

Ocean literacy and connection with the ocean in Chile

Alfabetización oceánica y conexión con el océano en Chile

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ABSTRACT

There is wide evidence on the relevance of both awareness and policymaking in coping with environmental progressive deterioration. With 6.435 km of coastline, Chile has one of the longest and most diverse marine ecosystems in the world. It is believed that a greater understanding of the marine environment is likely to make citizens feel responsible to act as stewards of the ocean. But knowledge is not everything, since we have personal values, attitudes and perceptions that are also an important part of active marine citizenship. In this study we answer the question: does a deeper connection with the

ocean means having more knowledge about ocean issues? Our results showed that, on average, our basic knowledge about the ocean is very limited even when feeling a strong connection with it. Research into knowledge plus perceptions towards the marine environment can aid in designing the most effective learning experiences.

Keywords: ocean literacy, outreach, communications, marine sciences

RESUMEN

Existe amplia evidencia sobre la relevancia de la concientización y de la formulación de políticas públicas para hacer frente al deterioro ambiental progresivo. Con 6.435 km de costa, Chile tiene uno de los ecosistemas marinos más extensos y diversos del mundo. Se cree que una mayor comprensión del entorno marino probablemente haga que los ciudadanos se sientan responsables de actuar como protectores del océano. Pero el conocimiento no lo es todo, ya que tenemos valores, actitudes y percepciones personales que también son parte importante en una ciudadanía marina activa. En este estudio respondemos a la pregunta: ¿Significa una conexión más profunda con el océano el tener más conocimientos sobre los problemas del océano? Nuestros resultados mostraron que, en promedio, nuestro conocimiento básico sobre el océano es muy limitado, incluso cuando sentimos una fuerte conexión con él. Investigar sobre el conocimiento y las percepciones sobre los ecosistemas marinos puede ayudar a diseñar experiencias de aprendizaje más efectivas.

Palabras clave: alfabetización oceánica, divulgación, comunicaciones, ciencias marinas

Introduction

The social, ecological, and economic value of the ocean is beyond dispute. The ocean is key for the health of Earth and the sustenance of human survival (FAO 2012), it drives a large part of the global economy (OECD 2016), and it even regulates the climate and weather (DeVries *et al.* 2017). Unfortunately, human activities continue to threaten the integrity of marine environments due to the rapid expansion of the human population and the increased exploitation of natural resources, which has disrupted the natural balance and functioning of the biosphere (Steffen *et al.* 2011).

Part of the degradation in marine environments is attributed to human lifestyle (Longo & Clark 2016) and the scarce activism that people have regarding ocean issues. Although there are conservation measures around the world that are related to the development of more and better public policies, new approaches should include participatory conservation strategies that involve citizens and aim directly to change their environ-

mental behavior (McKinley & Fletcher 2010). However, it has become evident that citizens of different countries have little knowledge about marine science and ocean-related problems, preventing individual behavior change from occurring (Eddy 2014). Furthermore, topics on marine science are scarcely included in the formal school curriculum (Ministerio de Educación de Chile 2016; 2018; 2019), making this a training problem that has been carried on from an early age (Hoffman & Barstow 2007, Fauville *et al.* 2018). Furthermore, the Trends in Mathematics and Science Study, which measures achievement in basic education between 4th to 8th grade students in 57 countries worldwide, showed that, in general, Chile is below both the average of the participating countries and that of those with a similar GDP (Carvacho *et al.* 2018).

Chile is a country that seeks to implement, not without difficulties, the policies to develop the so-called skills of the 21st century in education. These skills are oriented in general terms to the Sustainable Development Goals promoted by the Education 2030 agenda (OREALC / UNESCO,

2017). Bellei & Morawietz, L. (2016) explain the difficulties to integrate these skills of the 21st century in a Chilean school anchored in the dynamics of strong social segregation and educational inequality as in the Chilean education market (Bellei *et al.*, 2018). The skills of the 21st century in education seek to promote changes that lead to sustainable development through inclusive, equitable and quality education systems for children, youth, and adults, with relevant learning, responsible citizenship, and peaceful and inclusive societies.

