

WAVE

COVE
Workforce Initiative

OF THE FUTURE →

An interactive resource for kids, families and teachers.



CANADA'S SUSTAINABLE BLUE ECONOMY

Section Two: Feeding the World with the Blue Economy

Written by Dr. Sherry Scully and Anna Naylor
Centre for Ocean Ventures and Entrepreneurship

HOW I SEA THINGS...



My community of Arviat, Nunavut is on the shoreline, so you could just walk there anytime. Some of my best memories are tied to the ocean, both at home and with Students on Ice. I've grown up watching the sunset over the ocean with my friends and family. One of my favorite memories is fishing with my brother. On the Students on Ice expedition we got to see icebergs and they were huge! We saw so many of them.

- Shelton Nipisar- 2019 SOI Arctic Expedition

FILLING OUR PLATES WITH THE OCEAN'S BLUE BOUNTY

Do you ever worry about whether or not you will be able to eat today? Many people in the world worry about this every day¹ *Food security is defined by having access to enough food, with variety and quality for good nutrition.* Here's a way to think about the different levels of food security;

- **No food security** - may count on one meal a week, but may be poor quality and no choice in what it is
- **Limited food security** - can count on one meal a day, but the quality and variety may not always be great
- **Moderate food security** - can count on three meals a day with a fair amount of choice, but the quality and variety may not be great
- **Total food security** - can eat any kind of food, any time of the day, no concern for where next meal will come from. There will be plenty of variety and options for good quality food – though people need to make good choices to be well-nourished.

Where does the world get most of its protein from?

Have a guess first, and then click on the boxes to reveal the different sources of protein.



57% - plants



18% - meat



10% - dairy







9% - other meat



6% - fish & shellfish

1. FAO (2019). Food and Agriculture Organization of the United Nations. The state of food security and nutrition in the world. <http://www.fao.org/state-of-food-security-nutrition>

If we look at what it takes to raise a pound of animal-based protein, we see that not all proteins are created equal. Conversion ratios tell us how much feed it takes to raise a pound of each type of protein:

| CONVERSION RATIO - FEED : ONE POUND PROTEIN | | |
|------------------------------------------------------------------------------------|----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  | 1 : 1 | Fish and shellfish <i>Some species of seaweed and microalgae are known to contain protein levels similar to those of traditional protein sources, such as meat, egg, soybean & milk</i> |
|  | 1.7 : 1 | Chickens |
|  | 2.9 : 1 | Hogs/pigs (pork) |
|  | 6.8 : 1 | Cattle (beef) |

This means that, when it comes to providing sources of animal protein to the world, that fish and shellfish is our most efficient option – almost every ounce of food they are fed is converted into flesh that can be eaten or used.

Some types of seaweed and microalgae have nearly as much protein as eggs, milk, and meat.

Did you know that 1/3 of all food that is produced for people to eat is lost or wasted?!

Something to consider: Why do you think fish and shellfish have such good feed conversion ratios? *Hint: it has to do with the environment they live in.*

One of these answers is right. Which one makes the most sense? **Fish have the most efficient conversion ratio because of;**

- A. Gravity and Thermodynamics (*how the fish keeps its body the right temperature*).
- B. The salinity (*saltiness*) of the ocean.

It might surprise you that the answer is A! The water environment that fish live in helps to regulate their temperature, so they don't need to use their own energy to keep warm. Plus, the pull of gravity is countered by the push of buoyancy (*what makes us float*), and this means that unlike land-based, standing animals, they use very little energy to move or stay in place.



Shoal of fish

What is food security?

Many of us in Canada don't ever need to think about whether or not we will have reliable access to enough affordable, safe, high quality, nutritious food. Compared to many countries, we are a food secure nation. But many other countries around the world are not.

ACTIVITY: FOOD SECURITY

More people around the world are going hungry. There are many global pressures that are making it difficult for people to have access to affordable, good quality food. Some of these pressures include; growing populations, changing weather patterns and storms that damage crops, wasting food, growing crops that can't be eaten (like tobacco), and increasing poverty making it hard for some to afford good food.

Think about what you can do in your home, school or community to help with the problem of food security. Create a poster or pictogram, using the computer, or using paper, cardboard or a chalkboard, to show your ideas. You can share your pictogram with us **on Instagram** - Follow and tag us **@cove_workforce** and use the hashtag **#COVEWI** in your description.



If our plates are mostly full, why should we be concerned with food security?



Scan this QR code to learn more about the UN's sustainable development goals related to food security.



2. Click on this link to see some stats on Global Food Security <http://www.fao.org/state-of-food-security-nutrition>.

WHAT TRADITIONAL KNOWLEDGE CAN TEACH US

Around the world, many Indigenous cultures value sharing food, and value using food sources in completely. This helps to ensure that everyone gets enough, and that they throw away as little as possible. In traditional communities, it is believed that the tribe is healthy only if everyone is healthy!

