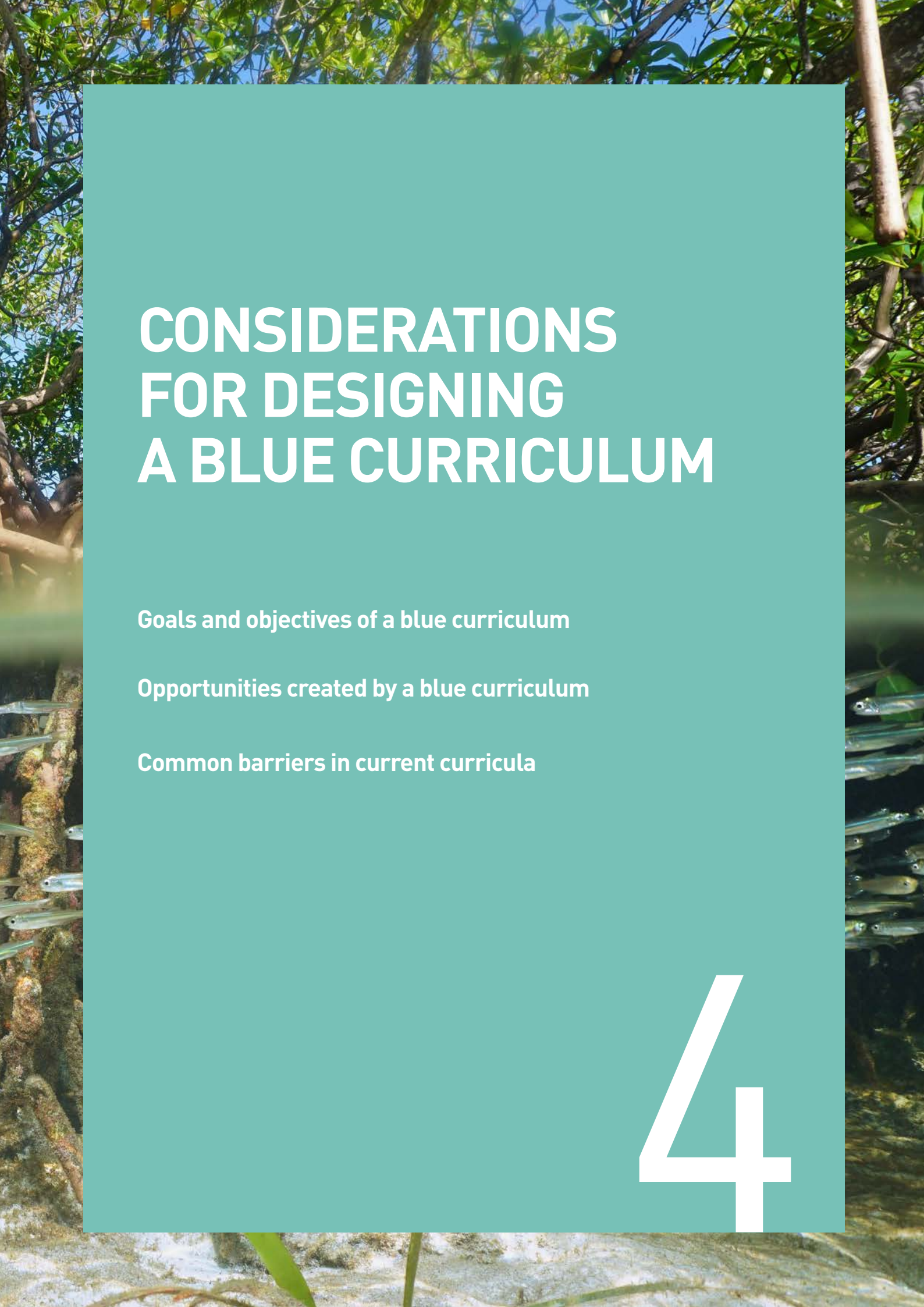

CONSIDERATIONS FOR DESIGNING A BLUE CURRICULUM

Goals and objectives of a blue curriculum

Opportunities created by a blue curriculum

Common barriers in current curricula

4

4

Goals and objectives of a blue curriculum

This section examines the goals and objectives of a blue curriculum, and explores considerations, opportunities and common barriers encountered by Member States upon its implementation.

The development of a blue curriculum includes the integration of the ocean into diverse parts of the curriculum, such as: objectives, scope and sequence, attitudes, time, student and teacher tools, statutory subject delivery, needs analysis, classroom activities, materials, study skills, language skills, vocabulary, grammar and assessment.[44]

In addition, the curriculum involves diverse approaches that consider the needs of learners, staff and the wider community, not only within the curriculum, but across the entire school and learning environment. This implies collective and collaborative action in and by a school community to improve student learning, behaviour and well-being, and the conditions that support these.[45]

The curriculum framework addresses learners' core knowledge related to marine, social sciences and other cultural types of knowledge by presenting materials and supporting the understanding of the need to appreciate present-day and historical discoveries about the ocean – thus building connections between ancestral, Indigenous and scientific visions.

[44] Zohrabi, M. 2008. Researching into Curriculum Components, *Journal of Pan-Pacific Association of Applied Linguistics*, Vol. 12, No, 2.
[45] Adapted from http://www.ibe.unesco.org/en/glossary-curriculum-terminology/w/whole-school-approach

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Opportunities created by a blue curriculum

Developing and implementing a blue curriculum can support the following actions:

Empowerment of government officials to conduct and support Ocean Literacy actions nationally

Policies govern and help to shape the operation of formal and non-formal education systems globally. The general adoption of policies regarding environmental education and education for sustainable development is increasing worldwide. However, in many cases there remains a critical need to strengthen ocean-specific issues within these agendas, including educational priorities. This requires informing policy-makers and further developing educational policies to advance Ocean Literacy.

How Ocean Literacy can be considered in different policy areas:

Figure 3 illustrates how Ocean Literacy can be considered in different policy areas. In some contexts, the policy areas mentioned in the chart (culture and society, economic affairs, environment, health and social welfare) may already be connected to education (e.g. climate change policy is connected to climate education, which can be connected to ocean and climate themes). By mapping these frameworks, the reader may be able to find synergies and opportunities to embed Ocean Literacy into the national curriculum. More material is available in the Toolbox, in the second part of the document.

Figure 3. Connections between five policy areas and Ocean Literacy topics. © UNESCO.

Systemic change in terms of mainstreaming Ocean Literacy will require relevant, context-specific and coherent educational policies that consider the ocean to be designed by ministries and local governments, and supported by cross-sectoral and multi-stakeholder engagement (e.g. supporting knowledge capacity, skills, educational agendas, and commitments to incorporate Ocean Literacy in local and regional policies).[46]

Encouragement of international cooperation on education during the UN Ocean Decade

One global ocean is shared between regions. Ocean Literacy provides the basis to develop global partnerships between Member States, schools, research institutions and the corporate sector. Through cooperation, stakeholders can raise awareness about common issues in the restoration and sustainable use of the ocean in order to improve public knowledge.

[46] Adapted from UNESCO-IOC. 2021. Ocean Literacy Framework for the UN Decade of Ocean Science for Sustainable Development 2021-2030. Paris, UNESCO. (IOC Ocean Decade Series, 22).

The UN Ocean Decade represents a unique window of opportunity to cooperate. The Ocean Literacy Framework for the UN Decade aims to integrate OL in four priority areas:

- **Mainstreaming OL in policy,**
- **Formal and non-formal educational settings,**
- **Corporate action, and**
- **Community engagement.**[47]

In this sense, schools across the world can use the momentum of the UN Ocean Decade to obtain access to high-quality Ocean Literacy educational resources in their own language (such as the OL Principles translated by NMEA). IOC-UNESCO has developed free Ocean Literacy training courses[48] delivered via MOOCs that can support formal educators to access pedagogical tools and incorporate Ocean Literacy in the classroom. The UN Ocean Decade also gives students worldwide the chance to increase their Ocean Literacy and learn how to contribute to ocean sustainability. During the UN Ocean Decade, formal education institutions worldwide may consider adopting a whole-institution approach towards Ocean Literacy where ocean sustainability is incorporated at each level of the administration.

Encouragement of funding for Ocean Literacy projects and initiatives

Ocean Literacy also requires fundraising and access to funding tools. Activities have traditionally been supported by public funds. However, the private sector is showing interest in financing Ocean Literacy through corporate responsibility projects such as Sea Beyond,[49] jointly conducted by IOC-UNESCO and the Prada Group. New sources of funding require creativity, but show that it is possible to promote Ocean Literacy in different scenarios.

Promotion of informed decision-making processes regarding the ocean

Ocean Literacy provides information and supports conscious decision-making regarding the ocean. Informed citizens develop internal (emotions and values) and external (politico-economic actions) pro-environmental behaviours, which are crucial to achieve behaviour change.[50]

Support for the value of local knowledge

Ocean Literacy can be adapted to diverse geographical and cultural contexts. As a tool, it can open the path to integrate Indigenous and local knowledge, thereby supporting the preservation of ancestral knowledge and heritage. Such initiatives have been developed in Canada and South Africa, where local and Indigenous knowledge are already integrated into blue curricula.

For example, the ocean may be included in local or Indigenous tales and literature, art classes, history classes, movie screenings and field trips. Thematic activities can also be organized that take into account heritage and cultural practices.

[47] Ibid.
[48] https://oceanliteracy.unesco.org/training/
[49] https://www.pradagroup.com/en/sustainability/cultural-csr/prada-re-nylon-sea-beyond-unesco.html
[50] Adapted from Stoll-Kleemann, S. 2019. Feasible options for behavior change toward more effective ocean literacy: a systematic review. *Frontiers in Marine Science*, Vol. 6, No. 273.

Furthering of whole-institution approaches

An integrated approach to Ocean Literacy is not limited to students but to all school stakeholders and school staff. Ocean Literacy is possible in all types of educational systems and levels of education.[51] Such an approach involves rethinking the curriculum, campus operations, organizational culture, student participation, leadership and management, community relationships, and research.[52]

As such, blue whole-school approaches involve staff, teachers, families and other education stakeholders in practicing Ocean Literacy. Stakeholders might include policy-makers, school administrators, students, families, community members, teachers' unions, parent–teacher organizations, NGOs, marine education associations, principals, and school boards.

[51] UNESCO. 2016. Training tools for curriculum development: A resource pack supporting inclusive education.
[52] UNESCO Division for Inclusion, Peace and Sustainable Development, Education Sector. 2017. Education for sustainable development goals: Learning objectives.

Multi-perspective approach to Ocean literacy

A multi-perspective approach to education was proposed by UNESCO in the UN's Decade of Education for Sustainable Development (2005–2014) and has since been applied to issues such as climate change, disaster risk reduction, and biodiversity conservation. The multi-perspective approach can be adapted in the context of Ocean Literacy, as an essential part of the educational framework proposed in the publication 'Ocean Literacy for All: A Toolkit'.[53]

- **The scientific perspective:**
  The scientific method is based on the observation of a natural phenomenon, on the formulation of hypotheses, on the collection and analysis of data, on their interpretation and on the definition of the results to draw final conclusions. This process must be replicable and verifiable in different settings. A blue curriculum incentivizes the understanding of the ocean from a scientific perspective, supporting students to solve complex problems by applying knowledge that is applicable to different situations and geographical contexts. A solid scientific background will help learners to find solutions from an individual and collective point of view.[54]

- **The historical perspective:**
  The relationship between humans and the ocean has changed over time. With a blue curriculum learners can study the history of ocean explorations, from the first Viking expeditions to Iceland and Greenland in the 10th century, through Magellan's first circumnavigation of the world to modern deep-sea exploration. With a historical perspective learners will understand how ocean issues have been addressed historically, how local and global communities have made ocean management decisions and what are the implications of those decisions.[55]

- **The geographic perspective:**
  The ocean is composed of several geographical features. For example, tides are a well-known ocean phenomenon that have different amplitudes in different regions of the planet. Specific natural or human-created ocean issues arise, and may recur, across a community, region, country or continent. Challenges or processes take on different complexities when examined at a local, national or international scale. With this in mind, a blue curriculum takes into account the geographic perspective of a problem, and incentivizes learners to gain deeper insights into the origin of a problem and potential solutions.[56]

[53] F. Santoro et al. (eds). 2017. Ocean Literacy for All: A Toolkit, IOC-/UNESCO & UNESCO Venice Office, Paris (IOC Manuals and Guides, 80 revised in 2018).
[54] Ibid.
[55] Ibid.
[56] Ibid.

- **The gender equality perspective:**

  In Zanzibar, the fortune of women is tied up with the Indian Ocean. Their work to harvest a particular species of seaweed is the second most important industry after tourism. Of the 20,000 farmers employed in this industry, more than 90% are women. This is one example of how social and cultural practices regarding access to, and use of, marine resources may affect men and women differently. Learners can explore gender roles in decision-making for using and protecting the ocean in different communities and at different levels. They can also consider how access and long-standing practices related to ocean resources, especially for domestic use, may have contributed to unexamined consequences of traditional gender roles, including differential access to education and work opportunities.[57]

- **The value perspective:**

  Different people's values, needs and perspectives on ocean issues are building blocks to develop common actions and collective marine citizenship. Learners can simulate public debates regarding real ocean issues, such as the creation or enlargement of a port, or the creation of a new marine protected area. By playing the roles of the different stakeholders, they consider their values and different perspectives. The focus should lie on which values are mutually supportive and which seem to be mutually exclusive. The final goal of such a simulation may be to suggest possible solutions that acknowledge and respect the values expressed, in an attempt to move the community toward a common course of action.[58]

- **The cultural perspective:**

  In Fiji, different communities or clans possess different coastal areas, each called a *qoliqoli* (pronounced 'go-lee go-lee'). These are clan-owned fishing grounds that are passed down from generation to generation. Traditionally, when the chief of a village dies, a portion of the community's fishing ground is set aside as a no-take, or tabu (pronounced 'ta-boo') area as a token of respect for the chief. After 100 days, the area is reopened and the community harvests fish to hold a feast to end the mourning. The power of the chief is usually measured by the abundance and size of the catch. A cultural perspective is often a unique perception associated with a particular community,[59] which may serve to separate that community from other cultural communities. A blue curriculum embraces cultural perspectives of the ocean and supports the safeguarding of ancestral, Indigenous and local practices in alignment with values of local communities.

[58] Ibid.
[58] Ibid.
[59] Ibid.

- **The sustainability perspective:**

  The interactions between the environment, economics and society define ocean sustainability for ecosystems and people, both today and in the future. Learners can identify an ocean sustainability issue (e.g. overfishing) and analyze the interactions between its environmental (species depopulation), economic (distortion of the market value of some species) and societal (unemployed fishermen) dimensions and frame them in a future projection. A blue curriculum considers possible solutions that might be developed taking into account the concept of intra- and inter-generational equity.[60]

Fostering cross-cutting curricula and diverse teaching and learning methods

Through a transdisciplinary and cross-cutting approach, Ocean Literacy can be incorporated into the curriculum of most classroom courses and subjects. Opportunities for learning techniques in realising a blue curriculum include:

- **Inquiry-based learning:**

  This learning approach provides opportunities for learners to construct their own understanding about the natural complexity and human world around them. Through an Ocean Literacy lens, students have the possibility to consider ocean problems and concepts, and to reach a conclusion by using discovery and examination as tools. The many species and features of the ocean offer unique and infinite possibilities for student-centred learning. This approach can support a blue curriculum that provides the capacity to develop and monitor learning strategies that centre the student perspective and thinking process.[61]

- **Project-based learning:**

  This process supports student engagement based on ocean problems and issues to be addressed. The project approach offers many possibilities for understanding environmental impacts and the effects of climate change. This approach allows students to think and work cooperatively through activities such as information gathering, data collection, clipping material from magazines, internet and reports, etc. Projects conducted with this methodology can evolve over days, weeks or months, and support critical thinking about information and data. Project assessment is commonly performance-based, flexible, varied and continuous. Students are also empowered by their ability to devise novel solutions to issues facing the ocean.[62]

[60] Ibid.
[61] Adapted from http://www.ibe.unesco.org/en/glossary-curriculum-terminology/i/inquiry-based-learning
[62] Ibid.

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- **Nature-based learning:**

  Nature-based learning seeks to constantly bring elements of nature into education. Marine features and processes can be used effectively through this approach, which can introduce students to organisms and components of the ocean (e.g. algae, fish, marine mammals, marine geology, etc). Through this approach, students are incentivized to think critically and develop sustainable behaviours, values and attitudes. This approach is also useful to help school staff, teachers and families learn about the ocean. Nature-based learning also supports emotional connection with nature, which provides a foundation for further interest, inquiry and positive behaviours towards the Ocean.[63]

- **STEAM education (science, technology, engineering, mathematics and the arts):**

  STEAM education is an approach to learning that takes science, technology, engineering, the arts and mathematics as access points for guiding student inquiry, dialogue and critical thinking.[64] The ocean also offers an opportunity to connect to STEAM through topics of ocean exploration, mapping and observation, which can serve as an opportunity to introduce STEAM. Ocean topics can also be introduced through interactive classes in labs, on field trips (e.g. to see submarines, research vessels and science centres) and in classes working through case study examples.
  In addition, Ocean Literacy supports stewardship and regular subject delivery. By fostering context-specific and hands-on learning, it can provide opportunities to enhance critical thinking, problem-solving and leadership skills. Finally, learning about the ocean can provide inspiration for the wide variety of careers available within the global blue economy.