Chile is a maritime country with an extensive coastline of more than 6,000 km. From the desert in the Northern part of the country to the Antarctic waters, the Chilean coast suffers from the same problems previously exposed (DeChano 2006, Pavez-Soto *et al.* 2016). One way to overcome this is through “ocean literacy”, which is defined as “understanding the influence of the ocean on you and how you influence the ocean” (Santoro *et al.* 2017). Consequently, a citizen with a good level of ocean literacy will be able to communicate knowledge and problems related to the ocean in a meaningful way and it will be able to make informed and responsible decisions regarding ocean issues (Cava *et al.* 2005).

This transition from knowledge to action has been recognized as “marine citizenship” and it is proposed as a method to reduce negative human impact on the ocean through collective behavior changes (McKinley & Fletcher 2010). It is believed that a greater understanding of the marine environment is likely to prompt citizens to feel the responsibility to function as stewards of the ocean (McKinley & Fletcher 2010). But knowledge is not everything since we have personal values, attitudes, and perceptions that are also an integral part of active marine citizenship.

This is important to consider when approaching ocean literacy education, as we learn from our previous knowledge, values, and experiences (DeChano 2006).

Research into oceanic knowledge and attitudes towards the ocean can aid in designing the most effective learning experiences, helping to improve marine citizenship. Due to the lack of research on this topic in Chile, this study is aimed to inform educators, policymakers, marine managers, conservationists, and industry, providing an insight into the level of knowledge and connection of Chilean people with the ocean. This objective is divided into two parts: (1) to characterize the level of oceanic knowledge and connection with the ocean of Chilean people, and (2) to determine if a deeper connection means having more knowledge about the ocean.

Methodology

During January and February 2020, we conducted the first online survey of Ocean Literacy and Connection with the Ocean in Chile (See Appendix 1). This instrument aimed at collecting information to characterize the respondent’s knowledge and connection with the ocean to improve the design and focalization of initiatives for marine sciences communicators. Most of the questions were extracted and adapted from a questionnaire by Fauville *et al.* (2018).

The survey was in Spanish and disseminated through Fundación Mar y Ciencia¹ social media (Instagram, Facebook and Twitter) and had a total of 913 responses. The requirements to partic-

¹ Fundación Mar y Ciencia: NGO dedicated to promote the valuation of Chile’s marine ecosystems through scientific communication and environmental education.

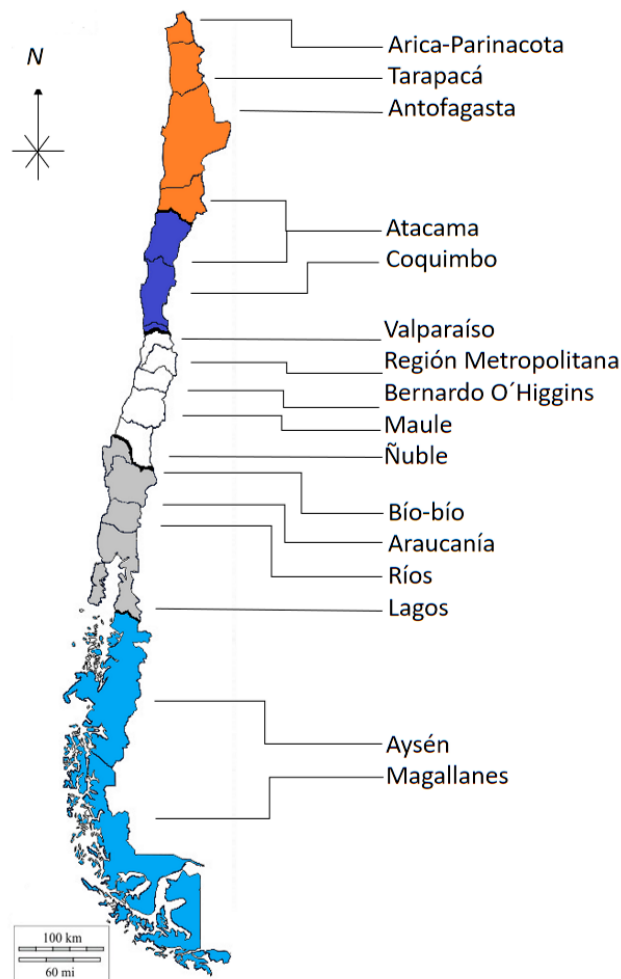
ipate were to live in Chile and to not be engaged in any discipline related to marine sciences. Although there are answers from all Chilean regions of a wide age range and gender identities, this survey was not designed to be necessarily representative of the national population.