Indigenous Perspectives on Farming the Ocean

Aquaculture is not a new idea. In traditional cultures around the world, people have been raising and cultivating freshwater and seafood in water-based or land-based farms for hundreds of years. What's new, is how we use technology and western science to become more efficient and careful about how we practice aquaculture.

In Canada, we can learn from practices of our coastal Indigenous Peoples, about how to respectfully, and sustainably, harvest from the ocean. Herring eggs have been a traditional food and source of nutrition for many coastal First Nations for hundreds of years. These Indigenous communities have suspended hemlock or cedar branches in the water near herring spawning grounds. The herring eggs are deposited onto the branches where they can then be lifted and the herring roe peeled off. Cedar branches might not be advanced technology, but it shows how resourceful people can be. Those who harvest the herring eggs know to take some, but not all – it is a lesson for all of us to respect nature and help keep fish stocks balanced. Sustainable practices like this method will help ensure the food source is available for the future as well.



Tla'amin community members harvesting herring eggs in Sliammon, BC. Photo: Roy Francis, 2014 / pacificherring.org

Oolichans – the Saviour fish

- Nicole Morvan, Nisga'a Fish & Wildlife

The oolichan is a fish of many names: eulachon, ooligan, hooligan. It is sometimes called candlefish because it is so high in oil content that when dried it can be fitted with a wick and used as a candle. To scientists it is *Thaleichthys pacificus*. To the Nisga'a it is saak, or the saviour fish.

For thousands of years, the Nisga'a people have harvested oolichan from K'alii-Aksim Lisims, the Nass River. It is their saviour fish, its arrival signaling winter is over and the season of harvest has begun. Both the fish and the oil produced from processing it (t'ilx in Nisga'a) were valuable trading commodities between First Nations communities. Across the pacific northwest, "grease trails" formed where First Nations travelled, carrying their bentwood boxes of t'ilx for trade with other communities, making it one of the earliest examples of what today is referred to as the blue economy.

These tiny but important fish are a good reminder from Indigenous communities, that the small fish matter – perhaps even more than the big fish (*like salmon and tuna and cod*) that we often think of when we talk about food from the ocean.



Nisga'a fishers harvest oolichan through the ice at Fishery Bay. Photo: Nicole Morven.

HOW SCIENCE AND TECHNOLOGY HELP THE BLUE ECONOMY

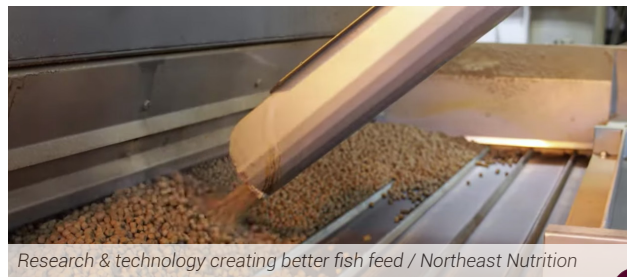
- **Remote sensing technology** is used to know how many fish are in the ocean (*stock management*) so the fishing industry can practice more sustainable fishing and harvesting of wild fish, seafood and sea-plants and avoid over-fishing. Fishtags can also be attached to fish, sea turtles or sea mammals to track where they go and learn more about where they spend their time.



- **Sensors and cameras** are being developed to use in aquaculture to monitor fish and lobster traps to alert the owner when a lobster has been caught (*so they don't waste time and gas boating out to empty traps*)



- Research helps to develop **better feed for the fish** to keep them healthier and to reduce effluent;



- **Deep Trekker remotely operated vehicles (ROV)** are swimming robots that help fish farmers get a look at things underwater. Fish farmers are using them to look at their fish, their nets and anything else they would normally have to scuba dive to. Scuba diving can be dangerous and is very expensive. Deep Trekker ROVs are really easy and fun to operate. Would you like to pilot one?