[63] Adapted from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6487259/
[64] Adapted from https://artsintegration.com/what-is-steam-education-in-k-12-schools/

Common barriers in current curricula

Depending on the structure of the curriculum, certain challenges may be faced by education stakeholders. It is important to be knowledgeable about these challenges when including Ocean Literacy in the curriculum, in order to create context-specific solutions. Common barriers that may impact the development of a blue curriculum include:

- **Inability to recognize the importance and value of the ocean**

  Prior to bringing Ocean Literacy into the classroom, teachers need to recognize the value of teaching about the ocean and its importance. The ability – or inability – to recognize the ocean as a crucial topic for students often stems from regional perspectives and priorities, linked to geographic and cultural matters.[65]

- **Lack of teacher training, confidence, and ready-to-use resources**

  Teachers should receive appropriate training on Ocean Literacy to gain confidence in their knowledge and successfully implement it into everyday activities in the classroom. A lack of teacher confidence on ocean topics may represent a barrier to practicing a blue curriculum. For this reason, training should focus on providing teachers with the necessary skills, materials and ready-to-use resources (translated into local languages).

  IOC-UNESCO provides free online training for formal and non-formal educators on Ocean Literacy, which is available to all teachers. The course provides a general overview of the importance of the ocean, the challenges it faces, ways forward for sustainability, and how to incorporate Ocean Literacy into their daily work. More information can be found at: http://oceanliteracy.unesco.org/training/.

  Local and national Ocean Literacy and marine education networks (such as EMSEA, NMEA, AMEA, the Blue Schools network, etc.) are also useful to support specialized training and upskilling for teachers.

- **Lack of maritime traditions**

  In coastal regions, geographic proximity to the ocean facilitates the inclusion of ocean topics in the curriculum. However, Ocean Literacy is important for all regions, as are finding ways to incorporate it in schools located far from the ocean (e.g. interior regions or rural areas).

[65] Fauville, G., McHugh, P., Domegan, C., Mäkitalo, Å., Møller, L. F., Papathanassiou, M., ... & Gotensparre, S. 2018. Using collective intelligence to identify barriers to teaching 12–19 year olds about the ocean in Europe. *Marine Policy*, 91, 85-96.

Inclusion of local and Indigenous knowledge is also crucial for a blue curriculum, which may benefit from knowledge transfer (including intangible heritage) from tradition holders, sailors and fishers, who could support schools and educators to develop thematic activities.

While coastal schools can make use of coastal traditions to foster Ocean Literacy through activities (e.g. by organizing field trips, participating in maritime festivities, restoring ecosystems, etc.), schools located in non-coastal or rural areas may face challenges and barriers. For this reason, it is important to reinforce the relevance of the ocean in a blue curriculum by providing examples of how peoples and cultures are related to the ocean regardless of proximity, through food, maritime traffic, internet connection underwater cables, the use of products originating from the ocean such as algae, and other examples in connection with OL Principles 3 and 4.

- **Overcrowded curriculum and national educational priorities**

The inclusion of Ocean Literacy in formal education may be challenged by overcrowded curricula[66] and the prioritization of national exams or university admission exams. In this sense, the inclusion of Ocean Literacy as a whole-school approach is a solution that can support teachers and learners. In this sense, Ocean Literacy activities can support sustainable behaviours (e.g. serving fish from sustainable sources in canteens, placing recycling bins around school buildings, building bicycle shelters close to the school, etc.) while reinforcing values to school staff and the wider education community (e.g. cooperation, inclusivity, etc.).

Regions may also develop 'sister city' partnerships with schools from coastal areas and land-locked areas, to support collaboration and interaction between students and teachers.

- **Inflexible curriculum**

A blue curriculum benefits from interdisciplinary, transdisciplinary and integrated approaches. As such, a fixed or inflexible curriculum threatens the successful integration of Ocean Literacy throughout teaching and learning. Instead, a cross-curricular programme supports teachers to bring ocean topics into science, arts, citizenship and ethics.[67] Active methodologies such as museum visits, contact with researchers, and doing experiments can bridge the parts of a rigid curriculum and enrich the learning experience.[68]

[66] McPherson, K., Wright, T., and Tyedmers, P. 2020. Challenges and prospects to the integration of ocean education into high school science courses in Nova Scotia. *Applied Environmental Education & Communication*, Vol. 19, No. 2.
[67] Adapted from Donert, K., Fauville, G., Gotensparre, S., Mäkitalo, Å., Van Medegael, L., and Zwartjes, L. 2015. Review of marine formal education. *EU Sea Change Project.*
[68] Ibid.

- **Misconceptions about the ocean**

Curriculum frameworks often tend to consider only terrestrial (non-oceanic) examples in disciplines such as natural science and geography. A lack of ocean consideration in the curriculum can generate misconceptions in the following categories:

Biological:

- *'Algae are plants':* Algae are a diverse group of aquatic organisms belonging to the Protista kingdom, not Plantae, which are present in bodies of water on land and the ocean. A blue curriculum may include materials about algae features, diversity and lifecycle, showcasing opportunities for sustainable development, algae as food and algae as biofuel.

- *'Phytoplankton are too small to be important':* A blue curriculum explains how phytoplankton are the basis of aquatic food webs and how they provide food for a wide range of creatures. Examples can explain concepts such as ecology, primary productivity and photosynthesis.

- *'Only trees produce oxygen':* A blue curriculum provides the basis for students to understand that at least half of Earth's oxygen comes from the ocean [69], where it is produced by oceanic plankton.

- *'Sharks are the most dangerous animals in the ocean':* A blue curriculum informs students that there are over 500 species of sharks and the majority pose no threat to humans.[70]

Geographical:

- *'Less rain falls over the ocean than on land'*: A blue curriculum includes knowledge about the water cycle and its connection to the ocean, in addition to ocean storms, waves and tsunamis.

- *'The oceans are not connected':* An ocean literate student understands that the ocean has no border and is an interconnected place, which is the basis of Ocean Literacy Principle 1. The student is also able to understand that there is one global ocean composed of many basins.

- *'Melting sea ice causes sea level to rise':* A blue curriculum informs students that sea ice is already floating on the ocean surface, so that sea level does not change when it melts.[71] A blue curriculum also provides students the possibility to test this through a simple experiment or by mathematical calculation.

[69] https://oceanservice.noaa.gov/facts/ocean-oxygen.html
[70] Adapted from https://oceanservice.noaa.gov/ocean/myths/
[71] Adapted from https://oceanconservancy.org/blog/2019/06/06/6-arctic-myths-need-debunking/

Plastic:

- *'There is a plastic "island" in the ocean':* A blue curriculum provides students with necessary information to understand that plastic in the ocean is present as a massive debris field which flows with water, rather than a solid island.[72]

- **Limited use of ocean terminology**

Curricula often feature a low frequency of wording and terminology related to the ocean, even in connection to sustainability or the environment. The inclusion of ocean wording in a blue curriculum is crucial to achieve a full understanding of how the ocean functions as a system in relation to the planet and humankind. Often it is only a requirement to know the names of the ocean basins, which has contributed to the misunderstanding that there is only one ocean body.

Ideally, a blue curriculum is able to provide teachers and learners with diverse ocean examples. These might include the names of marine species, geological information about the ocean, names of 'blue' professions (e.g. oceanographer, marine biologist, ocean policy analyst, marine protected area manager, underwater cinematographer, aquaculture geneticist, environmental scientist, aquatic veterinarian, etc.), role models, examples of marine ecosystems, and terms such as *ocean, climate, fisheries, fish, sea, marine, coastal ecosystem, water, aquatic, seabed, algae, polar, mangrove, marine snow, coral reef*, etc.

Wording should avoid terrestrial bias, such as the description and explanation of photosynthesis by land plants only, or the explanation that animals need 'air' to live without considering marine organisms.

- **Low or no importance given to sustainable behaviour in school ethos or structure**

Ocean Literacy can also be integrated into school values, behaviours, and attitudes that reinforce sustainable behaviour towards the ocean. These include sustainable behaviour by staff, organization of citizen science initiatives, displaying signs incentivizing recycling, composting activities, etc.

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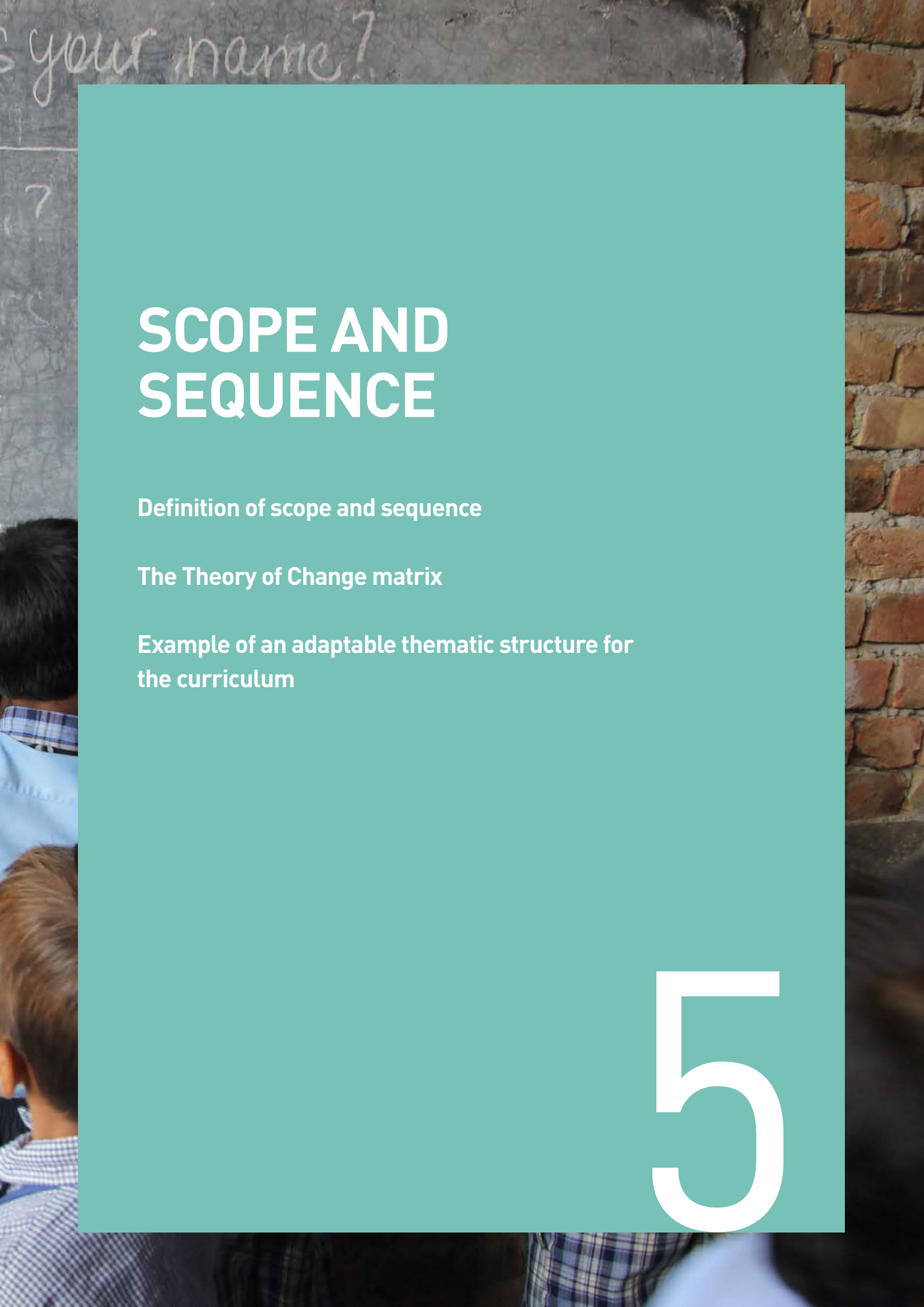

SCOPE AND SEQUENCE

Definition of scope and sequence

The Theory of Change matrix

Example of an adaptable thematic structure for the curriculum

5

5

'[Scope and sequence are] interrelated concepts that refer to the overall organization of the curriculum in order to ensure its coherence and continuity. Scope refers to the breadth and depth of content and skills to be covered. Sequence refers to how these skills and content are ordered and presented to learners over time.' [73]

Essentially, the 'scope and sequence' of a blue curriculum refers to the content and structuring of ocean content throughout the educational curriculum. Previous efforts to integrate Ocean Literacy as part of the curriculum scope and sequence include the framework proposed by the National Marine Educators Association (NMEA) in the United States, based on the seven essential principles; and the MARE - Marine Activities, Resources & Education Ocean Literacy scope and sequence, developed for K-12 educators and schools.

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[73] Source: IBE-UNESCO
http://www.ibe.unesco.org/en/glossary-curriculum-terminology/s/scope-and-sequence-curriculum

Since curriculum frameworks differ across the world, regions can consider the best solution for scope and sequence in their context by taking into account the seven essential principles of Ocean Literacy and the Theory of Change approach proposed in this Toolkit (Section 1). The final aim is to align the curriculum scope and sequence with the Ocean Literacy principles and concepts as far as possible.

Through the Theory of Change, this Toolkit seeks to guide policy-makers to leverage Ocean Literacy in a systematic way across school curricula. This can be achieved by considering a sequence of activities that continue during students' time at school and evolve according to their degree of maturity through different cognitive and learning processes. For this reason, this Toolkit considers three educational levels:

- Elementary (approximately 5–10 years old)
- Middle school (11–13 years old)
- High school (14–18 years old)

This section is divided into three parts:

1. Definition of scope and sequence,
2. Considering the Theory of Change matrix (with disciplines and examples), and
3. An example of a thematic adaptable structure.

Definition of scope and sequence

The scope and sequence is an intermediary reference document positioned between the curriculum and the classroom plan. It can support textbook writers, teachers, school curriculum developers, and other actors in the field of education in decision-making related to curricular and organizational factors.

The seven essential principles of Ocean Literacy serve as a basis to include ocean topics via the scope and sequence framework, and to guide implementation of the Theory of Change. The principles are divided into the following groups:

- **A** **Principles 1 and 5:** Characteristics of the ocean.
- **B** **Principles 2, 3 and 4:** Biological, chemical and physical processes of the ocean.
- **C** **Principle 6:** Human interaction with the ocean.
- **D** **Principle 7:** Ocean exploration and current knowledge of the ocean.

These proposed groups of principles can be included in specific disciplines. And support nature connectedness activities and promotion of values, attitudes, and competences throughout education. The core idea is to develop structures that are easily adapted to the school curriculum.

The Theory of Change matrix

The following tables provide examples on how to implement scope and sequence taking into account the Theory of Change model across educational grades. Examples of activities (theoretical and hands-on) are also provided for inspiration.

• Knowledge and awareness:

Encouraged from an early age, knowledge and awareness can support learners to carry out actions that shape long-term behaviour change. This learning process goes beyond memorizing how many marine species live in the ocean but extends to understanding ocean processes and how the ocean is crucial to life on Earth, as well as which challenges the next generations face regarding its protection and management.