We considered three groups of variables: sociodemographic features, connection with the ocean, and oceanic basic knowledge (for full questionnaire, see Appendix).

Sociodemographic. To have a socio-demographic overview of the participants, we asked them to report their gender, age, level of education, and the region of Chile they live in. Then, we grouped the regions according to the division of Chilean natural areas (CORFO 1950, see Figure 1): From top to bottom, Norte Grande (Far North, in orange), Norte Chico (Near North, in blue), Zona Central (Central Zone, in white), Zona Sur (Near South, in grey) y Zona Austral (Southern Zone, in light blue).

Fig 1.

Map of Chile with the division of Chilean natural areas (macrozones) and their respective regions.



Connection with the ocean. In this item, we were interested in how important the ocean is for the participants and why, which activities related to the ocean they enjoyed, which subjects related to the ocean they were interested in learning about, their opinion of what are the main benefits provided by the ocean, and the frequency of direct contact with the coast.

Ocean literacy. We designed a questionnaire of basic knowledge about the ocean, adapting questions from other surveys performed in other countries and consulting experts in the subject. We assigned each correct answer a 1 and a 0 if it was incorrect. Then we added the results to obtain the broad score of ocean literacy. Thus, a higher score means more correct answers.

Our analysis was conducted in two parts. First, we made a general characterization of the participants with t-tests and chi-squared tests, to have an overview of the ocean connection and knowledge, separated by geographic location. Second, we tried to answer our main question by fitting generalized linear models to explore the relationship between ocean connection and knowledge, controlling by age and educational level.

data coincides with Fundación Mar y Ciencia follower demographics, as social networks were the main media for the survey distribution.

Connection with the ocean

Survey results showed that 58.2% of the participants think that the ocean is extremely important, 35.4% think that is very important and finally, only a few (5.9%) consider that the ocean is moderately important.

Regarding the frequency of contact with the ocean (how frequently people from each zone go to the beach or other coastal areas), the survey showed that people in central Chile have less frequent contact with coastal areas, most of the people in this place have contact with the ocean annually (Figure 2). In the macrozones Norte Grande, Norte Chico and Zona Austral the largest number of people have contact with the ocean every week.

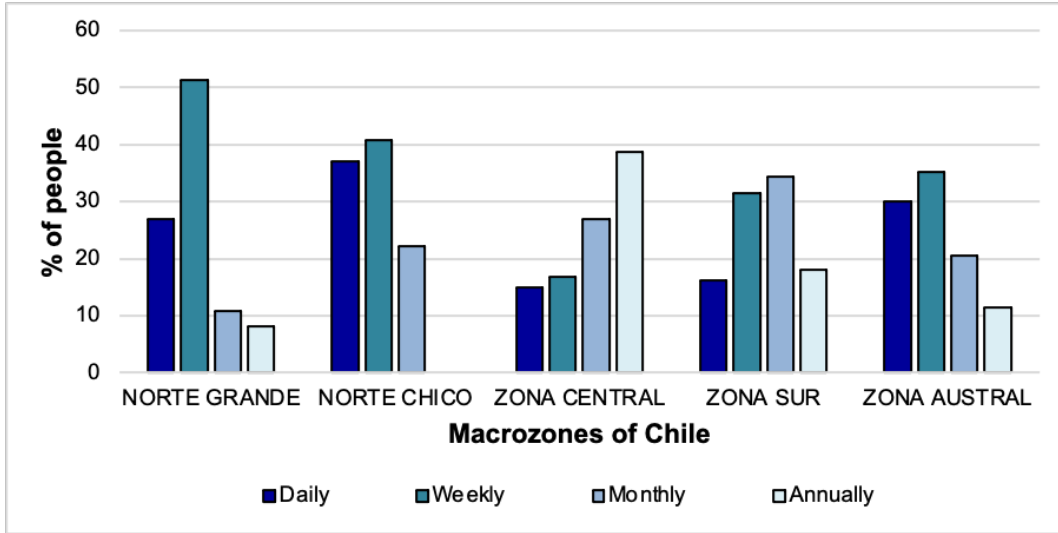
Results

Sociodemographic

A total of 931 participants answered the survey. From these, 62.8% were female, 36.4% were male and 0.9% were other. Most of the participants were between 18-44 years old (83.8%). In addition, most of the participants were living in the Metropolitan region (37.3%), Valparaiso region (24.2%) and Magallanes region (9.5%). This

Figure 2.