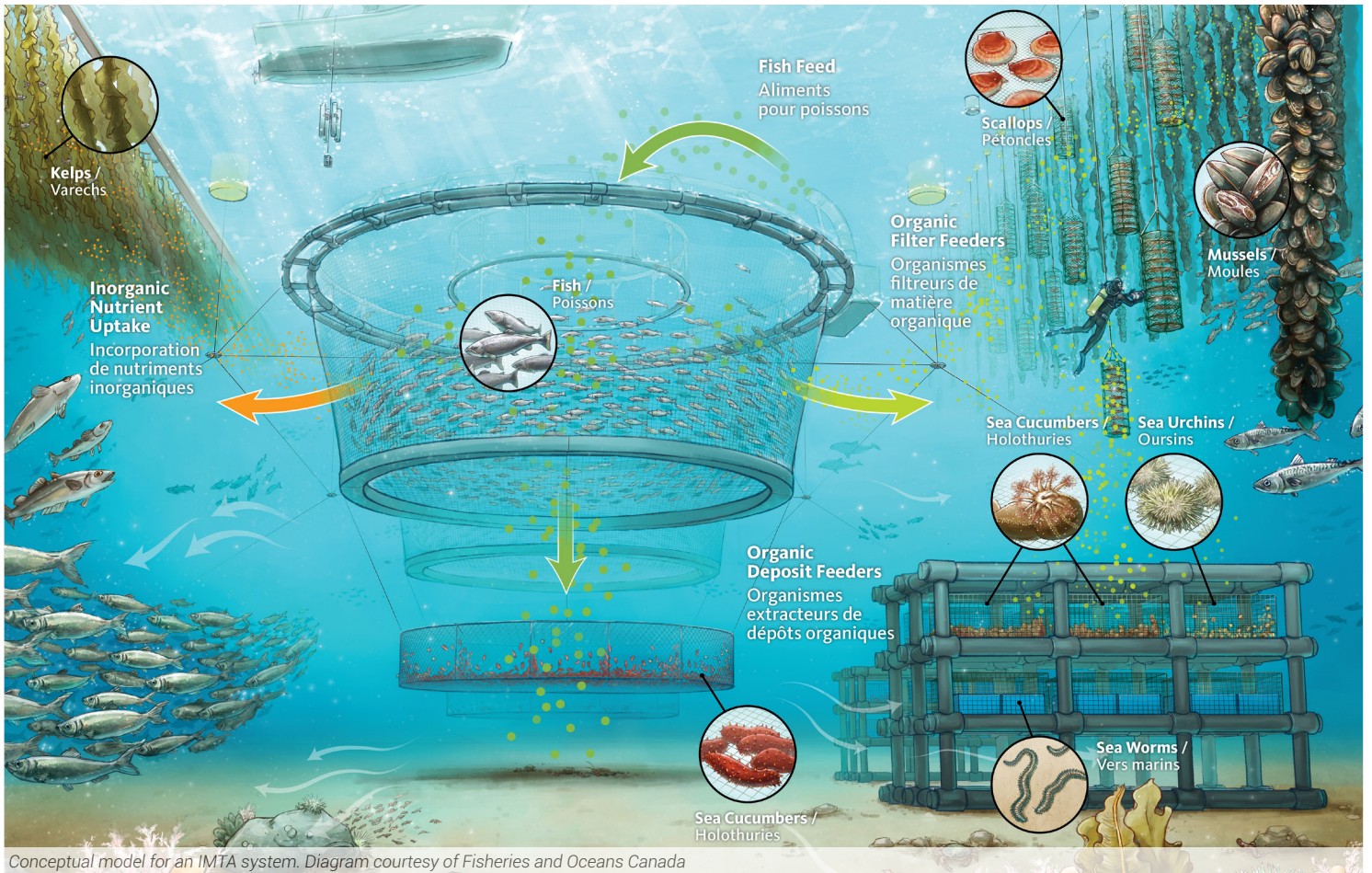
- Research has shown that using far **offshore pens** in aquaculture can allow for better flow of the water to naturally clean up the fish poop and effluent and circulate clean water. It also keeps the beaches and seashores clean and free for other uses like swimming and boating.



INNOVATIONS IN CANADA

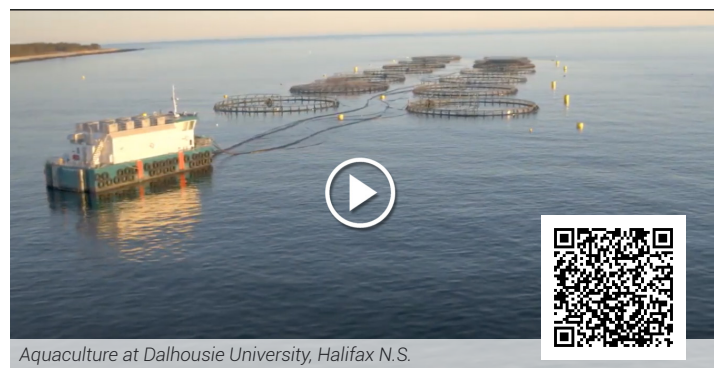
Integrated Multi-trophic Aquaculture³ (IMTA)
 Wow – that’s a fancy term that simply means **farming species together that are from the same food chain**. Researchers and aquaculture technicians are developing more sustainable aquaculture that is based on the idea of closed-loop farming. In the water, it means farming species in combinations that help each other to grow and

to keep their environment in balance. The species that are grown together are decided by normal food chains. One species provides food or benefit for another. For example; fish, algae, oysters. The farmer feeds the salmon, the algae consume the fish waste, the oysters are filter feeders that eat the algae and keep the water environment clean.