Knowledge and awareness approach	ELEMENTARY	MIDDLE SCHOOL	HIGH SCHOOL
	The curriculum can support students to...		
Basic locational knowledge	Identify features of coastal and ocean ecosystems (e.g. mangroves, coral reefs, salt marshes, seagrass meadows, the deep sea, etc.) and describe or draw which animals and plants live in these environments. Understand how far their school/city is from the ocean and which ecosystem this region belongs to.	Identify coastal and ocean ecosystems geographically, including geological features (seafloor morphology, mid-ocean ridges), ecosystems and zones of the water column (e.g. epipelagic, mesopelagic, bathypelagic, etc.). Recognize the main food webs as they correspond to the different ocean zones. Understand which services those ecosystems provide to humans (e.g. mangroves and seagrass meadows → production of oxygen and sequestration of carbon dioxide; coral reefs → protection from storms and erosion, provide recreational opportunities).	Understand species and habitat distribution and their relation to abiotic factors (e.g. light, temperature, salinity, wave exposure, nutrient availability, etc.). Grasp concepts of biology (photosynthesis and chemosynthesis). Identify the main threats, their drivers and which ecosystem they belong to (e.g. coral bleaching to coral reefs, heavy metal pollution in the mangrove ecosystem, eutrophication in coastal areas, etc.). Possess thorough knowledge of ecosystem services provided by the ocean (provisioning, regulating, cultural, supporting services, etc.).
Examples of disciplines	Natural sciences	Biology and geology	Biology, geography and chemistry
Group of OL principles	B	B	A B
Examples of strategies	Presentations and case studies	Observation, demonstration and experimental activities	Case studies, problem-solving activities
Scientific vocabulary	Formulate sentences that include ocean-related words (e.g. currents, water depth, the seafloor, etc.).	Comprehend scientific concepts about the ocean and use scientific and geographic vocabulary to construct meaningful sentences and arguments with a scientific basis. Debate in groups, presenting and defending their arguments about the ocean (e.g. thermohaline circulation, hydrological cycle, etc.).	Participate in or develop citizen science projects that include scientific vocabulary, analysis and tools. Defend their ideas in public and respect the opinions of other students.
Examples of disciplines	Sciences	Geography, sciences.	Geography, sciences, languages, ethics.
Group of OL principles	A	A B	A B C
Examples of strategies	Development of texts, debate	Debate, presentations, group workshops	Citizen science projects, scientific debates

Knowledge and awareness approach	ELEMENTARY	MIDDLE SCHOOL	HIGH SCHOOL
	The curriculum can support students to...		
Ocean processes	Understand basic physical and geological processes of the ocean (e.g. properties of seawater)	Understand and explain the chemical (e.g. acidification, pH), biological (e.g. species reproduction cycles), physical (e.g. water mixing) and geographic (e.g. coastal erosion) processes of the ocean.	Gain transdisciplinary knowledge and connect knowledge from two or more disciplines (e.g. to calculate ocean acidification levels in mathematics, understand mixing of water masses through physical concepts, develop a text about social consequences of climate change).
Examples of disciplines	Biology, geography	Chemistry, biology, geography.	Geography, biology, literature, mathematics, chemistry, Physics sciences, languages, ethics, etc.
Group of principles	B	B	A B C D
Examples of strategies	Presentations, case studies, examples of ocean processes	Observation, demonstration and hands-on activities (e.g. citizen science)	
Wonder-based knowledge	Develop a sense of caring and ownership for the ocean and its features (e.g. respecting the beach and the sea, caring for marine life, including microscopic and macroscopic species e.g. plankton, marine mammals, crustaceans, plants, etc.).	Care for the ocean and understand how humans interact positively (e.g.culture, festivities, celebrations, education, science) and negatively (e.g. environmental impacts, climate change) with the marine environment.	Act to care for the ocean and develop arguments regarding its protection. Advocate for the ocean individually and in groups (e.g. making a pledge for the ocean, developing an awareness or communication campaign).
Examples of disciplines	Biology	Geography, history, sciences	Arts, ethics, languages, philosophy and citizenship
Group of principles	B	B	B C
Examples of strategies	Analysis, research activities	Case studies	Development of texts, debates

Knowledge and awareness approach	ELEMENTARY	MIDDLE SCHOOL	HIGH SCHOOL
	The curriculum can support students to...		
Problem-based knowledge	Understand the main problems related to the ocean (e.g. overfishing, climate change, marine litter, etc.).	Understand ocean challenges and identify the main drivers (e.g. pollution → lack of management and education, overfishing → increasing demand and lack of regulation). Synthesize knowledge in text and spoken presentations.	Propose and develop solutions to tackle ocean problems. Gain skills such as collaboration and communication (e.g. through participation in hackathons, developing apps). Simulate how ocean problems can be solved.
Examples of disciplines	Sciences	History, geography, sciences	Sciences, mathematics, biology, geography, ethics, theatre
Group of principles	B	B	B
Examples of strategies	Case studies	Case studies, problem-solving, investigation, research, presentations	Group work, hackathons
Action-based knowledge	Learn about the ocean while using creativity and hands-on experiences (e.g. representing the development of bioplastics in art class, mapping shells on a beach trip, drawing and sculpting marine animals, plants and ocean features presented in biology and geography class, etc.)	Co-create hands-on projects that promote sustainable actions towards the ocean, both individually and in groups (e.g. sampling of sand, shells and plastics; development of a protocol for beach cleaning; data creation and analysis of samples).	Develop and participate in hands-on projects about the ocean in cooperation with student teams and teachers. Change behaviour towards more responsible actions (e.g. following a citizen science initiative on invasive marine species, is able to promote consumption of alternative seafood). Think and propose transformative change in their school, family and community contexts (e.g. installation of recycling bins, change of school or home menu, informed decision-making about seafood consumption and shopping choices).
Examples of disciplines	Biology, sciences, geography	Statistics, mathematics, biology, geography, sciences	Statistics, mathematics, biology, geography, sciences, culture, ethics
Group of principles	B	B C	A B C
Examples of strategies	Arts, transdisciplinary workshops drawing from two or more disciplines	Citizen science, data analysis, research	Group work, immersion, creative workshops

• Nature-connectedness:

Close contact with nature and the ocean can modify students' perception about marine life, building emotional connections and supporting knowledge and understanding about its importance. When visiting an aquarium, attending a field trip in a coastal location or taking a trip on a boat, students are able to meet species otherwise only encountered in books or digital media, and can visualize ocean processes presented in subjects such as biology (e.g. symbiosis, parasitism and competitive relationships), geography (e.g. nautical charts, bathymetry and oceanic zones) and chemistry (e.g. ocean acidification, components of seawater, periodic table and seabed minerals).

In addition, students are able to understand crucial socio-economic, ancestral, cultural, folkloristic, Indigenous, heritage-based and religious practices linked to the ocean when visiting local communities, gaining a new perspective on disciplines such as social sciences, history and ethics.

When in close contact with nature, students have the possibility to touch, hear and feel it in a different way that shifts their perspectives about ocean vulnerability. By visiting protected locations (e.g. marine protected areas and beaches) learners are able to see and sense the importance of responsible behaviours and scientifically informed mechanisms to track, generate data on and manage natural systems. Deep contact with the ocean through water sports, diving, snorkelling and swimming is also encouraged.

Nature connectedness-based approach	ELEMENTARY	MIDDLE SCHOOL	HIGH SCHOOL
	The curriculum can support students to...		
Spending time in nature	Recognize ocean features learned in the classroom and point to their location in the natural environment (e.g. fossils, elements of the water cycle, water depths, living organisms).	Recognize changes and patterns in the marine environment (e.g. cloud formation, waves and current patterns). Recognize ocean processes and their importance to the planet (e.g. marine primary production, ecological connections).	Understand the benefits of spending time near the ocean to their mental health (e.g. finding inspiration and relaxation) and physical health (e.g. sports) during a break or external activity. Understanding the ocean's chemical, physical and biological processes and their location. Support their explanations with scientific examples, using correct scientific vocabulary, both in writing and verbally.
Examples of disciplines	Geography and biology	Geography and biology	Geography, biology, chemistry, mathematics, ethics, art and social sciences
Group of OL principles	A B C D	A B	A B C
Examples of strategies	Outdoor classes		Field trips, student retreats, camping near the beach, outdoor classes, sports classes, water sports
Field trips	Understand how the ocean influences life on Earth (e.g. species evolution on planet Earth through the observation of fossils → visit to a natural history museum).	Recognize elements of the visit and how this content is linked with theoretical knowledge (e.g. ocean governance theory → geography class; recycling facilities → waste management). Develop close bonds and friendship with colleagues while travelling and gain team-building skills, which strengthen collaboration and group working attitudes.	Discover ocean-related careers by meeting ocean professionals (e.g. marine protected area manager, oceanographer, maritime historian, geographer, marine biologist, researcher). Develop empathy and trust, and connect experiences in the external world to their own reality (e.g. from a visit to a research vessel being inspired to become an oceanographer)
Examples of disciplines	Geography, biology, sciences	Geography, biology, sciences	Geography, biology, ethics, arts
Group of OL principles	A C	A B	A B C D
Examples of strategies	Visits to museums (e.g. science or natural history), aquaria, recycling facilities, research centres, fishing vessels, algae factories, coastal ecosystems, submarines, public governance bodies of the ocean, wind power plants, boats, etc.		Visits to facilities where students can meet ocean professionals (researchers, public managers, biologists, journalists, etc.).

Nature connectedness-based approach	ELEMENTARY	MIDDLE SCHOOL	HIGH SCHOOL
	The curriculum can support students to...		
Outdoor playgrounds and; blue; school infrastructure	Learn to care about the ocean through play, reduce stress and develop behavioural and social playing skills. Improve motor coordination and train their senses of sight, hearing, smell and touch. Connect with nature through interacting with colour, shapes and materials.	Socialize outdoors, exercise and improve motor coordination. Develop a sense of responsibility for natural resources.	Develop skills to safeguard nature, and strengthen their sense of community and social intelligence. Improve their mental health and well-being. Visit ocean ecosystems with and without school, and explore their interest in ocean topics.
Examples of disciplines	Sports, arts, citizenship education, history		
Group of OL principles	A C	C	A B C
Examples of strategies	Ocean-themed playgrounds, activities and games at the beach, images and colourful signs on recycle bins (accessible to all students)	Gardening, culturing algae in school labs, sports (swimming, diving, water sports)	
Contact with virtual reality	Identify ocean features (e.g. species, geological features) and have fun while learning. Experience and enjoy immersive learning	Use ocean knowledge across disciplines with technology (e.g. blending arts and computing).	Develop design, computing and art skills through contact with virtual reality. Learn to use apps and other technological solutions for the ocean (e.g. using an app to grow corals, track endangered species or show sea level rise)
Examples of disciplines	Biology	Citizenship education, geography and biology	Geography, biology, ethics, arts
Group of OL principles	A	A B	A B C D
Examples of strategies	Use of virtual reality technology to complement lesson plans		Hackathons, competition for best VR student ideas about the ocean

Nature connectedness-based approach	ELEMENTARY	MIDDLE SCHOOL	HIGH SCHOOL
	The curriculum can support students to...		
Use of videos and documentaries	Engage and become interested in the content, as videos support memory and visualization of ocean species learned in the classroom.	Understand the importance of the connected ocean and visualize how other cultures and people develop relations with the ocean. Gain awareness and visualize sustainability challenges. Recognize that life in the ocean is connected to terrestrial life (birds, insects, etc.).	Advance their interest in the ocean and learn the names and histories of role models, ocean professionals and the history of ocean exploration (e.g. Sylvia Earle, Jacques Costeau). Envisage multiple perspectives about the ocean by considering international challenges (e.g. El Niño, tsunamis, overfishing, habitat loss, etc.).
Examples of disciplines	**Biology and geography**	Biology, geography and history	Arts, computing (e.g. developing videos about classes), biology and geography
Group of OL principles	A	A B	A B C D
Examples of strategies	Film exhibition, school film festival (can be complemented with films developed by students).		

• Values and attitudes

The construction of values throughout early childhood education is essential for the solid ethical and social development of learners. Those with values and attitudes towards the ocean can also convince their friends, teachers and families to make sustainable and informed choices regarding consumption, shopping, tourism and education. They are able to act to safeguard the marine environment, reproduce good practices and influence others for collective change.

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Values and attitudes-based approach	ELEMENTARY	MIDDLE SCHOOL	HIGH SCHOOL
	The curriculum can support students to...		
Construction of egoistic, altruistic, hedonic, and biospheric values	Attain sensitivity to environmental issues. Understand values such as co-responsibility and citizenship.	Distinguish ocean components (e.g. geological, biological) and understand how human action impacts them. Understand the responsibility and capacity of young people to care for the marine environment. Distinguish beneficial and harmful environmental practices. Develop a sense of ownership and caring for natural spaces.	Recognize ocean mismanagement and successes (globally and locally). Argue about questionable ocean practices (e.g. greenwashing). Incorporate citizenship and sustainable habits into their daily habits (e.g. recycling, a sustainable diet, reducing plastic use, cycling, etc.). Values the ocean beyond the monetary (e.g. for its ecosystem services: and intrinsic, cultural, aesthetic, recreational, educational and climate regulatory value)
Examples of disciplines	Citizenship education, ethics, biology		Citizenship education
Group of OL principles	A B C	A B C	A B C D
Examples of strategies	Supporting ocean habitat restoration programmes (e.g. mangroves, corals, seagrass, etc.). Thematic activities about plastic such as beach cleanups.		Civic parades on national / international dates (e.g. Ocean Day, Sea Day, Fishers' day, etc.).

Values and attitudes-based approach	ELEMENTARY	MIDDLE SCHOOL	HIGH SCHOOL
	The curriculum can support students to...		
Sustainable behaviour	Understand how individual and collective actions impact the ocean (e.g. limit single-use plastic, dispose of plastic correctly, adopt sustainable daily water use, consider carbon footprint). Develop respect and values for the ocean (e.g. avoid playing with living creatures at the beach, avoid stepping on creatures when diving, etc.).	Debate with family and friends about ocean content learned at school. Try to convince others to shift behaviours. Reproduce sustainable behaviour inside and outside school structures. Behave as role models in climate and ocean action.	Defend sustainable actions. Practice and promote the spreading of sustainable behaviour across the community (e.g. banning plastic bags in local markets, supporting the development of cycle lanes, participating in awareness activities at the beach). Develop 'ocean clubs' and extension platforms that support community action.
Examples of disciplines	Sports and citizenship education Sports, citizenship education, biology,student clubs and extracurricular activities.		
Group of OL principles	C	C	A B C D
Examples of strategies	Thematic classes, workshops, sports near the ocean		Beach cleanups, nautical sports, painting public walls with ocean themes, parades and ocean festivals, and partnerships with local community stakeholders
Sports (nautical or water sports)	Develop values and attitudes through discipline (e.g. achieving goals, accomplishment and sacrifice), organization, commitment and persistence. Feel confident in the ocean environment, e.g. through learning how to swim.	Construct values such as empathy, cooperation and solidarity that are crucial for thinking about the climate crisis and social justice. Swim safely and have initial experience with marine activities.	Partake in nautical and watersports, which support socialization attitudes and team building. These are instrumental for the development and growth of moral reasoning, problem solving, creativity, and social competence. Swim confidently, be at sea, help others and participate in ocean activities.
Examples of disciplines	Sports	Sports and citizenship education	
Group of OL principles	C	C	A B C D
Examples of strategies	Swimming classes, introduction to snorkelling	Swimming classes, sailing, scuba diving, etc.	

Values and attitudes-based approach	ELEMENTARY	MIDDLE SCHOOL	HIGH SCHOOL
	The curriculum can support students to...		
Ocean citizenship	Understand concepts of citizenship extended to the beach and marine environment (e.g. avoid removing shells and corals from the beach, avoid playing with animals or feeding them).	Reflect on human actions in the ocean and recognize the ocean as territory. Comprehend how their actions reflect on the ocean and vice versa. Follow their interest in activities that take place close to the sea. Recognize marine organisms and understand their role in ecosystems (even if the species are not charismatic, e.g.plankton, viruses and bacteria).	Develop a sense of care for the ocean and act as local ocean guardians. Understand and recognize economic, social and cultural interactions with the ocean. Develop commitments (e.g. pledge or commit to ocean causes such as reducing plastic waste, restoring marine ecosystems, etc.). Identify unsustainable practices and advocate for change within the community (e.g. banning shark finning, solving unsustainable tourism, etc.).
Examples of disciplines	Biology, citizenship education, theatre	Biology, geography	Biology, citizenship education, geography, arts and history
Group of OL principles	C	A B C D	A B C D
Examples of strategies	Visit ocean ecosystems (mangroves, rocky shore, salt marshes, etc.)..	Watching whales and dolphins, monitoring species, citizen science, etc.	Participation in campaigns, promotion of campaigns developed by students.

• Competences

The development of competences throughout education is essential for practicing sustainable behaviour towards the ocean during life.[74] Young students are in the early process of constructing their competences, and a competence-oriented blue curriculum can influence their progress. Ocean-literate students are able to engage in ocean discussions, develop criticism about content, texts, news and campaigns, and take action for collective well-being.