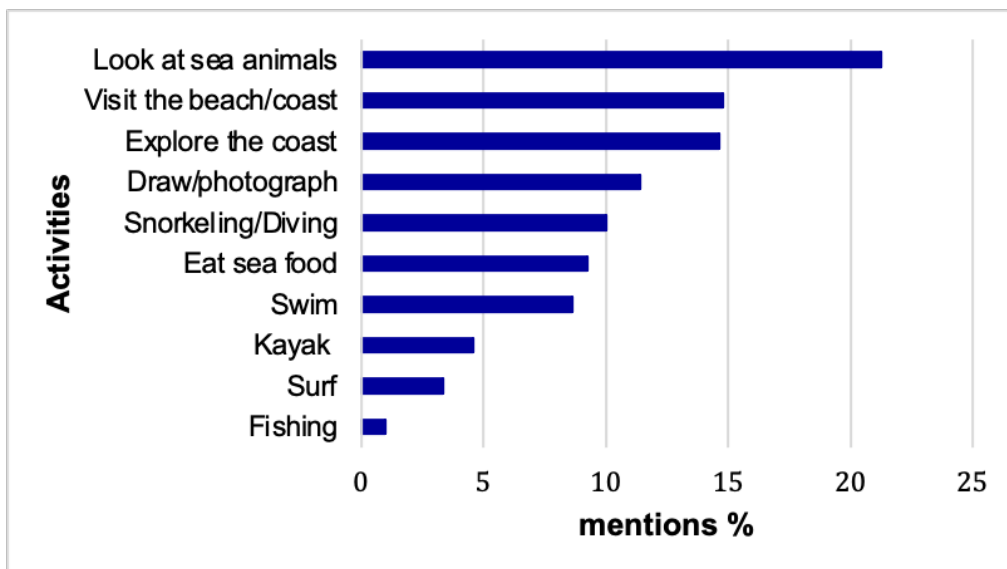
Frequency of contact with the ocean. There are significant differences between the macrozones ($p = 0.00002$).



In the survey, participants had to mention their 3 favorite activities related to the ocean, among 10 options. Figure 3 is the result of a sum of every

mention of each activity. “Look at sea animals” was the most chosen answer in all the macrozones in Chile, followed by “Visit the beach/coast”.

Figure 3.
Ocean activities



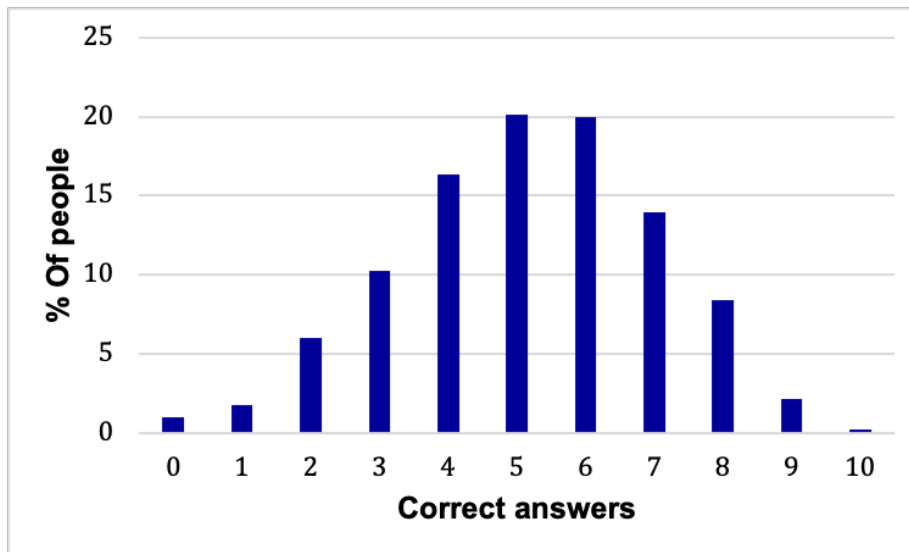
We found that most of the people surveyed would like to know more about marine fauna (23.36%), followed by marine flora (16.5%). There was no significant difference between macrozones ($p=0.0577$). People in the survey chose as main benefits provided by the ocean 1) Climate moderation; 2) Oxygen supply and 3) Food source, with significant differences between the macrozones ($p=0.0098$).