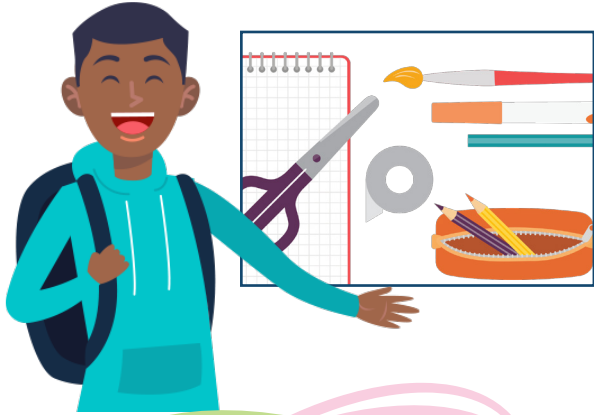
In Canada, IMTA is still being researched because, while it’s a great idea, it is not easy to keep the system in perfect balance. The systems need enough of each species to keep the water clean and to keep each thing fed – but small changes (like temperature, rain, and growth) can throw it out of balance.

Here’s a cool video that can tell you more about IMTA, and why it’s a industry for the future.



3. <https://www.dfo-mpo.gc.ca/videos/imta-amti-eng.html>

DESIGN CHALLENGE



Integrated Multi-trophic aquaculture is sometimes referred to as 'farming a plateful' – you can get a whole, healthy meal from one small farm. Now that's sustainable thinking!

Think about some of the popular fish and seafood (or freshwater) products that we eat and use. Design your own example of a multi-trophic aquaculture system.

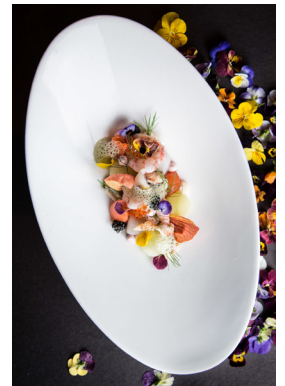
- Include at least three different species that are part of a natural food chain (*may include fish, shellfish, sea plants, bivalves*).
- Do some research to find out what species are part of the same food-chain, and what species help to keep the environment in balance.
- You can decide how to represent your IMTA. (*Hint: you could create a 3D paper terrarium in a shoebox, you could use clay figures in a big plastic pop bottle, you could draw or paint it on paper or on an old cereal box, or you could do your illustration on a computer.*) Take a picture of your work and share it with us [on Instagram](#) - Follow and tag us [@cove_workforce](#) and use the hashtag [#COVEWI](#) in your description.

CAREER PROFILE: CHEF WILL LEW

My journey started when I was very young, at the Vancouver Aquarium. I went there almost every week with my family and learned about many creatures and habitats that exist in our diverse world. I would go to bed dreaming about whales, sharks, and jellyfish. As I grew up, I discovered many passions like playing the violin, music, drawing, painting, and sports, and on weekends I would cook 10-course meals with my grandfather who was a chef. These were my unique passions. Eventually I made it to University where I got a degree in Animal Biology.

So how does one find their dream job connecting all their unique passions?

For me, I started washing dishes at a restaurant. Soon, I discovered that I could combine my interest in creating culinary art, teaching and inspiring others about the science of the ingredients. While working my way up to become a chef, the Vancouver Aquarium created Ocean Wise which was a resource of research and education that helped chefs and consumers learn about the impact of humans on the food chain. Every one of our decisions, big or small, has a direct relation



to how we treat and respect our ocean animals and environments. I was inspired to use my voice and decisions as a chef to tell creative stories through food. Not all sea life is the same - every creature has a purpose and a story. I want to preserve these animals and habitats and their stories for generations to come. And, I want people to appreciate the bounty of the ocean through the stories I tell with creative and artistic food. Together, we can inspire others to understand the importance of sustainability

ACTIVITY:

Are you a budding chef? Tag us [@cove_workforce](#) in a photo of a beautiful plateful that you cook with your family, that uses sustainable seafood. Yum!

FISHING INDUSTRY: CATCHING FISH IN THE WILD

People have been catching and eating fish from the lakes and oceans for hundreds of thousands of years. The ocean is so huge, it seemed it would never run out of fish. But there are so many people on the earth now, who want and need fish and seafood to survive, that we need to find a more sustainable way to catch fish in the wild.

'Ghost equipment' means the nets and other fishing gear that are lost or thrown out into the ocean and become garbage.