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[74] Adapted from: https://www.oecd-ilibrary.org/docserver/ade03ec8-en.pdf?expires=1641684479&id=id&accname=guest&checksum=ABA77B7BD011A77F08411554DAB4DCFD

Competence-based approach	ELEMENTARY	MIDDLE SCHOOL	HIGH SCHOOL
	The curriculum can support students to...		
Socio-emotional competences	Process information, adopt habits (e.g. going plastic free), make decisions (buying less and reusing more), work as a team (e.g. to reforest the coastal environment) by considering what is good for the ocean.	Understand their role in the future of the ocean as a citizen, student and future professional. Act as an agent of change in their school, home and community.	Understand the importance of intrapreneurship, entrepreneurship and leadership to solve ocean problems. Recognize themselves individually and collectively as capable of solving ocean-related challenges through innovation.
Examples of disciplines	Citizenship education, biology	Citizenship education, social sciences	
Group of OL principles	A B C D	A B C D	A B C D
Examples of strategies	Reforestation of ocean ecosystems (mangrove planting, coral rescue. monitoring activities, etc.)		Hackathons, student competitions, science fairs
Taking action for collective well-being	Recognize concepts and references of human conduct towards the ocean (justice, empathy, moral principles, etc.).	Engage with philosophy and extend concepts to the ocean. Encounter and grasp concepts such as 'one planet, one ocean' and 'no blue, no green'. Recognize the uniqueness of planet Earth.	Understand the importance of democratic discussion about ocean sustainability. Respect other colleagues' opinions about the ocean and defend a human point of view with dignity and respect for other peoples of the world (e.g. fishers, islanders and coastal communities). Disagree with and discourage misconduct regarding gender and ethnicity. View colleagues as allies in ocean protection.
Examples of disciplines	Ethics and citizenship education		Ethics, history, languages and civil education
Group of OL principles	A B C D	A B C D	A B C D
of OL principles Examples of strategies	Debates, case studies, immersive experiences, creative workshops		Debates, presentations, dispute exercises

Competence-based approach	ELEMENTARY	MIDDLE SCHOOL	HIGH SCHOOL
	The curriculum can support students to...		
Promotion of sustainable development actions	Understand the sustainable development concept and its connection to the ocean (through food, transport, medicine, etc.).	Think about the ocean's future, taking into account scientific knowledge about sustainable development. Understand concepts such as fish stock management, biotechnology and renewable energy.	Discuss the benefits of sustainable development to collective well-being from an ocean perspective (considering livelihoods, how people depend on coastal and marine services, food security, etc.). Understand how the ocean is crucial to human life, particularly to Indigenous peoples and vulnerable groups dependent on marine resources.
Examples of disciplines	Geography and sciences	Geography, biology and sciences	Social sciences, geography, biology and ethics
Group of OL principles	A B	A B C	A B C D
Examples of strategies	Case studies	Mathematics exercises (e.g. calculating fish stocks), serious games with roleplay.	Visiting local fishing communities, thematic research with interviews considering the vision of vulnerable coastal groups.
Critical thinking **Examples of disciplines** **Group of OL principles** **Examples of strategies**	Recognize 'extreme' points of view regarding the ocean (e.g. fanaticism, intolerance, radicalism, etc.).	Understand scientific perspectives about the ocean and develop an argument to defend a point of view.	Communicate about the ocean in an effective way, gather and assess relevant data about the ocean, and develop well-formulated conclusions.
Examples of disciplines	Languages, biology, social and human sciences	Scientific methods, mathematics, statistics, social sciences	
Group of OL principles	A B C D	A B C D	A B C D
Examples of strategies	Debates, movie screenings.		Debates, visits to research facilities, citizen science.

Competence-based approach	ELEMENTARY	MIDDLE SCHOOL	HIGH SCHOOL
	The curriculum can support students to...		
Tolerance and respect towards others	Think about how the ocean positively (i.e. leisure, tourism) and negatively (i.e. disasters, environmental impacts) interacts with human life and people around the world in different ways (e.g. vulnerable groups are the most affected by climate change).	Critically think about ocean history, culture and peoples. Respect and understand different opinions about the ocean, and cultural and religious practices. Demonstrate awareness of basic human rights topics	Create bonds and friendships with colleagues from other cultures or social contexts. Hold a positive attitude regarding social topics relevant to the ocean (e.g. care for coastal communities, Indigenous people, fishers, and marginalized groups). Cultivate a local and global sense of ocean justice.
Examples of disciplines	Ethics, history	Ethics, geography, history, social sciences	Geography, ethics, civic education, ethics
Group of OL principles	A B C	C	A B C D
Examples of activities	Documentaries and movie screenings, use of illustrated books about the ocean	Visits to local festivities about the ocean	Visits to coastal communities, practicing inclusive approaches

Example of an adaptable thematic structure for the curriculum

The four strands described in this section are examples of how Ocean Literacy can be applied or adapted to the existing structure of the national school curriculum. A curriculum framework and guidelines that include examples related to environmental and climate change, such as erosion, extreme events or desertification, can be complemented by a blue view that considers subjects like coastal erosion, sea level rise and ocean biodiversity loss. In this way, a blue curriculum provides complete training in terms of understanding Earth and its cycles and mechanisms, with continuous consideration of the ocean.

Strand 1: Plastic pollution

Plastic objects and micro- and nanofragments are the most significant, harmful and persistent fraction of marine litter, accounting for at least 85% of total marine waste[75] and representing of the biggest challenges faced by the ocean. According to the IUCN, at least 14 million tons of plastic end up in the ocean every year.[76] Plastics are discarded in rivers, water bodies and the ocean and profoundly impact marine life on microscopic and macroscopic scales. Plastic also poses threats to human health once it has entered marine lifecycles and food chains.[77] An ocean-literate student with a critical understanding about plastics knows how to articulate arguments, build sentences, develop texts and think about solutions.[78]

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[75] https://www.unep.org/interactive/pollution-to-solution/
[76] https://www.iucn.org/resources/issues-briefs/marine-plastic-pollution
[77] https://uneplive.unep.org/media/docs/early_warning/microplastics.pdf
[78] Adapted from Guidelines for Excellence K-12 Learning. For students, parents, educators, home schoolers, administrators, policy-makers and the public. North American Association for Environmental Education (NAAEE).

Guidelines	Grades *The curriculum supports students to...*	Connection with disciplines
a - Formulating questions regarding plastics	**Elementary:** Formulate questions about how plastic litter affects marine life. **Middle school:** Develop questions about the causes of plastic pollution and understand solutions from the answers (e.g. recycling, production, design, improved sanitation). **High school:** Identify behaviours and human patterns (ideas and beliefs) that inform questions.	Literature, philosophy, sciences, mathematics and history Optional: organization of regular field trips to and cleanups at the beach or ocean ecosystem regions (river, delta, mangrove, rocky shore, etc.) with students. Implement a cleaning protocol and analyze data to explore the composition of plastic litter and understand littering patterns. Question how and why plastic ends up in the environment.
b - Designing solutions for plastic pollution	**Elementary:** Identify plastic problems and look for creative solutions individually and in groups (e.g. recycle, reuse, redesign). **Middle school:** Unite disciplines in the construction of a solution (e.g. mathematics and arts → sustainable packaging design; or informatics and geography → development of maps to research on plastics). **High school:** Think about innovative solutions to plastic problems (e.g. bioplastics, zero waste products, city management) and implement solutions with the support of the school community (e.g. banning plastic bags in the school environment or inclusion of recycling bins in school building). Promote awareness campaigns to the community to eradicate the causes of plastic pollution at sea.	Arts, informatics, geography, sciences, mathematics, business Optional: submission of proposals to tackle plastic littering to municipalities (e.g. installation of recycling bins in natural spaces, development and dissemination of informative material).
c - Collecting information about plastics	**Elementary:** Learn how to collect information about plastics through observation, experimentation, simulation, etc. in citizen science projects. **Middle school:** Collect information about plastics (e.g. by doing research on the internet, clipping newspapers and magazines, looking for fragments of videos and documentaries, collecting interviews with experts and local communities). Organize material in databases (Excel, tables). **High school:** Reason with and understand 'fake news' or sensationalism around the theme of plastic (i.e. extreme ideas supported by poor scientific data). Analyze data about plastic and create graphs and statistics (e.g. consumption of plastic in kg per capita during 1 year; analysis of decomposition time of different plastic types). Conduct interviews with experts or coastal community members and analyze the results (e.g. types of plastic found by fishers in their nets).	Sciences, mathematics, statistics, social studies, languages, philosophy

Table 2: An adaptable curriculum structure for plastics.

Guidelines	Grades *The curriculum supports students to...*	Connection with disciplines
d - Evaluating the accuracy of data	**Elementary:** Understand knowledge gaps and what humans don't know about plastics. **Middle school:** Identify extreme visions in politics, television and their community regarding plastic. Evaluate data accuracy (e.g. looking for trustworthy sources, checking junior scientific journals). Formulate an argument including data about plastics (e.g. microplastics were found in the human food chain). **High school:** Recognize discrepancies and have statistical and mathematical knowledge. Assess the accuracy of studies by understanding bias, funding sources and interpretation as well as data collection methods.	Statistics, mathematics, sciences
e - Organizing information about plastics	**Elementary:** Distinguish plastic types and understand what is recyclable **Middle school:** Evaluate weak data and understand what are the best mechanisms to look for information about plastics. **High school:** Integrate material collected individually or in groups for a project and merge this content with databases to create a hypothesis.	Sciences, mathematics, statistics, social studies, languages, philosophy
f - Working with models and simulations	**Elementary:** Understand basic concepts such as how ocean currents carry plastics from one place to the other. **Middle school:** Relate the plastics to other statistical systems (e.g. population income, urbanization rate, recycling rate, etc.). **High school:** Combine data from multiple subjects to develop research (e.g. biology data and plastic → most common plastics found in turtles, mammals and seabirds stomach, etc.) or combine data geographically (e.g. develop a map of the regions most affected by plastic in the world). Evaluate used models and explain them in a critical way.	Informatics, geography, arts, statistics, mathematics
g - Drawing conclusions and explanations	**Elementary:** Understand arguments about plastic challenges. **Middle school:** Possess a scientific knowledge base that allows the identification of plastic data and its presentation in a critical way. **High school:** Propose statistics with the use of a model (e.g. amount of plastic that needs to be recycled yearly).	Literature, languages, mathematics, physics, chemistry, statistics, sciences

Strand 2:
Impact of climate change in the ocean (ocean acidification)

The continuous impacts of climate change on the ocean are affecting its productivity and biodiversity. According to the IPCC, the rising concentration of atmospheric greenhouse gases is causing ocean acidification, which has increased globally over the past four decades.[79] Other reports warn that coral reefs, one of the most unique ecosystems on Earth, may disappear entirely by the end of the century.[80]

Climate change affects the ocean in many ways, from ocean acidification to sea level rise and biodiversity loss. An ocean-literate student knows how to develop arguments, think critically and reason about the permanent effects of climate change on humans, including young people, and its long-term effects.

[79] https://www.ipcc.ch/report/ar6/wg1/downloads/factsheets/IPCC_AR6_WGI_Regional_Fact_Sheet_Ocean.pdf
[80] https://news.un.org/en/story/2020/12/1080582
[81] https://sciencenotes.org/abundance-of-elements-in-earths-oceans-periodic-table-and-list/

Guidelines	Grades *The curriculum supports students to...*	Connection with disciplines
a - Understanding ocean chem	**Elementary:** Understand chemical concepts such as the pH scale, acids and bases, and how these affect seawater and ocean ecosystems (e.g. through experiments with vinegar and eggshells). **Middle school:** Understand processes such as ocean acidification and the chemical components of this process (e.g. decrease of pH, uptake of carbon dioxide, etc.). Recognize the periodic table and its relation to the properties of seawater (e.g. behaviour of calcium, carbon, hydrogen, etc.). **High school:** Calculate and use mathematical exercises about ocean acidification. Combine concepts from mathematics and chemistry to construct an argument.	Statistics, mathematics, sciences
b - Looking for drivers	**Elementary:** Understand examples such as coral bleaching and their main human drivers (e.g. air pollution). **Middle school:** Explain the different drivers of ocean acidification (e.g. excess of carbon dioxide in the atmosphere, pollution, non-renewable energy, role of fossil fuels) and understand the current and long-term effects of those drivers. Understand what is necessary to change at the individual and collective level. **High school:** Experience school as a transformative place to suggest community changes regarding ocean acidification. Organize or take part in citizen science projects about the topic (e.g. measuring seawater pH, observing effects of ocean acidification on shells, corals and other biomineralizing species).	Sciences, mathematics, geography, statistics, chemistry, ethics
c - Understanding chemical processes (and equations)	**Elementary:** Understand ocean features and organisms affected by ocean acidification (e.g. shell formation, corals). **Middle school:** Understand the chemical processes involved in ocean acidification through theory and equations. **High school:** Understand the differences between the chemical forms of calcium carbonate present in the ocean (i.e. aragonite and calcite) and how they are formed by biomineralizing organisms. Explain why ocean acidification is occurring and identify factors that change the results of equations (pH, calcium, chemical balance, etc.). Understand the solubility of carbonate and the variations in value of the carbonate compensation depth (CCD) in the ocean.	Scientific initiation, mathematics, chemistry, languages, computing statistics, sciences

Table 3: An adaptable curriculum structure for ocean acidification.

Guidelines	Grades *The curriculum supports students to...*	Connection with disciplines
d - Drawing conclusions and explanations	**Elementary:** Identify ocean acidification as an aspect of climate change. **Middle school:** Summarize materials, compare findings and use mathematics and chemistry knowledge to design an argument and conclusion. **High school:** Use data and models to explain the effects of acidification on marine species. Explore and identify behaviour patterns in society that enhance ocean acidification (e.g. use of vehicles sourced by non-renewable energy, industry and fossil fuels). Act as local ocean guardians concerning ocean acidification (e.g. alerting civil society, promoting awareness campaigns, organizing citizen science initiatives, measuring pH). Present arguments with maps and information sourced from databases.	Scientific initiation, mathematics, chemistry, languages, computing

Imfoto via Shutterstock

Strand 3:
Food from the ocean

The ocean supports many food systems. Every year it plays a central role in providing food for almost 3.6 billion people who live in coastal areas or within 90 miles of coastal waters, which accounts for about 66% of the global population.[82]

People around the world are also dependent on seafood as the ocean accounts for the planet's largest source of protein, with more than 3 billion people relying on the ocean for their primary source of protein.[83] The ocean provides not only fish as a food source but many others, such as edible seaweed, mussels and oysters, crustaceans, molluscs, jellyfish, sea urchins, octopus, shrimp, lobster, sea cucumber, squid and many sea vegetables.

Although the ocean is a shared responsibility, growing food demand may generate diverse environmental impacts from overfishing, depletion of stocks, pollution, and algae blooms, which are scaled further with climate change. This section offers examples of how food from the ocean can be developed as a theme in blue school curricula.

[82] https://www.un.org/sustainabledevelopment/wp-content/uploads/2017/05/Ocean-fact-sheet-package.pdf
[83] https://www.un.org/en/conf/ocean/background.shtml

Guidelines	Grades *The curriculum supports students to...*	Connection with disciplines
a - Food from the ocean	**Elementary:** Recognize and name marine species (edible or not). **Middle school:** Understand which food comes from the ocean and in which cultural context it is more common to find certain types of seafood. **High school:** Describe seafood production chains (e.g. fishing, algae, salt harvesting, marine aquaculture). Understand ocean lifecycles (e.g. seasonality of seafood, food webs from plankton to marine mammals). Understand the monetary and other values (e.g. health, sustainability) of food from the ocean.	Biology, history, literature, citizenship education, culture, geography
b - Impact drivers and how they affect food webs.	**Elementary:**Introduce the main ocean threats and how they affect the human food chain (e.g. pollution, climate change, overfishing). Represent concepts graphically with drawings or art projects. **Middle school:** Recognize the ocean's importance to human diets and understand the most pressuring impacts (e.g. overfishing). that affect food cycles and food webs. **High school:**Develop models or experiments about food from the ocean (e.g. development of an algae farm or a hydroponic system in science class).	Geography, biology, arts, sciences, history
c - Sustainable development	**Elementary:** Understand which species are endangered **Middle school:** Understand basic concepts and careers such as aquaculture, fishing and industry, and their roles in sustainable development. **High school:** Comprehend sustainable and unsustainable practices towards the ocean (e.g. fishing practices such as trawling and long-line fishing, and their impacts). Understand concepts related to fishing regulation (seasonality, fishing yields, fishing efforts, etc.).	Geography, mathematics, biology, physics
d - Future of food	**Elementary:** Develop curiosity and interest in future food sources from the ocean. **Middle school:** Understand the benefits of ocean food (e.g. provision of omega-3, vitamins, protein). Name and understand the processes behind potential ocean food sources (e.g. need for sustainable fisheries, technology, science). **High school:**Compare different data sources and develop simple models to understand sustainable ocean food sources. Connect knowledge about ocean food to economic, policy and environmental strategies. Recognize sustainably sourced food and reproduce habits (e.g. look for certified fish, advise their families on how to buy sustainable seafood).	Sciences, biology, geography

Table 4: An adaptable curriculum structure for food from the ocean.

Strand 4:
The ocean and culture

The ocean is strongly connected with heritage, arts and other forms of cultural expression in many parts of the world. Since early human history, humans have portrayed the ocean through cave and rock paintings (e.g. paintings of whale hunts in Chile's Atacama Desert dated to 1,500 years ago), represented the ocean throughout art history (e.g. Van Gogh, Gaugin) and even promoted cultural festivities about the ocean linked to religious beliefs (e.g. Yemanjá festivities in Brazil).