Ocean literacy

From this section of the survey, 40% of the people answered between 5 and 6 questions correctly, while a very small group of people (0.2%) managed to answer the 10 questions correctly and 0.9% answered all of them incorrectly (figure 4).

Figure 4.

Ocean literacy. Percentage of people and number of correct answers. There was no significant difference among macrozones ($p=0.4575$).



Question number 9 (What is a fishing ban?) obtained the highest number of correct answers (78.7% of people answered correctly) and question number 2 (what is the ocean influence on climate?) obtained the least number of correct answers, with only 5.9% of respondents answering correctly.

Relation between connection with the ocean and ocean literacy

Table I shows coefficients for generalized linear models, with oceanic knowledge as the dependent variable, and age and education as controls. Model 1 shows that people with a higher frequency of contact with the ocean have more correct answers in the knowledge questionnaire ($B=0.176$), while Model 2 shows that the higher

is the importance of the ocean, the more correct answers they get ($B=0.467$). Model 3 shows that people who consider that the ocean is important

for environmental reasons have more correct answers ($B=0.375$).

Table 1:
generalized linear models' coefficients for ocean knowledge

	Model 1	Model 2	Model 3
Freq. of contact (0=less than yearly...3=daily)	0.176*** (0.05)		
Importance of the ocean (0=not very...4=very)		0.467*** (0.092)	
Why is the ocean important? (1=for environmental reasons, 0=other)			0.375** (0.178)
Age	-0.020*** (0.006)	-0.017*** (0.006)	-0.020*** (0.006)
Educational level	0.328*** (0.057)	0.328*** (0.057)	0.345*** (0.061)
Intercept	4.259*** (0.245)	2.954*** (0.386)	4.276*** (0.279)
AIC	3681.7	3748.5	3363.6
N	912	930	831

Standard errors in parenthesis. ** $p < 0.05$; *** $p < 0.01$.

Interestingly, in the three calculated models, age reduces the number of correct answers to the survey, while educational level increases it.

Discussion

In sum, we found a significant difference between Chilean zones ($p=0.00002$), indicating a direct relationship between the location of the people and their frequency of contact with the ocean, where three of the activities that respondents enjoy the most are to look at sea animals, visit the coast/beach and explore the coast. This is good news as novel studies show that being near the

ocean can foster strong emotional interest in marine environments while also improving well-being (Nichols 2014). The emotional interest for nature is something that should be encouraged since place-based attachment (the emotional bond people have with a place; Altman & Low 1992) infers that people who develop deep attachments and/or strongly identify with a place will truly consider the interest of that place beyond their own (Brown & Raymond 2007).

Our results also highlight that most people surveyed would like to know more about marine fauna, interest that has already been demonstrated in other studies (e.g., Marrero 2010; Guest *et al.*

2015). This is something to consider when designing ocean literacy activities since learners often orient themselves towards topics, they already hold an interest in (Falk 2010).

We also found that having a higher connection with the ocean has a positive effect on knowing about it. This agrees with Steel *et al.* (2005) who find that frequency of visits to the coast has positive effects on both subjective and objective forms of knowledge. Another study in the UK (Jefferson *et al.* 2014) found that respondents reporting limited interaction with the coast showed lower knowledge, greater pessimism, and disinterest in sea areas. A similar study by Cummins and Snively (2000) found that a wide majority of the surveyed students in coastal British Columbia, Canada, reported learning about the ocean by doing things on or by the ocean. These results show the importance that the incorporation of visits to the sea or bringing ocean science to the people could be essential to designing effective ocean science activities.