We can learn from our mistakes...



MISTAKES:

- over-fishing
- fishing endangered species
- thinking there is an endless supply
- wasteful techniques (blasting)
- huge fishing boats (leave nothing for small companies or individuals to catch)
- fishing for a single species/throwing out the "waste" species that are also caught
- interfering with Indigenous access/rights
- pollution from boats
- large marine life getting tangled in fishing gear
- pollution from "ghost equipment"
- using only 40% of what is caught and disposing of the rest

IMPROVEMENTS:

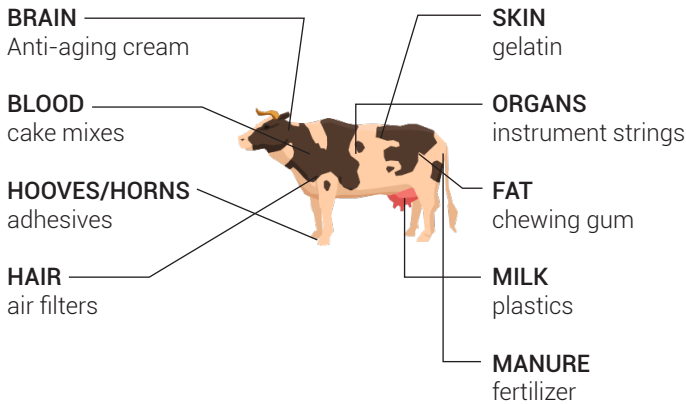
- better catch limits to manage stocks
- enforcing no fishing laws on at-risk species
- researching stock for better information
- making wasteful techniques illegal
- honouring Indigenous fishing rights
- using technology & innovation to recapture "ghost equipment"
- make it more difficult to lose equipment
- using all by-catch species
- using more of the fish & seafood that is caught - doing more with less!

'By-catch' means the fish and sealife that are caught by accident. They are usually thrown out as 'waste'

Watch this cool video to learn how we're using technology to make improvements!



DOING MORE WITH LESS!



We can make better use of what we already harvest from the ocean too— do more with less! Instead of throwing away many parts of the fish or shellfish, we can use their by-products (*like their shells, skin, scales, fat, and other flesh*) to make other useful things.

What in the world are they doing?!

The Icelandic Ocean Cluster⁴ is focused on the future of the ocean. They've figured out how to 'do more with less' meaning that, instead of taking more fish out of the ocean, use more of the fish that they are already catching. Believe it or not, we only use about 40% of the fish that we catch – the rest gets thrown away. But in Iceland, they've figured out how to make use of 100% of the fish, turning the by-products (*what used to be waste*) into new, useful and highvalue products.

⁴ <http://www.sjavarklasinn.is/en/about/>

⁵ <http://www.atlanticleather.is/>

Go into a browser and search 'what can be made with fish by-products'? Create your own illustration to show some of the many uses of fish by-products. Share your image with us on Instagram [here](#). Remember to tag us @cove_workforce

An Icelandic company called Atlantic Leather⁵ is making fashionable and exotic leather out of a surprising source – fishskins!! The fishleather is made from salmon, perch, wolffish and cod. They are taking by-products, or the parts of the fish that would normally be thrown out as waste, and turning it into something beautiful that they can sell. This is economy and ecology acting together. Atlantic Leather is doing more, with less! But this isn't a new innovation – it's actually an old one. The idea came from early Icelanders who made their shoes from wolffish skin! What's old is new again!



"The key is simply to uncover value in waste."

– Gunter Pauli

*The Blue Economy 3.0: The Marriage of Science, Innovation and Entrepreneurship
Creates a New Business Model That Transforms Society*

DESIGN CHALLENGE

In the theme of doing more with less, what could you design using beautiful junk?! Have a look through your recycling for inspiration, and using the clean plastic, paper, aluminum foil, cardboard, etc. design a fashion item, making full use of the materials at hand.

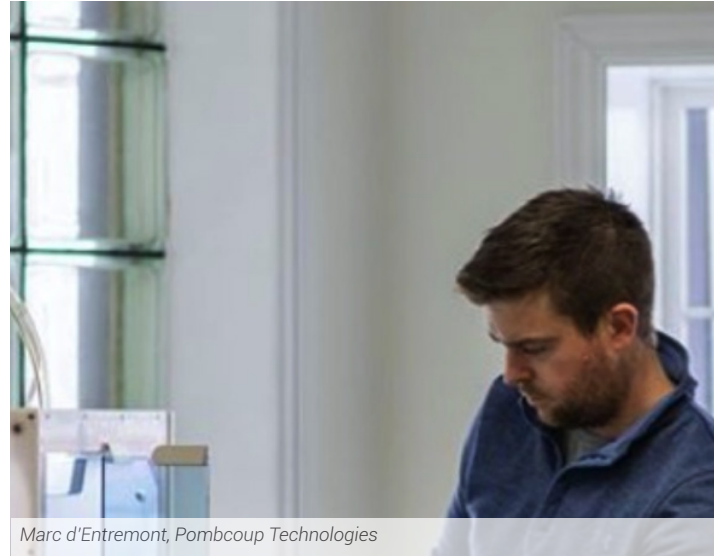
You may want to design a purse, backpack, shoes, boots, hat, jewelry or clothing. Share a picture of your creation with us on Instagram [here](#). Remember to tag us @cove_workforce