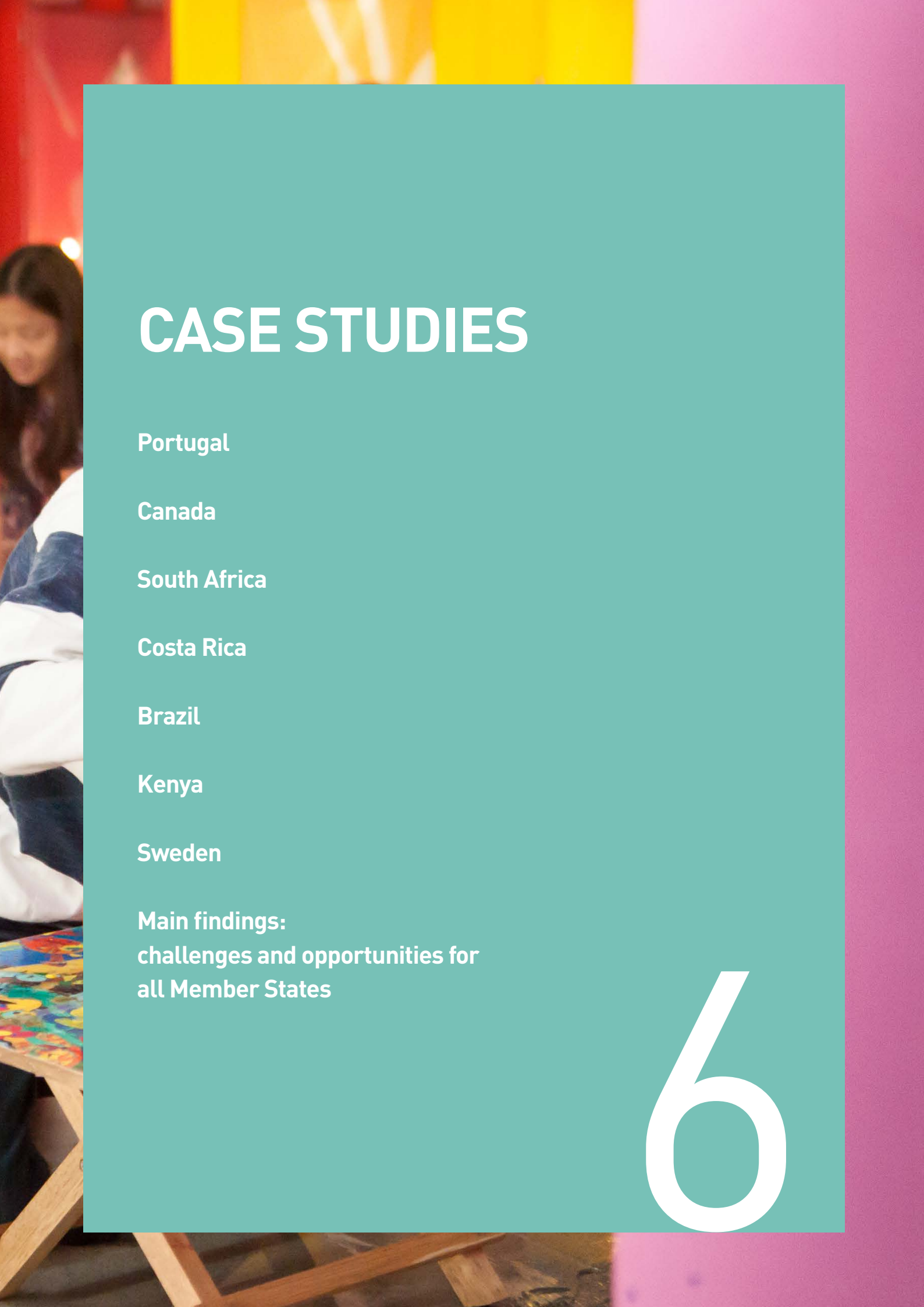
A blue curriculum can highlight culture-related examples to complement social science content such as history, art, literature, citizenship education, and ethics. In addition to promoting student interaction with their home regions, where such cultural events may take place, a focus on culture can provide students with examples of how humans benefit from and value diverse ocean ecosystem services.

In some contexts, certain cultural practices are under threat and becoming less common. A blue curriculum may support the safeguard and transmission of ancestral and traditional knowledge through educating students and introducing them to cultural practices. This section provides examples of how the intersections between the ocean and culture can be part of a blue curriculum.

Guidelines	Grades *The curriculum supports students to...*	Connection with disciplines
a - Cultural dimension of the ocean	**Elementary:** Represent ocean elements and characteristics in art classes (e.g. shells, fish forms, the life of an octopus, etc.). **Middle school:** Study the diverse dimensions of ocean and culture through history and geography. **High school:** Understand how the ocean has influenced artistic and creative movements in literature and art (e.g. influence of historic voyages and artistic movements).	Arts, history, biology, geography
b - The ocean represented in art	**Elementary:** Use examples of ocean-related artists in art classes and create interventions with recycled materials such as plastic. **Middle school:** Develop their own art pieces related to the ocean and are receptive to teachers' and colleagues' feedback about the creative process. Research ocean and culture topics, collecting material from diverse sources. **High school:** Participate in creative classes related to the ocean and realize the value of working individually and collectively. Gather knowledge about artists and art exhibitions. Meet local professionals from the arts sector to develop interventions at a community level (e.g. painting an ocean-themed mural).	Arts, literature, citizenship education
c - Ocean and literature	**Elementary:** Read books and other literature that include ocean features. **Middle school:** Have access to well-known and popular works of literature about the ocean, especially those that are culturally and locally relevant (e.g. Lusíadas by Luís Vaz de Camões or Moby-Dick by Herman Melvill, etc.). **High school:** Pursue their interest in writing about the ocean. Develop writing and communication skills that support the construction of arguments about the cultural dimension of the ocean.	Literature, history, social sciences

Table 5: An adaptable curriculum structure for ocean and culture.

Jakarta, Indonesia-Mei 2016



CASE STUDIES

Portugal

Canada

South Africa

Costa Rica

Brazil

Kenya

Sweden

**Main findings:
challenges and opportunities for
all Member States**

6

Portugal

Respondent: Raquel Lorenz Costa (Ministry of the Sea)

Jornadas Escola Azul (361)

CASE STUDY:
Blue School Programme

Escola Azul (Blue School) aims to join all Ocean Literacy activities under the same umbrella. However, the Blue School programme is not recognized by the Ministry of Education, so schools may only apply voluntarily.

How is Ocean Literacy included in the national curriculum?

In Portugal, ocean topics are embedded throughout the statutory curriculum, although not explicitly treated, with principles and dimensions of Ocean Literacy approaches across several subjects (e.g. citizenship, natural science, history, literature, arts, geography) from the ages of 5–18 years.

How is Ocean Literacy applied outside the national curriculum?

There is a strong and diverse landscape of Ocean Literacy initiatives and activities. Institutions like surf and sailing schools, private sector organizations, universities, and NGOs all implement activities for Ocean Literacy.

Although activities for nature-connectedness are not present in the national curriculum, they are mentioned in the National Ocean Strategy 2020–2030, as well as by **tourist boards** and municipalities.

Sustainable values and attitudes are treated by the Portuguese Sport school programme and in specific school networks like the UNESCO school network, the Eco-Schools network and **Escola Amiga da Criança**.

Advice and visions of experts regarding the future of Ocean Literacy:

- **An integrated national strategy:** Ocean Literacy should be included as a mandatory aspect of citizenship at all education levels (citizenship is currently a mandatory subject from the ages of 10–15 years); and a National Ocean Literacy Strategy should be developed, implemented and monitored within the next decade.

The main obstacles to introducing Ocean Literacy to the curriculum:

- **Low priority:** Ocean Literacy is not considered a priority in educational policy in Portugal.
- **Teacher support and training:** Training courses are needed to prepare teachers to teach the different perspectives of Ocean Literacy.
- **Pressure on teachers:** Teachers face conflicting requirements and agendas.

Key enabling factors for Ocean Literacy:

- **Research and evaluation** is key to improving and guiding Ocean Literacy efforts in Portugal.
- **Funding mechanisms** are needed for research and implementation.

Canada

Respondents: Dr. Lisa Glithero (Canadian Ocean Literacy Coalition); Boris Worm (Dalhousie University and Ocean Frontier Institute)

CASE STUDY:

Ocean Literacy In Nova Scotia

The Ocean School vision is not to make ocean content a new learning outcome, but to teach a wide range of topics through ocean-related materials. The materials are immersive and interactive, also aiming to foster emotional connectedness in the learner. Our vision is to pair these online materials with hands-on learning experiences near or on an actual water body, oceanic or otherwise.

Efforts are being made to provide at least one ocean-themed field trip to every student over the course of their junior high school years. The public school system supports a number of extracurricular activities, although few of them are ocean based. Examples include The Nova Scotia Sea School[84] and various student-run 'Green Clubs' at schools across the province. Ocean School just received a UN Ocean Decade grant to build more community-focused Ocean Literacy resources.

How is Ocean Literacy included in the national curriculum?

The curricula differ by province and territory, and while there is abundant focus on sustainability and climate change education (mandatory in younger grades and elective in older), much less content is specific to the ocean.

How is Ocean Literacy applied outside the national curriculum?

Canada hosts a very active NGO and community-led Ocean Literacy landscape, largely coordinated at the national level by the Canadian Ocean Literacy Coalition (COLC). Many resources developed for and by Canadian educators are available on ocean education, curriculum-linked professional development, and classroom learning, largely led by ocean education NGOs and networks. Examples include CaNOE's Education Resource Library, Ocean School (see above), and Ocean Wise's OL programmes. Likewise, most support for extracurricular activities linked to Ocean Literacy is provided by external organizations.

Advice and visions of experts regarding the future of Ocean Literacy:

- **Integrated environmental education supported through a national strategy:** Ocean, climate and sustainability education, including Indigenous education, should be integrated through an interdisciplinary approach into elementary, secondary and postsecondary education across Canada. To this end, COLC has produced a National Ocean Literacy Strategy with 9 action streams: one is specific to strengthening ocean education in public schools and postsecondary institutions in Canada over the next 10 years. This work by COLC is supported by NGO and private sector funding.

The main obstacles to introducing Ocean Literacy to the curriculum:

- **Fragmented policy:** There is no federal government department or agency that oversees education at the national level in Canada, and thus very little support for formal education initiatives (ocean or otherwise) at a national scale from a governmental perspective.
- **Pressure on teachers:** Teachers face too many conflicting requirements and agendas.
- **Lack of awareness:** There is little awareness of ocean issues in the inland communities where most Canadians live.

Key enabling factors for Ocean Literacy:

- **Cooperation:** Champions in federal government and cooperation between Ocean Literacy leaders in Canada with various national-scope education councils (e.g. Council of Ministers of Education in Canada; Association of Canadian Deans of Education, Canadian Teachers Federation, etc.).
- **Support and training for educators:** Strengthened teacher education programmes and professional development learning opportunities for in-service teachers specific to ocean–climate–sustainability learning.
- **Coordination:** The coordinating efforts of COLC have been incredibly valuable, particularly their development of a national strategy; this is a key factor in implementing a more coordinated approach to Ocean Literacy in Canada.

[84] https://www.seaschool.org

South Africa

Respondent: Russell Stevens (Two Oceans Aquarium)

CASE STUDY: Two Oceans Aquarium

Two Oceans Aquarium, together with South Africa's Department of Basic Education, have developed a national Marine Sciences Curriculum. This successful bridging of formal and informal sectors has led to the setup of Marine Sciences Node Schools, allowing teachers to attend regular meetings to find support and inspiration. Two Oceans Aquarium also runs holiday courses and has adopted online teaching under COVID-19 pandemic conditions. Following the roll-out of the curriculum program, Two Oceans Aquarium will continue to support schools in its implementation through involvement with practical tasks, fieldwork and investigations.

How is Ocean Literacy included in the national curriculum?

The South African Marine Sciences Curriculum, developed by Two Oceans Aquarium in partnership with the Department of Basic Education, is the overarching formal curriculum designed for high school level students. The aims and content therein are used as a guideline for high school scope and sequence, and the curriculum is based on a set of values and attitudes that reinforce the Sustainable Development Goals.

How is Ocean Literacy applied outside the national curriculum?

Many NGOs endeavour to support schools and the formal curriculum, providing hands-on experience as well as adult basic education. These include uShaka Marine World, the Centre for Conservation Education, and Save our Seas; with the Marine and Coastal Educators Network as a national base. However, COVID-19 regulations have curtailed the progress of many programmes.

Advice and visions of experts regarding the future of Ocean Literacy:

- Growing the Marine Science Node Schools network and continuing online teaching.

Key enabling factors for Ocean Literacy:

- **Funding:** funding for data and devices is required to roll out marine science initiatives to unresourced areas.

[85] In South Africa the equivalent of grades 10–12.
[86] In South Africa the equivalent of Grades R–9

Costa Rica

Respondents: José Pablo Zárate Monter, Ana Lorena Orozco Alvarado, Luis Barquero Ulate, Carlos Bermudez Vives, Cecilia María Sevilla Solano (Ministerio de Educación Pública)

CASE STUDY: Cooperation With Non-Government Stakeholders

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Among those stakeholders, it's important to highlight the work of the International Union for Conservation of Nature (IUCN), Marviva, Mission Blue, Instituto de Conservación Marina, the High Seas Alliance, Programa Restauración de Tortugas Marinas, Red Integral de Tortugas Marina, World Wildlife Fund, Costa Rica por Siempre, Coral Raising, Misión Tiburón and the Programa Bandera Azul Ecológica, along with others that actively promote Ocean Literacy activities and are in contact with schools, teachers and students.

How is Ocean Literacy included in the national curriculum?

In Costa Rica, knowledge and awareness activities related to the ocean are included in policy and in the curriculum. The Educational Policy 'La persona: centro del proceso educativo y sujeto transformador de la sociedad' (The person: centre of the educational process and transforming subject of society) intends to generate actions that foster societal transformation, which allow the reduction of gaps between social classes and mitigation of effects related to human actions that threaten ecosystems.

The mentioned policy is also in alignment with the Aichi-Nagoya Declaration and the Earth Charter, which assumes the systemic approach of Education for Sustainable Development. In the basic education programme, the marine environment is mentioned in the curriculum and students are expected to:

Recognize the characteristics of living beings from different environments and understand the need to conserve them,
Distinguish causes and effects of pollution caused by human activities in the natural environment,
Value the promotion of activities that maintain a harmonious natural and socio-cultural environment,
Describe basic concepts related to biodiversity that support a better understanding of the natural environment,
Explain the aspects that determine the biodiversity of Costa Rica and its importance worldwide, and
Become aware of the factors that threaten biodiversity in the community and their impact on the country.

How is Ocean Literacy applied outside the national curriculum?

Nature-connectedness and Ocean Literacy are also promoted outside the national curriculum with the 'Política de Educación para el Desarrollo Sostenible' (Educational Policy for Sustainable Development) which fosters projects and programmes aligned with marine education.

In Costa Rica, commemorative dates related to the ocean and the environment are also included in school calendars as a way to promote knowledge and awareness about ocean challenges. Values and attitudes related to Ocean Literacy are reinforced by diverse programmes and projects such as the **Bandera Azul Ecológica** (Ecological Blue Flag), indicating a category of educational centre that aims to promote a culture of sustainability and strengthen the student learning process.


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How is Ocean Literacy applied outside the national curriculum?

Non-government stakeholders such as NGOs, alliances and foundations are deeply involved with marine education. In addition, in Costa Rica, contact with the ocean is also incentivized by extracurricular activities such as arts, environmental field trips, community service and student organizations.
Advice and visions of experts regarding the future of Ocean Literacy:

Advice and visions of experts regarding the future of Ocean Literacy:

Include Ocean Literacy integrally throughout student life: Ocean Literacy can expand to include the participation of the whole educational community, both in and beyond coastal areas. Ocean Literacy is also a need and it is necessary to strengthen knowledge, action implementation within the educational community.
The main obstacles to introducing Ocean Literacy to the curriculum:

The main obstacles to introducing Ocean Literacy to the curriculum:

- **Capacity development:** despite the interest, teachers need appropriate training in Ocean Literacy.
- **Funding and infrastructure:** funding and the creation of spaces for the development of actions are crucial. Some obstacles also involve displacement of students and teachers to coastal areas and educational centres located in these zones.
- **Family involvement:** parents or family also play a crucial role in enabling the development of different activities.

Key enabling factors for Ocean Literacy:

- **Support for teachers:** Teachers of all educational levels must be offered more training, materials and technology, enabling learners to conduct assignments and research in this area.
- **Cross-sectoral cooperation and partnerships:** Cooperation among sectors, funding and compiled policy are also crucial to the implementation of Ocean Literacy.

Brazil

Respondent: Ronaldo Christofoletti (UNIFESP – Universidade Federal de São Paulo, answering by request of: UNESCO Brazil, Interministerial Commission of Ocean Resources CIRM – Programmes PROMAR and PPGMAR, Ministry of Science, Technology and Innovation)

CASE STUDY:
Santos à Luz da Leitura programme, Brazilian Ocean Olympics and the Ocean Literacy Law

© Blue School Network Brazil.

There is a free surf school in Santos, 'Sonhando sobre rodas', that works with disabled people and eldery people through surf classes, also holding a strong sustainability discussion during the activities. This project links to nature-connectedness, values and attitudes by working on inclusion.

Brazil has already started the Blue School programme and there are many extracurricular activities taking place in the territory. In one recent example, classes by the sea provide a nature-connectedness activity.

Ocean Literacy has been accepted as public policy in school education in Santos, Brazil. The Municipal Law guarantees the inclusion of Ocean Literacy in the municipality's schools, making it the first city in the world to establish Ocean Literacy as public policy in the school curriculum.[87]

How is Ocean Literacy included in the national curriculum?

Ocean Literacy activities are not included in the statutory curriculum or policy materials in Brazil. There are mentions of 'environmental education' in the curriculum but in many cases these are not specifically related to the ocean. However, Ocean Literacy was assumed as public policy in school education in Santos, Brazil (on the municipal–local scale). The Municipal Law #3.935 was enacted on November 12th 2021, and ensures the inclusion of Ocean Literacy in the municipality's schools.
With this law, an interdisciplinary educational strategy will integrate knowledge and awareness, nature-connectedness, values and attitudes, and competence frameworks by developing educational projects within the different realities from the schools in the city.