The “ocean knowledge” was measured through ten questions. The respondents answered on average between 5 or 6 correct answers, corresponding to 40% of the total respondents of this study. But we did not find differences in terms of knowledge between macrozones, so oceanic knowledge seems to be equivalent throughout the country.

From the 931 participants of the survey, most participants think that the ocean is extremely important, which is very promising. Similar studies have shown that most people think that marine environments are very and extremely important (e.g., Guest *et al.* 2015). This reveals the importance of not just connecting people to the ocean but also transmitting knowledge about how we can act for ocean conservation.

We know the ocean is important, but we need the tools to protect it.

Since this is an exploratory study with a questionnaire design specifically for it, future research should consider a wider, more representative sample, ideally with data from other countries --and in other continents-- as well. This will allow us to have a broader understanding of oceanic literacy and connection and thus contribute to its conservation worldwide.

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Appendix 1

Encuesta Mar y Ciencia

La siguiente encuesta tiene por objetivo diagnosticar 1) la relación de los/as habitantes de Chile con el mar, y 2) los conocimientos que tenemos sobre el mar y sus procesos. Consta de 15 preguntas y no toma más de 10 minutos.

La información recopilada ayudará a crear y mejorar estrategias de divulgación científica que Fundación Mar y Ciencia realiza en distintas regiones del país.

****Si eres estudiante o profesional de una carrera relacionada a las ciencias del mar, por favor abstente de contestar la encuesta****

***Obligatorio**

1. Género *

Marca solo un óvalo.

Hombre

Mujer

Otro

2. Edad *

3. Región *

Marca solo un óvalo.

- Región de Arica y Parinacota
- Región de Tarapacá
- Región de Antofagasta
- Región de Atacama
- Región de Coquimbo
- Región de Valparaíso
- Región Metropolitana de Santiago
- Región del Libertador General Bernardo O'Higgins
- Región del Maule
- Región de Ñuble
- Región del Biobío
- Región de La Araucanía
- Región de Los Ríos
- Región de Los Lagos
- Región de Aysén del General Carlos Ibáñez del Campo
- Región de Magallanes y de la Antártica Chilena

4. Último nivel educativo completo *

Marca solo un óvalo.

- Educación básica
- Educación media
- Educación técnica superior
- Educación universitaria
- Magíster
- Doctorado

CONEXIÓN
CON EL
OCÉANO

Esta sección busca medir la percepción y cercanía que tienes con el océano, responde de forma honesta y pensando en lo que haces habitualmente

5. ¿Qué tan importante es el océano para ti? *

Marca solo un óvalo.

- a) Me es indiferente
- b) Es poco importante
- c) Es medianamente importante
- d) Es muy importante
- e) Es extremadamente importante

6. Si respondiste entre c y e ¿Por qué el océano es importante para ti?

Marca solo un óvalo.

- Razones medioambientales: el océano es importante para la vida marina, el clima , etc.
- Razones económicas: el océano da trabajo, comida, transporte, pesca, etc.
- Razones recreativas: deporte, exploración, fotografía, etc
- Razones culturales: el océano es importante para nuestra historia, tradición, inspiración, etc
- Otro: _____

7. ¿Qué actividades relacionadas con el mar te gusta realizar? (marque hasta tres) *

Selecciona todos los que correspondan.

- Surf
- Snorkeling/Buceo
- Mirar a los animales marinos
- Dibujar/Fotografiar
- Explorar la costa
- Kayak o navegación en bote
- Comer comida marina
- Pescar
- Nadar en el océano
- Ir a la playa/costa
- Ninguna

Otro: _____

8. ¿Qué es lo que más te interesa aprender sobre el océano? (marque hasta tres) *

Selecciona todos los que correspondan.

- Barcos y botes
- Energía desde el océano
- Flora marina
- Fauna marina
- Historia del hombre y el océano
- Relación océano-clima
- Exploración científica
- Amenazas del océano
- Océano Austral
- Mareas y corrientes (oceanografía)
- Políticas oceánicas
- Ninguna

Otro: _____

9. Marca las 3 opciones que, según tú, son los principales beneficios del océano *

Selecciona todos los que correspondan.