INNOVATIONS IN CANADA

Marc d'Entremont, Pombcoup Technologies

"Today, the way we catch fish is very hurtful to the bottom of the sea. There is a large net that the boat pulls, the large net also drags on the bottom of the ocean destroying everything in its path including important corals that create a home for all the fish! Without these homes, the fish will struggle to find food to survive! My company has created a new net that will float above the seabed so it will not disturb the important homes and food source for the fish! I love being an entrepreneur because it gives me the freedom to be creative and to help make a better world and hopefully inspire people like you to do the same!"



Marc d'Entremont, Pombcoup Technologies

WATCH & LEARN

HOW WE'RE LEARNING AND SHARING KNOWLEDGE



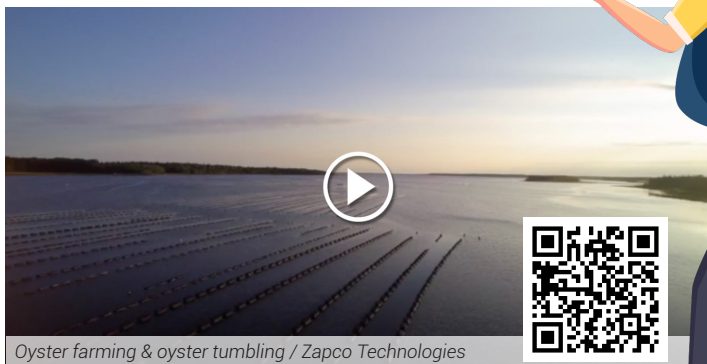
Recirculating aquaculture systems technologies / Pentair



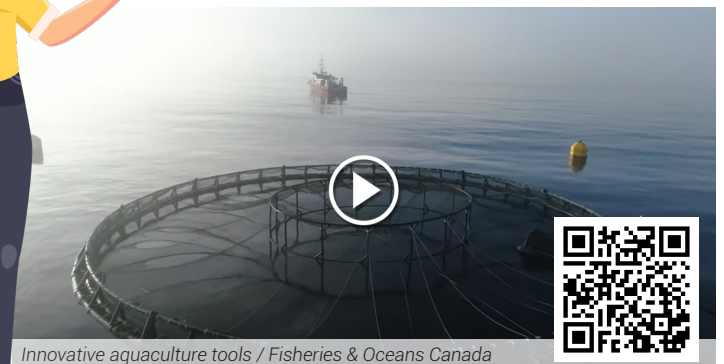
Rethinking fish farming / Rethink Water, Denmark

Some things to think about while you watch:

1. What natural resources do recirculating systems help to sustain?
2. What would happen if we didn't filter the water that fish are being raised in?
3. What are the by-products (waste) of a recirculating system? What can they be used for?
4. How are recirculating systems an example of doing more with less?



Oyster farming & oyster tumbling / Zapco Technologies



Innovative aquaculture tools / Fisheries & Oceans Canada

ACTIVITY: INDUSTRY ANALYSIS

No industry is without its flaws and its advantages. Use your own knowledge, and do some research online or have a discussion with friends or your family, to help you complete an industry analysis chart of traditional fishing and aquaculture (*a few have been done for you*).