Values and attitudes for sustainable development are already covered in the statutory curriculum and policies, although sustainable development is mentioned as a general topic without a link to the ocean. In the last few years there have been many efforts from formal education to include statutory and non-statutory curriculum materials to promote citizenship, cooperation, sports competitions and so on. These efforts have provided synergy and opportunities to advance the Ocean Literacy discussion in Brazil.

How is Ocean Literacy applied outside the national curriculum?

Ocean Literacy is not included in policies for the non-statutory curriculum. Some schools have been developing optional activities in Ocean Literacy, including schools far from the sea. This engagement has increased since the launch of Ocean Literacy for All (2019) in Brazil, and expanded with the 'Brazilian Ocean Olympics' where more than 1,000 participants from 17 different states (including states with no coastline) have been developing activities. One private school in Ribeirão Preto city (450 km from the sea) has worked for three consecutive years on Ocean Literacy as a non-statutory action.

[87] https://ioc.unesco.org/news/ocean-literacy-law-signed-santos-brazil

Aerial image of river waters

How is Ocean Literacy applied outside the national curriculum?

Regarding the Brazilian public educational system, in the city of Santos there is a non-statutory programme called Santos à luz da Leitura. This programme is organized by the city's Secretary of Education and chooses a different topic every year to promote a high-quality artistic exposition, created by public schools. In 2021 the programme had the theme of 'Ocean'. Another example is the Secretary of Education of the city of Rio de Janeiro, which started a programme in 2021 for public schools to develop non-statutory activities related to the ocean.

Advice and visions of experts regarding the future of Ocean Literacy:

- **Ocean Literacy can have a strong presence in future education initiatives:** In the short term it is necessary to engage and increase community awareness by developing a 'freestyle' approach where a teacher from any discipline of any socio-economic reality can develop an action. In the mid-term, the fewer rules and barriers we promote for Ocean Literacy development the larger the engagement. From the mid- to long-term this will allow us to increase capacity building, allowing teachers to promote high-level Ocean Literacy actions.
- **Promote sustainable projects such as the Blue School approaches and Ocean Olympics:** In which schools can participate as institutions. However, it is also important to engage groups of students/teachers without an institutional commitment. Presenting a wide range of possibilities will allow schools to promote frequent Ocean Literacy activities, and instead of being a 'modal' exercise due to the ongoing movement of Ocean Literacy, it will allow each school to find their way to connect to the ocean.
- **Support of policies:** An essential step in the mid term is to develop formal Ocean Literacy policies with initial engagement and activities. In the short term it is desirable to have the support of policies to guarantee the long-term sustainability of Ocean Literacy.

The main obstacles to introducing Ocean Literacy to the curriculum:

- **Lack of resources:** The lack of policy, material and training for teachers.
- **Low awareness:** Many groups do not recognize their activities as Ocean Literacy, yet their environmental education activities are clear examples of knowledge and awareness.

Key enabling factors for Ocean Literacy:

- **Translated materials:** One essential factor to make Ocean Literacy successful is having materials in Portuguese to support such activities, as well as resources to support schools in areas of high vulnerability, allowing Ocean Literacy for all and not only for the schools that can dedicate time and resources to be part of the network.

Kenya

Respondent: Dr. Bernerd Fulanda, Pwani University

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CASE STUDY:
Extracurricular programmes at Pwani University

In Kilifi County, Ocean Literacy initiatives bring together bodies from the county and the government, NGOs (such as the WWF) and schools (mainly high school students) with monthly campaigns on beach cleanups that raise awareness on marine litter and plastics.

The Coasts and Reef Club also facilitates nature-connectedness activities by providing marine safety training to students, as well as beach rescue activities on a voluntary basis. Kenya collaborates with many NGOs, including the WWF, and community-based organizations that promote the inclusion of women and youth groups, in addition to high school students who collaborate with ocean awareness about plastic pollution.

Values related to sustainable development and the ocean are also reinforced through internships and student programmes.

How is Ocean Literacy included in the national curriculum?

In Kenya, Ocean Literacy is present in Pwani University policy with the establishment of two key clubs, Coast and Reefs Club and the Environmental Club, focused on environmental and marine pollution awareness. Monthly beach cleanups and awareness campaigns are organized for high schools through programmes such as 'I am Scientist'.

High-school outreach programmes will soon become part of the ocean programme of Pwani University, and schools are already participating in monthly beach cleanups.

Nature-connectedness is also approached through specific field trips to the Early Tsunami Warning System at Kilindini, visits to landing sites, salt manufacturing farms and communities of mariculture. Kenya also offers training on Maritime Safety and Survival (swimming and diving), as well as diving certifications.

How is Ocean Literacy applied outside the national curriculum?

Ocean Literacy is present through initiatives such as World Ocean Day, with activities that incorporate schools, beach cleanup events and Wildlife Club events. These are promoted through the Mtafiti Newsletter, produced by the Kenya Marine and Fisheries Research Institute.

The main obstacles to introducing Ocean Literacy to the curriculum:

- **Finance and logistics:** Activities outside the main curriculum have often been difficult to push and implement due to reduced University funding, consequently generating a lack of finances and funding of activities related to Ocean Literacy, outreach and community engagement.
- **Curriculum:** It's necessary to implement an Ocean Literacy structure in the curriculum and focus on professional training.

Sweden

Respondents: Per-Olov Ottosson (Skolverket); Maria Lewander (Swedish Institute for the Marine Environment, SIME)

CASE STUDY:
Statutory and non-statutory curricula

In Sweden, many of the public activities connected to Ocean Literacy are delivered by NGOs and foundations. For example, The Keep Sweden Tidy Foundation organizes ocean cleanups, the Swedish Society for Nature Conservation is one of the largest environmental organizations in Sweden with national and local grassroot activities and campaigns, and there are many others such as WWF Sweden, which organizes action programmes for youth. The Foundation for the Westcoast is one example of an organization that arranges beach cleanups.
Nature-connectedness activities are also delivered by non-governmental actors such as the Swedish Society for Nature Conservations, which develops more general activities for children called 'Natursnokarna', WWF and the Association for Nature Conservation.

Some projects delivered by non-governmental stakeholders also reinforce values and attitudes such as The Keep Sweden Tidy Foundation, Swedish Society for Nature Conservation, WWF Sweden action programme for youth.

Extracurricular activities:
There are student clubs connected to each university that arrange different activities and engage in questions connected to student life, such as SFS.

Other examples of extracurricular activities are The School Stream, the Maritime Museum & Aquarium of Gothenburg, the Science Centre Universeum of Gothenburg and the school project VIRTUE, which is about learning and measuring the biodiversity of aquatic environments.

Other extracurricular activities include student clubs connected to each university, and clubs that connect different sports activities connected to schools. There are also projects that connect swimming in school and engage people in physical activities combined with cleanups. A new initiative called the OneWater Race combines a race with ocean education.

Another initiative from The National Agency of Education offers web-based peer training for teachers in the area of Education for Sustainable Development, from pre-school to upper secondary. The training is developed in cooperation with five universities.

Nature-connectedness activities are also delivered by non-governmental actors such as the Swedish Society for Nature Conservations, which develops more general activities for children called 'Natursnokarna', WWF and the Association for Nature Conservation.

How is Ocean Literacy included in the national curriculum?

Knowledge and awareness activities related to the environment and sustainable development are included in the statutory curriculum for Swedish schools in a broader perspective. Environment and sustainable development is one of the four perspectives that should influence all subjects in an interdisciplinary way. An environmental perspective provides opportunities not only to take responsibility for the environment in areas where they themselves can exercise direct influence, but also to form a personal position with respect to overarching and global environmental issues. Teaching should illuminate how the functions of society and our ways of living and working can best be adapted to create sustainable development, as highlighted in the curriculum structure.

The Swedish National Curriculum (LGR 11) emphasises the environmental perspective. In the syllabi there are connections to the Swedish official environmental goals in the different subjects. Goal 10 is related to Ocean Literacy. There are also a few more specific goals such as learning to swim and lifesaving, which are included in the statutory curriculum.[88]

Values and attitudes towards sustainable development are applied in all levels of education.

How is Ocean Literacy applied outside the national curriculum?

In Sweden, many municipalities work in close cooperation with nature schools who work with ocean and aquatic literacy, so even if some materials are not in the statutory curriculum, students are able to visit centres during their education. Examples are located in Malmö, Kristianstad, Stockholm, Västervik, Docksta and Lysekil.
More information can be found at the following links:
Malmö: https://en.smkc.se/
Kristianstad: https://vattenriket.kristianstad.se/other-languages/english/.
Stockholm: https://www.skansen.se/en/baltic-sea-science-center.
Västervik: https://naturumvastervik.se/index.php.
Docksta: https://www.hogakusten.com/en/naturum-hoga-kusten
Lysekil: https://www.havetshus.se/en/

In the non-statutory curriculum, some nature-connectedness activities such as snorkelling and skating take place. There are also a number of Natureschools run by private actors or municipalities who work to enhance nature connectedness with excursions and experiments. They focus on how learning is achieved when using all parts of your body: all senses, brain and heart, hand and foot – combining body and soul, lust for life and learning outdoors.

There are also several national 'Naturums' (visitor centres in the National Parks) which are open to schools, and the general public. One example is Sweden's first Marine National Park. And last but not least, the overall goal of Swedish environmental policy is to hand over to the next generation a society in which the major environmental problems have been solved, without increasing environmental and health problems outside Sweden's borders.

Some projects consider values and attitudes outside of the national curriculum, such as the project Ocean Blues at Gothenburg University that aims to turn eco-anxiety into eco-action.

Advice and visions of experts regarding the future of Ocean Literacy:

- **Inclusion of Ocean Literacy in the statutory curriculum:** In connection with other fields such as climate change, deforestation, biodiversity, etc. It is important to highlight the connection with fresh water bodies, such as streams and lakes. Sustainable development in general will have a greater focus in the future. The connection between climate and ocean is also an opportunity to bring the ocean to the classroom if the school is not close to the coast.

The main obstacles to introducing Ocean Literacy to the curriculum:

- **Low awareness:** Authorities working with education need to understand the importance of the ocean, the connection between climate and ocean, biodiversity and ocean-literate students/pupils.
- **Availability of learning opportunities:** Education about Ocean Literacy, or ecoliteracy, should be provided to everyone who is employed by the state and government.

Key enabling factors for Ocean Literacy:

- **Cross-sectoral engagement:** Engagement from all sectors of society (including companies) is central to changing the way our ocean is valued, understood and managed.

[88] Please check more content with concrete examples on page 48-54 of:
https://www.skolverket.se/andra-sprak-other-languages/english-engelska

Main findings: challenges and opportunities for all Member States

Taking into account the responses and case studies provided by Member States, the following common challenges and opportunities are identified in developing and implementing Ocean Literacy activities within and beyond a blue curriculum:

Opportunities → Public policy:

Public policy mechanisms improve the reach and coordination of Ocean Literacy at national, regional and local levels, supporting dissemination and implementation. Local instruments such as the Municipal Law on Ocean Literacy of Santos may also support long-term initiatives such as the development of national Ocean Literacy strategies.

Depending on the context, it is also advised to include Ocean Literacy as part of an integrated national strategy (which requires implementing, monitoring and evaluation cycles, as well as specialized staff in public bodies). The development of coherent policy provides a basis for Ocean Literacy across education (and eventually also to other sectors) and guarantees long-term sustainability of initiatives.

Ideally, a blue curriculum reinforces the Sustainable Development Goals and Agenda 2030, in addition to other related timeframes such as the UN Ocean Decade (2021–2030) across education.

Challenges → Public policy:

Fragmented policy is a common barrier to Ocean Literacy, aligned with little support in formal education. Some Member States pointed to the need for one main authority dealing with Ocean Literacy (i.e. a ministry or secretary of education), which could support the inclusion of Ocean Literacy in the curriculum.

Opportunities → statutory curriculum:

A well structured blue curriculum considers ocean topics embedded in the statutory curriculum for all students. This process takes a cross-cutting approach, which can be diverse depending on the region (e.g. one region with sports as a mandatory discipline can use Ocean Literacy as an approach, while others with ethics as mandatory can consider Ocean Literacy through citizenship content).

Ideally, the inclusion of Ocean Literacy in the statutory curriculum considers regional differences in curriculum content. This topic is particularly important for landlocked, rural and remote regions with little or no contact with the sea, but still influenced by the ocean (e.g. transport, climate regulation, temperature, economy, etc).

Challenges → statutory curriculum:

Including Ocean Literacy in the statutory curriculum poses some challenges regarding scope and sequence. For example, Ocean Literacy may be considered as non-mandatory for some educational cycles, being compulsory in some grades, but elective for older students. A blue curriculum ideally takes into account all cycles of education from elementary to middle and high school (as suggested in Section 5: Scope and Sequence).

Opportunity → integrated frameworks and guidelines:

Member States with educational policy oriented towards ESD, deforestation, biodiversity or climate change education can benefit from Ocean Literacy to complement the curriculum content. It is also crucial to connect Ocean Literacy to other emergent topics such as water sanitation, water access, freshwater resources, streams and lakes. Another opportunity is to link Ocean Literacy materials to professional development and career orientation, supporting the learner's interest in ocean-related careers. A well structured blue curriculum builds upon existing national structures for other related subjects such as arts, sports and STEAM.

This strategy can be aligned with the development of Ocean Literacy activities considering national priorities and training, such as Early Tsunami Warning System, swimming, lifesaving and maritime survival. Ocean Literacy can also be promoted in alignment with national priority dates by the establishment of ocean-related national celebration days.

Opportunity → collaborations with non-governmental stakeholders:

In some contexts, Ocean Literacy is developed by cooperative processes with non-governmental stakeholders such as NGOs, sailing communities and private sector organizations (which can be fundamental in supporting students to understand career paths within the blue economy). Those stakeholders may support the development of activities that require infrastructure or specialized tools and teachers, such as water sports, outdoor activities, field trips, excursions and experiments.

Non-governmental stakeholders may also be parents and family members, who are crucial to the establishment of sustainable behaviour, and give permission for students to participate in field trips and outdoor activities.

Opportunity → hybrid learning

Hybrid learning represents an opportunity regarding teacher training for Ocean Literacy. Some teachers may have tight schedules and obstacles to participate in training far from their local region. As such, the development of online courses in local languages may support continuous teacher training. To deliver successful online courses, organizations need specific services such as a reliable online connection, development of a long-term digital strategy, and digital marketing to capture the attention of educators.

Another opportunity for hybrid learning is the increased use and skill development of technology for learning by students and teachers alike, making virtual reality and other digital Ocean Literacy resources easier to access and learn from.

Challenge → hybrid learning

With the COVID-19 pandemic, educational patterns have changed. As a result, schools and teachers may need to consider the need to adapt Ocean Literacy activities to online formats and hybrid learning methods. Teachers may feel overwhelmed by new tools, and this first contact may represent a barrier to advance Ocean Literacy. The closure of schools and spaces like aquaria and museums due to limited staff also restrict interventions and social interactions between students and teachers. This may be overcome with creative strategies, including the use of online tools and platforms.

Opportunity → identification of cultural patterns:

Ocean Literacy may also benefit from appropriate identification of cultural patterns. For example, some regions with a strong culture of outdoor activities (e.g. camping, use of public spaces such as the beach, aquaria, etc.) may use nature-connectedness as an approach. In addition, Ocean Literacy activities may support the initial involvement of teachers and learners in Ocean Literacy. This approach may require promotion of activities that facilitate experiential learning, such as snorkelling, visits to marine parks, field trips, excursions, experiments or even surf classes for students.

Challenge → scope and sequence:

The success of Ocean Literacy is also dependent on the continuity of activities; many initiatives are interrupted during education, which may impact positive behaviours towards the ocean.

Opportunity → Ocean Literacy networks:

The inclusion of Ocean Literacy in the curriculum benefits from a well-informed society and educators, which can support mobilization for education. Networks of teachers, associations and schools such as the Blue School network (Portugal, Brazil and All-Atlantic), Bandera Azul Ecologica (Costa Rica) and the Nature Schools (Sweden) support coherence and reinforcement of Ocean Literacy initiatives across regions.

Challenge → lack of priority:

In many contexts, Ocean Literacy is not considered as a priority in education. As a result, Ocean Literacy is neglected from high-level decisions and societal awareness. Low awareness is present in authorities and educational groups, as well as the marginalized communities that need Ocean Literacy and education the most.

Opportunity → teacher training

Teachers need support and training regarding Ocean Literacy. Training may involve an introduction to ocean topics and features (including the seven essential principles and the Theory of Change matrix presented in this Toolkit) and guidance on how to integrate Ocean Literacy into current disciplines. Teachers also need capacity development and translated resources to make the best use of Ocean Literacy materials.

Challenge → teacher training

Teachers often have conflicting agendas and feel pressure from the amount of work and content in the curriculum. In such cases, Ocean Literacy can be integrated through an embedded approach in the curriculum. Ideally, teacher surveys may be conducted to understand their level of pressure, workload and interest in Ocean Literacy.