- Comida
- Medicinas
- Moderación del clima global y regional
- Transporte (bienes de consumo, viajes)
- Energía (petróleo, gas, mareas, hidroeléctrica)
- Recreación y deporte
- Minerales
- Fuente de oxígeno
- Ninguno

Otro: _____

10. ¿Con qué frecuencia tienes contacto directo con el borde costero (playas, bahías, costaneras, etc.)? *

Marca solo un óvalo.

- Todos los días
- Al menos una vez por semana
- Al menos una vez al mes
- Al menos una vez al año
- Menos de una vez por año

**CONOCIMIENTOS
DEL MAR**

Esta sección busca determinar cuanto conocemos los/as chilenos/as sobre el mar y sus procesos. Responde con honestidad, esto servirá para hacer un diagnóstico general.

11. ¿Dónde se encuentra la mayoría de agua del planeta? (entre dulce y salada) *

Marca solo un óvalo.

- En el océano
- Congelada en los casquetes polares
- Atrapada en reservas subterráneas
- Circulando en la atmósfera
- No lo sé

12. El océano tiene gran influencia sobre el clima a través de la absorción, almacenamiento y movimiento de: (selecciona todas las que apliquen) *

Selecciona todos los que correspondan.

- Sales
- Carbono
- Calor
- Contaminantes
- No lo sé

13. ¿Cuál es la afirmación más acertada sobre el calentamiento global en Antártica? *

Marca solo un óvalo.

- El impacto del calentamiento global en Antártica es el mismo que en el resto del planeta
- Antártica se está calentando más rápido que el resto del planeta
- Los glaciares se están derritiendo en algunas zonas específicas de Antártica, mientras que aumentan de tamaño en otras del mismo continente
- Poblaciones de animales de aguas cálidas están migrando a Antártica
- No lo sé

14. ¿De dónde proviene la mayoría del oxígeno que se encuentra en la atmósfera? *

Marca solo un óvalo.

- Del mismo proceso que formó la Tierra
- Fotosíntesis de plantas que se encuentran en tierra
- Fotosíntesis de organismos que se encuentran en el océano
- Respiración de animales
- No lo sé

15. ¿Cuál de las siguientes afirmaciones sobre consumo pesquero es verdadera? *

Marca solo un óvalo.

- Todos los tipos de animales que viven en el océano están en peligro, por lo que nadie debiese comer animales del océano
- Algunas poblaciones de organismos marinos están disminuyendo, por lo que la gente debiese elegir con cuidado que comer
- En el océano, solo ballenas y delfines se encuentran en peligro de extinción
- Los recursos marinos sobreexplotados no se siguen pescando
- No lo sé

16. ¿Qué produce el desarrollo y actividad humana en el océano? Selecciona todas las que correspondan *

Selecciona todos los que correspondan.

- Contaminación
- Cambios físicos en las playas
- Cambios en la química del océano
- Incremento en la frecuencia de tsunamis
- No lo sé

17. ¿Cuál es la descripción más adecuada sobre el océano? *

Marca solo un óvalo.

- Existe un solo gran océano conectado, y que tiene suficientes recursos para sustentar el crecimiento de la población humana
- Cuando los recursos se acaban en un océano, siempre podemos encontrar más en otro océano
- Existen varios océanos y cada uno puede renovarse a sí mismo
- Existe un solo gran océano, finito y sus recursos son limitados
- No lo sé

18. Ciertas actividades humanas han cambiado la temperatura y pH del océano ¿Cuál de las siguientes afirmaciones han ocurrido debido a estos cambios? Selecciona todas las que apliquen *

Selecciona todos los que correspondan.

- La salinidad del océano está aumentando
- Muchos arrecifes de corales están muriendo
- La frecuencia de derrames de petróleo ha aumentado
- La biodiversidad del océano está disminuyendo
- No lo sé

19. Una veda es: *

Marca solo un óvalo.

- a) Periodo de tiempo durante el cual está prohibido cazar o pescar en un determinado lugar o una determinada especie.
- b) Una etapa de vida de un organismo marino
- c) A y B son Correctas
- d) No lo sé

20. El hábitat marino que provee las áreas más importantes y productivas para muchas especies es/son: *

Marca solo un óvalo.

- Zonas costeras
- Zonas profundas (bajo los mil metros)
- Océano abierto
- Estuarios
- No lo sé

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