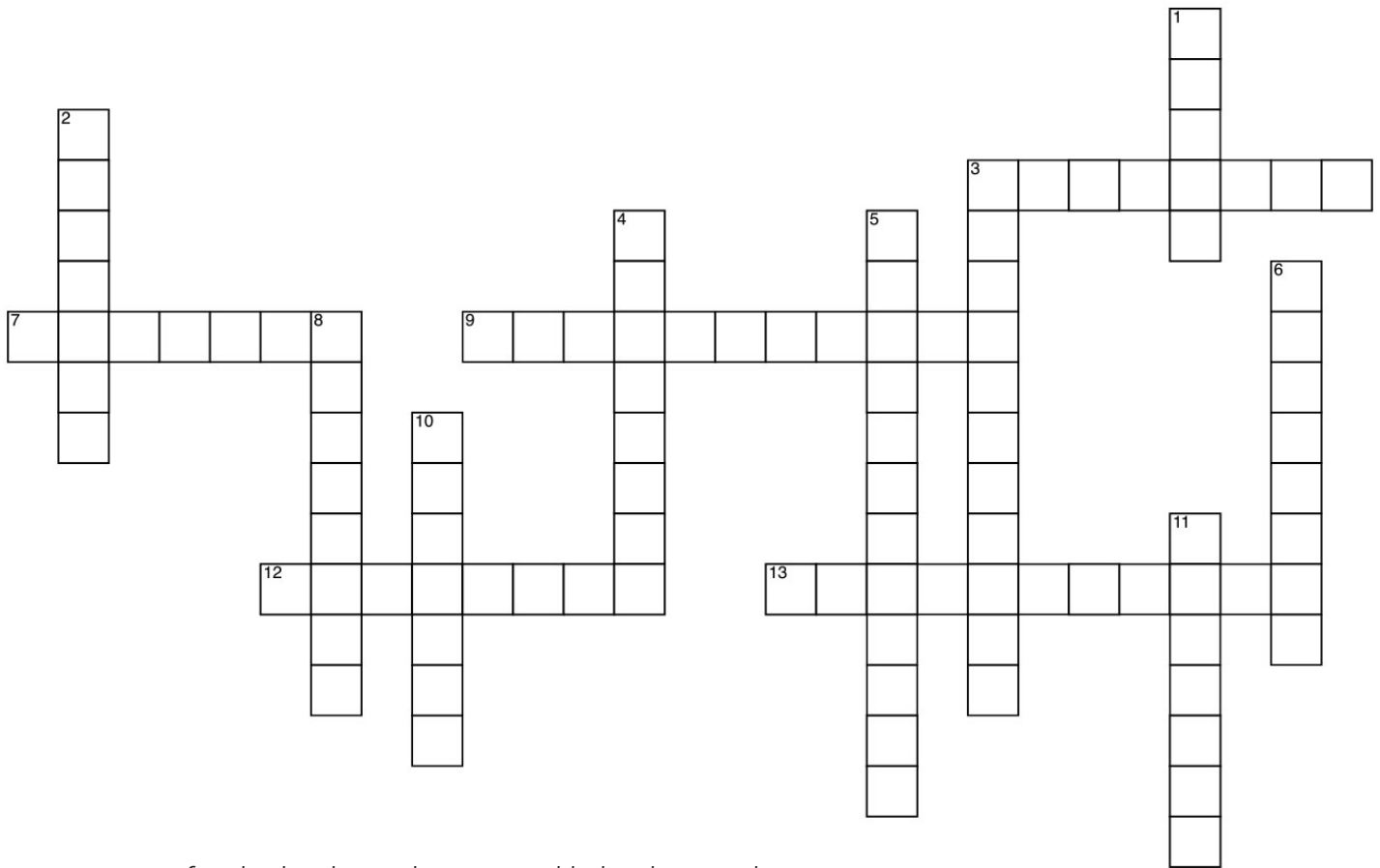
| FLAWS / ADVANTAGES | TRADITIONAL FISHING & HARVESTING | AQUACULTURE |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Environmental Impact | <ul style="list-style-type: none"> • drag nets damage natural ocean habitats and sea floors • fish that are accidentally caught in nets are thrown out (dead) as waste • fishing boats pollute air and water | <ul style="list-style-type: none"> • open-pen systems in the ocean can produce a lot of waste (fish poop and undigested fish food) that are smelly and gross and can raise bacteria levels in the water • fish can escape from open-pen systems and if they are sick, can bring that sickness to wild fish • closed-loop systems can have a positive impact on their environments because they are self-cleaning |
| Providing food for people | | <ul style="list-style-type: none"> • Aquaculture already supplies 50% of all fish eaten, globally |
| Managing fish stocks in the wild | | |
| How it is affected by the warming of the ocean and pollution | <ul style="list-style-type: none"> • Lobster are moving further north to find cooler water | |
| How it is affected by storms and weather changes | | |
| How it helps to provide food to the people who need it most | | |
| How it gets food to people who don't live near the ocean | | |
| How it deals with by-catch (fish and other creatures that are caught by accident) | | <ul style="list-style-type: none"> • There is no by-catch in aquaculture |



Based on your Industry Analysis, what advice would you give to industry to help the industry be more sustainable?