The development of Ocean Literacy assets should be also compatible with teachers' knowledge, and made suitable for vulnerable regions and diverse groups of teachers and students.

Challenge → funding

Funding and lack of infrastructure are strong and common obstacles to the success of Ocean Literacy. Long-term funding mechanisms are needed not only for Ocean Literacy activities but also for educational research, data generation, implementation and the monitoring of a blue curriculum.

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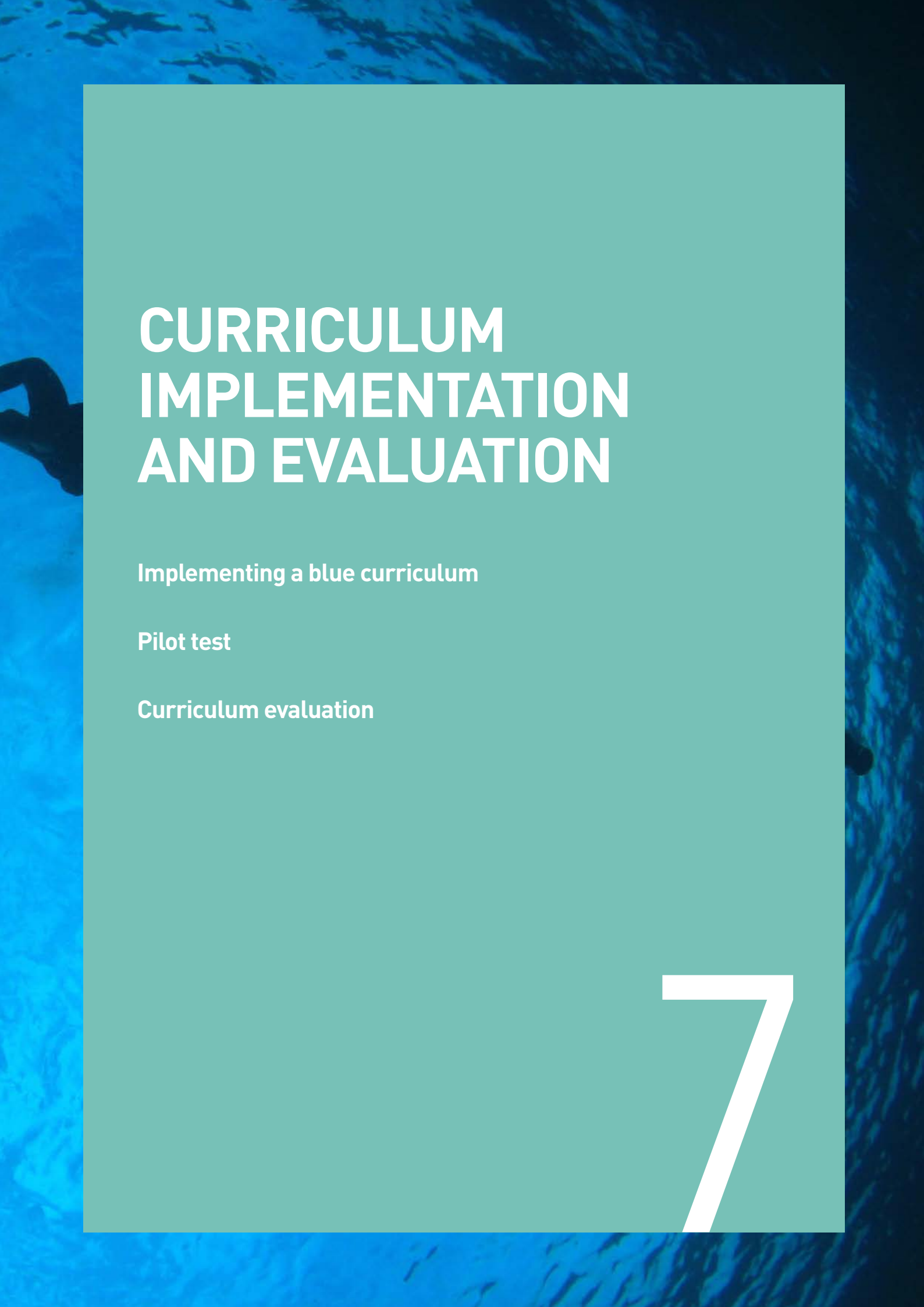

CURRICULUM IMPLEMENTATION AND EVALUATION

Implementing a blue curriculum

Pilot test

Curriculum evaluation

7

7

This section suggests how to evaluate the success of a blue curriculum, along with supporting tools. Evaluation refers to the process of measuring and judging the extent to which the planned courses, programmes, learning activities and opportunities expressed in the formal curriculum actually produce the expected results.[89] If carried out effectively, the evaluation process can enable decisions to be made about improvements and future progress.

With evaluation in mind, policy-makers and curriculum developers are able to envisage Ocean Literacy approaches that support sustainable action for educational stakeholders and students in the long term.

Implementing a blue curriculum

Curriculum implementation ideally includes the schools and other relevant ocean stakeholders, such as NGOs, participating in the development and improvement process. These steps can be fostered by school leadership and teachers' organizations (e.g. networks of active and ocean literate teachers, marine educators' associations, etc.), but also require ongoing teacher training on ocean topics, the development of new textbooks, teaching and learning materials, and the formulation of guidelines.[90]

Educational authorities interested in developing a blue curriculum should also consider how it may differ from the curriculum in use, familiar to schools and teachers. In many cases, the key feature of unsuccessful curriculum change is the level of difficulty or complexity presented to teachers by the new curriculum. To implement Ocean Literacy in the curriculum, teachers need appropriate training and skills to allow the development of cross-disciplinary thinking. This will allow teachers specializing in all fields to implement a blue curriculum, particularly those outside natural sciences.

Other decisive issues faced by educational authorities include social and political influences, which may lead to opposition, and the need for financial resources to develop and distribute a blue curriculum.[92]

Pilot test

Prior to rolling out a blue curriculum on a large scale, pilot tests can be developed with the collaboration of stakeholders. Pilot testing a blue curriculum enables awareness of gaps and needs, and the identification of blind spots, which can be improved through curriculum evaluation. In a pilot test, empirical data can be gathered to justify the implementation of a blue curriculum by demonstrating its practicality and 'real-world' applicability for involved stakeholders.[93] Pilot testing a blue curriculum can be carried out via the following methodologies,[94] keeping in mind the four axes of the Theory of Change:

[89] http://www.ibe.unesco.org/en/glossary-curriculum-terminology/c/curriculum-evaluation
[90] Adapted from http://www.ibe.unesco.org/en/glossary-curriculum-terminology/c/curriculum-implementation
[91] Adapted from http://www.ibe.unesco.org/fileadmin/user_upload/COPs/Pages_documents/Resource_Packs/TTCD/sitemap/Module_7/Module_7_1-concept.html
[92] Ibid.
[93] Lewy, A. 1990. 'Curriculum Tryout'. In: Walberg, H.J. and Haertel, G.H., The International Encyclopaedia of Educational Evaluation, Oxford, Pergamon Press. pp 203-205.
[94] Lewy, A. 1990. 'Curriculum Tryout'. In: Walberg, H.J. and Haertel, G.H., The International Encyclopaedia of Educational Evaluation, Oxford, Pergamon Press. pp 203-205.

Laboratory tryout

This first stage takes place very early on in the curriculum development process, and consists of a formative evaluation about Ocean Literacy conducted by national authorities. The laboratory may be organized with individuals or small groups of interested parties. The responses of learners are observed and modifications to the curriculum materials may be suggested.[95] The material presented in Ocean Literacy For All: A Toolkit may support this process, which should provide educators with practical teaching tools (e.g. lesson plans).

Pilot tryout

The objective of this stage is to identify possibilities for the implementation and adaptation of the blue curriculum, and the conditions needed for it to succeed. In this phase, the blue curriculum is made publically available to school stakeholders and the curriculum development team may take on the role of teacher.[96]

To facilitate the pilot tryout, stakeholders can map and select participant schools, brief school leaders on the need for a blue curriculum, and equip teachers with Ocean Literacy content (e.g. textbooks and syllabuses). From the pilot tryout they gather and analyze feedback from participants to feed the field tryout phase.

Field tryout

This stage involves the autonomy of teachers in their classrooms and attempts to establish a programme for use without the support of a curriculum development team.[97]

Implementing a blue curriculum

The evaluation of a blue curriculum is part of a permanent and ongoing process of curriculum development in which responsible authorities constantly revise and adjust the curriculum framework and guidelines to improve learning outcomes. Evaluation of the blue curriculum itself includes the assessment of student progression through the curriculum, and the evaluation of programmes, interventions, methods and organizational factors. This process also can be enriched with the feedback collected from teachers and learners in the previous phases.[98] Overall, the evaluation process aims to examine the impact of the implemented curriculum and can be revised considering the:

- Specific strengths (e.g. are concepts easily adaptable to include Ocean Literacy?) and weaknesses (e.g. are examples far from students' contexts? Is the complexity too high? etc.) of a blue curriculum,
- Critical information for strategic changes and policy decisions,
- Indicators for monitoring,
- International and regional assessments.

The evaluation process may be internal or conducted by a commissioned review process including Ocean Literacy experts, ocean scientists, marine education networks, and teachers interested in Ocean Literacy. This process may examine the effectiveness of the curriculum content, methodologies applied, and student assessments to assess comprehension and the efficacy of educational strategies.[98] This process may be repeated through evaluation cycles that continuously consider feedback from the involved stakeholders.

[95] Adapted from http://www.ibe.unesco.org/fileadmin/user_upload/COPs/Pages_documents/Resource_Packs/TTCD/sitemap/Module_7/Module_7_1-concept.html

[96] Adapted from http://www.ibe.unesco.org/fileadmin/user_upload/COPs/Pages_documents/Resource_Packs/TTCD/sitemap/Module_7/Module_7_1-concept.html

[97] Adapted from http://www.ibe.unesco.org/fileadmin/user_upload/COPs/Pages_documents/Resource_Packs/TTCD/sitemap/Module_7/Module_7_1-concept.html

[98] Adapted from http://www.ibe.unesco.org/fileadmin/user_upload/COPs/Pages_documents/Resource_Packs/TTCD/sitemap/Module_8/Module_8.html

CONCLUSIONS

Toolbox

Initial assessment and guidelines:

- Tool 1: Considering approaches for developing a blue curriculum

Checklists for implementing a blue curriculum:

- Tool 2: Implementing the Theory of Change
- Tool 3: Understanding the elements of a blue curriculum
- Tool 4: Revising the current curriculum structure
- Tool 5: Mapping national priorities, policies and Ocean Literacy

8

4

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As this Toolkit forefronts, the ocean is essential to every human being and interacts with many aspects of our lives on a daily basis. However, despite this intrinsic connection, there is still a lack of knowledge, awareness, positive action and sustainable behaviour towards the ocean. As a result, the decline in its health continues, disproportionately harming the younger generations.

The challenge to reverse the situation begins with the lack of accessible educational resources about the ocean in school curricula. Such materials are often challenging to find and are not accessible for teachers and schools, subsequently impacting students' knowledge about the ocean and the threats it faces. Taking this challenge into account, this Toolkit provides updated materials for educational stakeholders with the aim to boost the inclusion of Ocean Literacy in curricula.

The international and participative scope of the Ocean Decade offers the unique opportunity to host and promote a wide range of Ocean Literacy initiatives and support its advancement worldwide.

As explored in this Toolkit, a 'blue' curriculum can be co-designed in cooperation with policy-makers and educational stakeholders, as well as communities and families, who ultimately need to be engaged to sustain the promotion of values, attitudes and competences in safeguarding the ocean.

This publication provides the necessary guidelines and tools for policy-makers to support the inclusion of Ocean Literacy throughout the curriculum in a coordinated way, taking into account a flexible approach that can be adapted by each Member State to nourish students with the skills required for the future.

Over the past 5 years, IOC-UNESCO has developed materials and activities for teachers that can be used in local contexts, such as Ocean Literacy For All: A Toolkit, available in English, Spanish, Portuguese, Italian and French. Further materials targeting authorities and teachers can be found on the Ocean Literacy Portal. IOC-UNESCO is committed to promoting Ocean Literacy worldwide by providing a platform for sharing and collaboration with stakeholders.

Institutional setting plays a fundamental role in developing a blue curriculum that is coherent and context-specific. The reflective questions in Tool 1 can support policy-makers to assess existing needs and priorities for a blue curriculum.

TOOLBOX
Initial assessment and guidelines

Tool 1:
Considering approaches for developing a blue curriculum

Think about how the approaches mentioned in the Toolkit (Sections 3 and 4) can be integrated into Ocean Literacy educational practices in your territory, considering:

- What local, national and global priorities (e.g. fisheries, marine protection, extension of continental shelf) are connected to Ocean Literacy and the essential principles in your context?

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- How can Ocean Literacy be connected to educational policies in your context?

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- Are there possibilities to partner with non-governmental stakeholders (e.g. research institutes, marine stations, NGOs and non-formal educational centres) to promote Ocean Literacy activities and adapt the current curriculum?

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- In landlocked, rural or remote regions: what alternative approaches to Ocean Literacy can be adapted to the curriculum to ensure that students and teachers are aware that we are connected to the ocean, wherever we live? (e.g. rivers and climate content)

_____
_____
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_____.

Tool 1:
Considering approaches for developing a blue curriculum

- What tools are needed to ensure that teachers have access to translated and adapted materials about the ocean? Do current materials in the existing curriculum provide a vision of the ocean accounting for cultural and social aspects where schools are based? Do teachers need training? Could teachers receive training from national marine education networks?

_____
_____
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- What monitoring and evaluation process could be implemented to review the inclusion of Ocean Literacy in the curriculum?

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_____
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_____
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- How can Ocean Literacy be implemented in your context, considering teachers' busy schedules and deadlines?

_____
_____
_____
_____
_____
_____.

- How can Ocean Literacy be connected to school infrastructure (e.g. gardens, pools, recycling facilities, bicycle parking, sustainable design) and which changes will be required?

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- Which available or potential mechanisms could be used to allocate funding for a blue curriculum?

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These questions have no one correct answer to serve all regions. Most importantly, they provide a starting point through deep reflection on how each Member State can include Ocean Literacy in the curriculum. With these questions in mind, when adapting Ocean Literacy to the curriculum the competent authority is able to understand that:

Ocean Literacy is about:	Ocean Literacy is NOT about:
Ocean Literacy is about considering local social, environmental and economic aspects of the community.	One size fits all.
Facilitating the inclusion of Ocean Literacy for all students regardless of their gender, ethnicity, age, etc. through field trips, extra-curricular activities and whole-school approaches.	Creating experiences and activities that will benefit only certain students, disregarding accessibility (e.g. by organizing activities that are not adapted to learners with disabilities, or that exclude girls, ethnic groups, religious practices, minorities and other vulnerable groups).
Enabling contact with the ocean for schools in coastal regions, non-coastal regions, landlocked regions and rural areas, regardless of their location.	Only organizing activities for regions that are geographically close to the ocean.
Providing teachers with resources translated into their local languages and adapting Ocean Literacy to the school schedule.	Overloading schedules, teachers and students through inappropriate organization, overambition and unreachable deadlines.
Learning approaches that include knowledge and awareness activities, nature-connectedness, the promotion of values and attitudes, and support for competences related to sustainable development and Ocean Literacy.	Creating a rigid curriculum with no flexibility.

TOOLBOX
Checklists for implementing a blue curriculum

The checklists presented below are intended to serve as guiding tools to review and evaluate the curriculum scope and sequence. The material serves as a basis for planning, adapting and developing a blue curriculum, and can be used by policy-makers, curriculum developers, writers and teachers.

Tool 2:
Implementing the Theory of Change[100]

Tool 2 guides educational stakeholders through the process of developing a blue curriculum, by considering the four elements of the Theory of Change for Ocean Literacy (see Section 1).

THEORY OF CHANGE MATRIX	Situation analysis	Including Ocean Literacy in educational policy	Including Ocean Literacy in educational policy	Monitoring and evaluation
	What are the current challenges or opportunities for Ocean Literacy regarding the Theory of Change matrix?	What actions are needed and which stakeholders should be contacted?	What actions are needed and which stakeholders should be contacted?	What information needs to be collected, monitored and evaluated? Who will do this?
Knowledge and awareness				
Nature connectedness				
Values and attitudes				
Competences				

[100] This table was adapted from the framework proposed by http://www.ibe.unesco.org/sites/default/files/Guidelines_for_Inclusion_UNESCO_2006.pdf

This checklist table works through the scope and sequence of a blue curriculum (Section 5) to consider which elements to include, and to assess the 'blueness' of the curriculum. The reader may select 'yes', 'no' or 'partially' for their context.