CROSSWORD PUZZLE



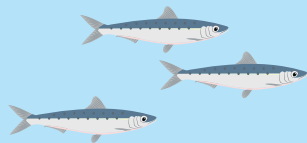
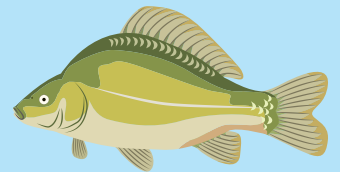
Use a square for the hyphen when a word is hyphenated

ACROSS

- 3 The fish and sea-life that are accidentally caught and thrown out
- 7 Technology that can be used in the water or in a net to sense if something has been caught
- 9 Type of farming that recycles the organic matter back into the system to keep it healthy and balanced
- 12 Technology that can be attached to a fish so we can track where it goes and how it spends its time
- 13 Farming the ocean and other water systems

DOWN

- 1 The one great, salty body of water that the whole earth shares
- 2 A type of sea plant that can be eaten or used in nutraceuticals
- 3 The 'waste' parts of fish that can be used to make other useful things
- 4 Where fish are kept in an aquaculture farm
- 5 Being able to find healthy and affordable food whenever we want it



Across: by-catch, sensors, closed-loop, fishtags, aquaculture
Down: ocean, seaweed, by-products, fishpens, food security

About COVE:

COVE is a world-class facility for applied innovation in the ocean sector and the only such hub of its kind in the world where start-up companies, small and medium sized enterprises, large firms and post-secondary expertise are housed together developing ocean technology. COVE Workforce Initiative focuses on workforce development and engagement in Ocean Industries where youth and teacher engagement is a primary focus. COVE brings together people, ideas, industry and research to help our community and members work in new ways. Together, we are a catalyst in creating the world's next practical, commercial and revolutionary ocean tech advances. Irving Shipbuilding, as part of its Value Proposition commitments under the National Shipbuilding Strategy (NSS), has invested over \$6 million in COVE to support development of the programs and operations. Learn more about COVE, our projects and our members at coveocean.com



Irving Shipbuilding, Inc.

Jim Hanlon, CEO of COVE

As the son of a navy commander, I developed a curiosity for the ocean from a very young age. When I was just 5 or 6, we were living in Victoria, BC, where my father was stationed, and he took me down to the port and showed me a jet-powered catamaran! It was amazing – and my attention was grabbed. I eventually became an electrical engineer, and while I could work in any industry, the ocean was where I saw the most interesting opportunities. For years I lived and worked around other ocean tech entrepreneurs, and eventually I bought my first ocean tech business in my late 30's. Now, at COVE, I help other ocean entrepreneurs to start and build their businesses. I still find it fascinating – this is an industry for the curious and inventive – it's an industry where people with many different skills can come together because the issues and opportunities of the ocean are so intertwined, so untouched compared with other industries. And COVE is a place where other ocean entrepreneurs come to bring their ideas to life.



COVE WORKFORCE INITIATIVE - BLUE ECONOMY TEACHING RESOURCE
Prepared by the Centre for Ocean Ventures and Entrepreneurship (COVE)
Written by Dr. Sherry Scully, Content developed by Anna Naylor
Layout & Graphic Design, Maria Gallagher / inkbottledesign.com

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Dr. Sherry Scully swimming with nurse sharks, Belize.



**Author: Dr. Sherry Scully, Executive Director
COVE Workforce Initiative**

The first time I saw the ocean in real life I was 9 years old. I had grown up hundreds of kilometers from the coastline but a family vacation took me to the beaches of the Pacific. I was nervous at first about stepping into the waves. I had seen enough shark movies to feel certain that the ocean was a deep and dark pool of biting teeth and stinging tentacles and slithering serpents. But, my curiosity won out over my imagination and I tugged on a mask and snorkel and bravely waded in.

I felt the pull of the tide at my feet drawing me deeper. I fitted the snorkel onto my face, squeezed my eyes shut, and dipped my face down for a first breath beneath water – and was surprised when my lungs filled with cool air. The snorkel worked! And then I opened my eyes...

I saw sea grass dancing slowly, I saw fish – so many fish – all around me. And what really struck me was the quiet. All I could hear were my own slow deep breaths. Bubbles floated gracefully past my face. I saw nothing scary. No teeth. No stinging tentacles. Nothing slithered. It was an aquamarine scene of calmness. It was a whole new world that I had never been aware of. And in that moment – I was hooked. I knew I wanted to explore the mysteries of this great water-world.

Content Developer: Anna Naylor, COVE

I once was asked to think about a place where I felt the most relaxed and at peace. Without hesitation, I knew it was being in the ocean watching and observing a whole other world. When you are underwater, you realize how small you are in the larger ecosystem. You see all the other animals and plants who have evolved to spectacularly survive in the ocean. You learn that the ocean holds so much history, science and opportunities and we have so much yet to discover! The ocean has always been my favourite place, and as I got older I knew I wanted it to be part of my career so I could share my passion about it and get others just as excited as me.



Anna Naylor doing a handstand while scuba diving