Tool 3:
Understanding the elements of a blue curriculum

THEORY OF CHANGE MATRIX	Are these necessary elements of a blue curriculum included?	Yes	No	Partially
Level of educational materials to be reviewed: ☐ **Elementary** ☐ **Middle school** ☐ **High school** ☐ **All**				
Knowledge and awareness	• Are knowledge and awareness materials included in statutory materials in your territory? • Do educational materials about the ocean support cross-cutting knowledge? (e.g. mathematical calculation of a biology concept) • Is content about the ocean scientifically based, and do students have contact with ocean science methods? • Are students aware of multiple human perceptions of the ocean through art, history, cultural heritage, Indigenous, local and ancestral knowledge? • Are teachers trained in Ocean Literacy? Are teachers aware of the ocean's importance? • Are syllabuses and curriculum content connected to the Ocean Literacy principles?			
Nature connectedness	• Are nature-connectedness activities included in statutory materials in your territory? • Are subjects such as citizenship reinforced by nature-connectedness activities? • Are field trips to coastal regions or ocean ecosystems part of the curriculum?			
Values and attitudes	• Is valuing the ocean and its services included in statutory materials in your territory? (e.g. intrinsic, cultural, aesthetic, recreational, educational values) • Are attitudes related to the ocean considered in the current curriculum? (e.g. empathy, cooperation, solidarity, etc.) • Does curriculum content about ocean ecosystems and processes incentivize students to develop values and attitudes towards the ocean?			
Competences	• Are competences included in statutory materials in your territory? • Does curriculum content about the ocean incentivize students to envision and assess ocean futures and solutions? (e.g. through holistic and critical thinking) • Are competences reinforced by a cross-cutting approach? (e.g. sports, arts, etc.)			

Tool 4:
Revising the current curriculum structure

Tool 4 supports policy-makers, curriculum authorities and curriculum developers in reviewing current curriculum structure and identifying where Ocean Literacy can be connected across specific curriculum content.[101] Readers may fill the table for the curriculum under consideration and use this material as a guide.

Level of educational materials to be reviewed:
- ☐ **Elementary**
- ☐ **Middle school**
- ☐ **High school**
- ☐ **All**

Disciplines	Curriculum content	Learning objectives		Concepts that consider Ocean Literacy
	Identify any curriculum component that is connected to Ocean Literacy:	Existing tools How do the current learning objectives account for Ocean Literacy?	Obstacles and opportunities List the existing gaps in your context (social, financial, environmental):	Identify which concepts already consider Ocean Literacy:
Arts and design				
History				
Geology/Earth				
Science				
Geography				
Biology				e.g. Earth and ocean formation
Economics				
Mathematics				
Physics				
Philosophy				

[101] Table adapted from https://www.educationcbd.org/Tools_Decision/021020151201292.pdf

Level of educational materials to be reviewed:
- ☐ **Elementary**
- ☐ **Middle school**
- ☐ **High school**
- ☐ **All**

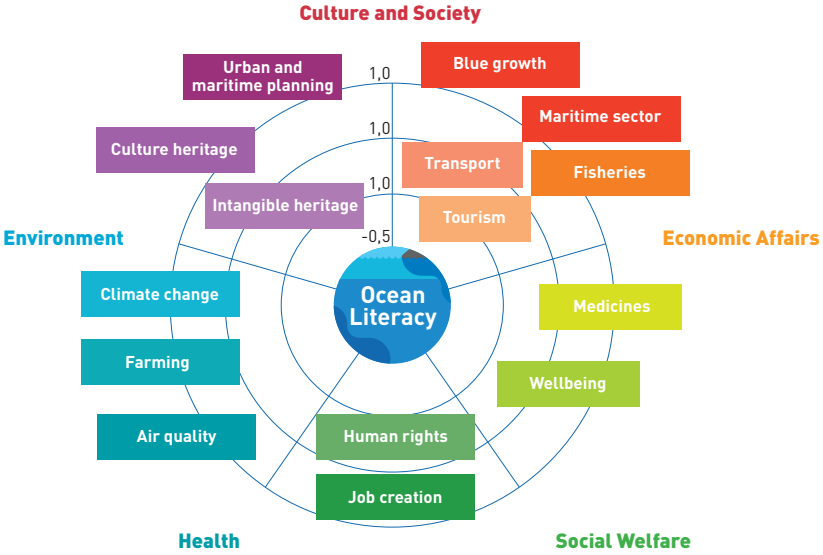
 **Disciplines**	**Curriculum content**	**Learning objectives**		**Concepts that consider Ocean Literacy**
	Identify any curriculum component that is connected to Ocean Literacy:	Existing tools How do the current learning objectives account for Ocean Literacy?	Obstacles and opportunities List the existing gaps in your context (social, financial, environmental):	Identify which concepts already consider Ocean Literacy:
Chemistry				
Statistics				
General sciences	e.g. STEAM guidelines			
Literature				
Languages				
Citizenship education				
Ethics				
Sports				
Computing and information technology			e.g. lack of maritime traditions, limited sports infrastructure such as swimming pools, far from the coast, etc.	

Tool 5:

Mapping national priorities, policies and Ocean Literacy

Tool 5 assists with mapping national priorities (or existing policies) and integrating them into a forward-thinking blue curriculum oriented towards sustainable development. National priorities and policy areas are divided into five areas, with relevant Ocean Literacy topics shown in yellow. Considering the chart, readers may respond to the questions for their context.

How Ocean Literacy can be considered in different policy areas:



THEORY OF CHANGE MATRIX	NATIONAL PRIORITY (OR EXISTING POLICY): List which Ocean Literacy concepts can be linked to national priorities or policy to develop a blue curriculum, considering the Theory of Change:				
	Culture and Society (e.g. national holidays connected to the ocean, promotion of ocean cultural heritage, safeguarding of underwater heritage)	Economic Affairs (e.g. maritime sectors that are crucial to your context, blue economy, priorities of your local government relating to the ocean)	Environment (e.g. frameworks and guidelines that consider air quality, climate change, farming, water, rivers, etc.)	Health (e.g. priorities related to food safety and security, health, well-being, water sports, medicines, well-being, etc.)	Social Welfare (e.g. human rights, job creation, dignity at work, youth policy, etc.)
Knowledge and awareness					
Nature connectedness					
Values and attitudes					
Competences					

Appendix 1
Index of marine educators networks

Appendix 2
Sustainable Development Goals for a blue curriculum

Appendix 1
Index of marine educators networks[102]

Africa

MzanSea — https://mzansea.org/about/

Asia

Asian Marine Educators Association (AMEA) — https://sites.google.com/view/asia-marine-ed/

Australia and Oceania

Australian Association for Environmental Education (AAEE) — https://www.aaee.org.au/

International Pacific Marine Educators Network (IPMEN) — https://ipmen.net/

Europe

Blue Schools Network Portugal (Escola Azul) — https://escolaazul.pt/

European Marine Science Educators Association (EMSEA) — https://www.emsea.eu/

EuroGOOS Ocean Literacy Network — https://eurogoos.eu/ocean-literacy/

Irish Ocean Literacy Network — https://irishoceanliteracy.ie/

Ocean Literacy Italia — https://oceanliteracyitalia.it/

Po Bangom (Lithuania) — https://www.pobangom.lt/

Latin America

Brazilian Alliance for Ocean Literacy — https://maredeciencia.com.br/projetos/alianca/

Red de Educación Latinoamericana para el Océano (RELATO) — https://relatoceano.org/

North America

Canadian Network for Ocean Education (CaNOE) — https://oceanliteracy.ca

National Marine Educators Association (NMEA) — https://www.marine-ed.org/ocean-literacy/

Regional / International

All-Atlantic Blue Schools Network — https://allatlanticblueschools.com

[102] Being aware that this might not be a fully comprehensive list we ask you to contact us at oceanliteracy@unesco.org in case you wish to be added

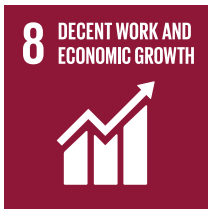
Appendix 2
Sustainable Development Goals for a blue curriculum

Although discussions of ocean subjects are typically centred around SDG 14, designing a blue curriculum offers an opportunity to engage with all 17 SDGs. This allows students to learn about the ocean's wide-ranging influence in all areas of human life and the global environment, and the many interconnected sectors and subjects that must come together to care for the ocean. This appendix lists examples of how the ocean can be connected across the 17 SDGs in a blue curriculum.

Figure 4. The Sustainable Development Goals. © United Nations.

Sustainable Development Goals	Possible connections to the ocean
 SDG 1: No poverty	The ocean supports economic activity, including jobs, fisheries, food, marine transportation, trade, fuel, and energy.[103] A blue curriculum may provide examples of how the ocean contributes to eradicating poverty in association with many sectors. For instance, marine fisheries contribute directly and indirectly by employing over 200 million people.[104] A blue curriculum may promote materials on how the ocean economy influences sustainable development and is crucial to coastal livelihoods across the globe.
 SDG 2: Zero hunger	A blue curriculum provides information about food from the ocean and the vital role the ocean plays by feeding over 3 billion people, who depend on marine and coastal biodiversity for their livelihoods.[105] Schools and students may also benefit from interactive collaborations with chefs, agriculture and mariculture experts, and other food-related stakeholders.
 SDG 3: Good health and well-being	The ocean provides cultural, recreational, educational, aesthetic and spiritual services. A blue curriculum provides students and schools with knowledge, awareness and potential actions related to this dimension. Educational frameworks may also support students to understand ecosystem services and medicinal resources provided by the ocean, and its ability to boost well-being through sport and recreation.
 SDG 4: Quality education	A blue curriculum is tightly connected with the SDG 4 targets. It aims to promote OL across all levels of education, incentivizing learners to understand ocean challenges but also to act collectively and individually towards changes.
 SDG 5: Gender equality	Gender inequalities are present among the seafood industry, including fisheries, aquaculture, seafood processing and all related services; women represent half of the total working population worldwide, while 2% of the 1.2 million seafarers worldwide are female.[106] [107] A blue curriculum supports the inclusion and empowerment of all in ocean science and blue careers, regardless of their gender.

[103] https://www.cbd.int/ecosystems/doc/marine-goods-services-en.pdf
[104] https://www.un.org/sustainabledevelopment/oceans/
[105] https://www.un.org/sustainabledevelopment/oceans/
[106] https://www.imo.org/en/OurWork/TechnicalCooperation/Pages/WomenInMaritime.aspx
[107] World Bank, 2012, OECD, 201

Sustainable Development Goals	Possible connections to the ocean
 SDG 6: Clean water and sanitation	A blue curriculum informs learners about ocean challenges and their connection to water and sanitation (e.g. 90% of plastic polluting the oceans comes from just 10 rivers).[108] Schools and educators may promote Ocean Literacy in regions where the ocean is not present but where rivers interact with people and the environment (more than 80% of wastewater produced by human activities is discharged into rivers or seas without any pollution removal).[109]
 SDG 7: Affordable and clean energy	The ocean offers immense opportunities for renewable energy generation, such as offshore wind, tidal, wave, floating solar, salinity gradient and ocean thermal energy production. Renewable energy is playing an increasingly significant role in mitigating global climate change.[110] Schools and teachers may promote the future role of ocean energy and provide field visits for students to ocean energy sites and factories (e.g. offshore wind farms). A blue curriculum incentivizes ocean energy careers and a transition towards a carbon-neutral society.
 SDG 8: Decent work and economic growth	Millions of people depend directly on the ocean for their livelihoods and hundreds of millions more rely on it for food. A blue curriculum promotes students' inclusion in all sectors of the ocean economy, and supports decent work conditions and economic growth.
 SDG 9: Industry, innovation and infrastructure	Science is crucial to achieving global sustainability and the adequate stewardship of our ocean. It provides the ability to deepen our understanding of marine environments and monitor the ocean's resources and health, as well as predict changes in its status.[111] Many regions lack sufficient coastal and ocean infrastructure (especially survey vessels) and skills for the assessment of fish stocks and evaluation of the economic impact of subsidies[112]. A blue curriculum offers students the possibility to learn about coastal infrastructures by considering such spaces in coastal cities and discussing gaps and opportunities.
 SDG 5: Gender equality	A blue curriculum takes into account inclusive approaches that aim to reduce inequalities across education. In the ocean, inequality manifests in the unfair distribution of commercial fish catches; the limited political power of small-scale fishers, particularly women and other minority groups; and the limited engagement of developing nations in high seas activities and associated decision-making.[113] A blue curriculum fosters awareness of these inequalities, and supports and empowers students.

[108] https://www.weforum.org/agenda/2018/06/90-of-plastic-polluting-our-oceans-comes-from-just-10-rivers/
[109] https://www.un.org/sustainabledevelopment/water-and-sanitation/
[110] https://unglobalcompact.org/take-action/ocean/communication/ocean-renewable-energy
[111] OECD. 2019. *Rethinking Innovation for a Sustainable Ocean Economy*, OECD Publishing, Paris,https://doi.org/10.1787/9789264311053-en.
[112] https://www.un.org/depts/los/global_reporting/8th_adhoc_2017/Technical_Abstract_on_the_Ocean_and_the_Sustainable_Development_Goals_under_the_2030_Agenda_for_Susutainable_Development.pdf
[113] Osterblum, H. et al. 2020. Towards ocean equity. World Resources Institute.

Sustainable Development Goals	Possible connections to the ocean
 SDG 11: Sustainable cities and communities	Cities located both close to the coast and in interior regions can promote Ocean Literacy initiatives. Local educational stakeholders at the municipal level are essential for the promotion of a blue curriculum. Ocean cities are also particularly vulnerable and exposed to natural hazards, including storms, tropical cyclones, earthquakes, tsunamis and volcanic activity.[114] A blue curriculum may promote security and specialised hazard training in alignment with Ocean Literacy.
 SDG 12: Responsible consumption and production	Production cycles affect the ocean in many ways. For instance, in the last 50 years plastic production has increased more than 22 times. Yet in 2015, only an estimated 9% of plastics were recycled.[115] A blue curriculum promotes the education of learners towards responsible consumer behaviour while promoting sustainable attitudes inside the school space by reducing the consumption of single-use plastic in the school environment. A blue curriculum also promotes sustainable consumption beyond plastics to encompass all aspects of a student's life (e.g. food, water, energy).
 SDG 13: Climate action	The ocean is a major influence on weather and climate, and is disproportionately impacted by increasing carbon dioxide (CO2) and other greenhouse gas emissions from human activities.[116] A blue curriculum provides transdisciplinary activities that support the understanding of the ocean–climate nexus (OL Principle 3).
 SDG 14: Life below water	A blue curriculum supports the inclusion of ocean science in education, considering all targets of SDG 14, and educates students about marine litter, ecosystem restoration, ocean acidification, sustainable fisheries, and many other topics.
 SDG 15: Life on land	The ocean makes Earth habitable. Most oxygen in the atmosphere is made available by the photosynthetic activity of marine organisms. This accumulation of oxygen in Earth's atmosphere was necessary for life to develop and be sustained on land. A blue curriculum considers the ocean's role in providing water, oxygen, climate regulation and nutrients to Earth. Students from coastal and landlocked regions benefit from a blue curriculum that highlights this point.

[114] Ibid.
[115] https://www.unep.org/news-and-stories/speech/marine-litter-and-challenge-sustainable-consumption-and-production
[116] https://www.iucn.org/resources/issues-briefs/ocean-and-climate-change

Sustainable Development Goals	Possible connections to the ocean
 **SDG 16: Peace, justice and strong institutions**	The ocean is governed by an international legal framework and national priorities that are important for sustainability and the maintenance of international peace and security.[117] A blue curriculum introduces topics such as ocean governance and ocean law, and supports students to understand national priorities regarding the ocean (e.g. seabed mapping, climate change adaptation and resilience).
 **SDG 17: Partnerships for the goals**	A blue curriculum builds long-term partnerships with many ocean sectors (e.g. NGOs, sports, food production, etc.) and supports students' contact with the 'real' ocean world. Policy-makers, schools, educators, teachers, school staff and students' families can strengthen partnerships to achieve common goals and develop a solid structure for a blue curriculum.

Additional resources

Discover more about the ocean's connections with the SDGs by reading The Ocean and the Sustainable Development Goals under the 2030 Agenda for Sustainable Development: a technical abstract of the First Global Integrated Marine Assessment. © United Nations, 2017

[117] https://www.un.org/depts/los/global_reporting/8th_adhoc_2017/Technical_Abstract_on_the_Ocean_and_the_Sustainable_Development_Goals_under_the_2030_Agenda_for_Susutainable_Development.pdf

A New Blue Curriculum

A toolkit for policy-makers

Knowing and understanding the ocean's influence on humanity and humanity's influence on the ocean for different actors in society, regardless of their proximity to the coast, is the essence of Ocean Literacy.

More than a tool, the concept of Ocean Literacy seeks to build and nurture care for the ocean, driving sustainable behaviour changes at the individual and collective level.

One of the pillars of this Manual is providing support for transformational change and empowering policy-makers to further the inclusion of Ocean Literacy in curriculum frameworks during the United Nations Decade of Ocean Science for Sustainable Development.

This Toolkit brings together the latest trends in education, a Theory of Change matrix, ready-to-use resources and examples of case studies from all over the world about the inclusion of Ocean Literacy in the school curriculum.

The Manual is part of a set of materials developed by UNESCO and its Intergovernmental Oceanographic Commission (IOC), which seeks to engage internationally with interdisciplinary and diverse partners for Ocean Literacy actions around the world.

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With the support of AXA XL