An Educational Unit for Primary Schools

Jeepers Creepers Salmon Leapers

Level

5-6

Curriculum Area

Design and Technology

Print Resource

Rationale

This resource material aims to help teachers and students in primary schools investigate and understand more about primary industries in Australia.

The objectives of the educational resources are to:

- Support Primary Industries Education Foundation Australia and its members in expanding awareness about primary industries in Australia by engaging and informing teachers and students about the role and importance of primary industries in the Australian economy, environment and wider community.
- Provide resources, which help build leadership skills amongst teachers and students in communicating about food and fibre production and primary industries in Australia.

- Develop educational resources that can be used across Australia to provide encouragement, information and practical teaching advice that will support efforts to teach about food and fibre production and the primary industries sector.
- Demonstrate to students that everyone can consider careers in primary industries and along the supply chain of food and fibre products.
- Develop engaging learning programs using an inquiry process aligned with the Australian Curriculum.
- Develop in school communities, an integrated primary industries education program that emphasises the relationship between food and fibre industries, individuals, communities, the environment and our economy. These educational resources are an effort to provide practical support to teachers and students learning about food and fibre production and primary industries in schools.

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About the approach

Several key principles underpin the theoretical and practical application to this unit. Students are guided to:

- Search for information using both digital and non-digital means
- Use research techniques and strategies
- Use thinking and analysis techniques
- Present findings to a real audience, and
- Reflect both on the product created and the process undertaken.

Rather than seeing knowledge as something that is taught, the emphasis in this unit is on knowledge and understanding that is learned. The unit involves students in:

- Working from a basis of their prior knowledge and experience
- Seeing a real task or purpose for their learning
- Being directly involved in gathering information firsthand
- Constructing their knowledge in different ways
- Presenting their learning to a real audience
- Reflecting on their learning.

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Resource description

This unit of study will investigate the technology used to grow fish, with a focus on Salmon. The health and nutritional benefits of eating fish are reported widely in the scientific literature. To meet increasing demands of human consumption, fish are grown in managed environments. Salmon farming or 'ranching' will be used as a context to investigate how they are best suited to be grown in the Tasmanian environment, to produce a quality product for consumption.
This unit will provide students with the opportunity to investigate an industry challenge and use design and technology to produce an innovative solution. Design will form major part of this learning experience.

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Curriculum focus

Students will:

- Investigate technological developments that have been applied to fish farming to improve yield and sustainability
- Investigate the supply chain of all elements that go in to producing salmon, 'pen to plate'
- Design and/or create a model using technology to create a solution to an industry based challenge
- Present these models or designs to an audience following the study
- Explore the nutritional benefits of consuming salmon

Based on Australian Curriculum, Assessment and Reporting Authority (ACARA) materials downloaded from the Australian Curriculum website in February 2015. ACARA does not endorse any changes that have been made to the Australian Curriculum.

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Australian Curriculum content descriptors

Year 5/6 Design and Technologies:

Knowledge and Understanding

Investigate how and why food and fibre are produced in managed environments and prepared to enable people to grow and be healthy **(ACTDEK021)**

Generate, develop and communicate design ideas and processes for audiences using appropriate technical terms and graphical representation techniques **(ACTDEP025)**

Develop project plans that include consideration of resources when making designed solutions individually and collaboratively **(ACTDEP028)**

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Other Curriculum Capabilities/Priorities

General Capabilities

Literacy

This resource incorporates the two overarching processes of literacy: Comprehending texts through listening, reading and viewing; and Composing texts through speaking, writing and creating.

Numeracy

On the numeracy learning continuum, students will apply their understanding of patterns and relationships when solving problems in authentic contexts. In this resource students will recognise that mathematics is constantly used outside the mathematics classroom and that numerate people apply general mathematical skills in a wide range of familiar and unfamiliar situations.

Sustainability

OI.8: Designing action for sustainability requires an evaluation of past practices, the assessment of scientific and technological developments, and balanced judgments based on projected future economic, social and environmental impacts.

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Using this unit

This resource can be used in a number of ways. It will be of most benefit to teachers who wish to implement the sustained sequence of activities that follow the learning experiences around the content descriptors in year 5 and 6 Design and Technologies in the Australian Curriculum.

You may add to or complement the suggested activities with ideas of your own activities or investigations.

The resources have been designed as a hyperlinked unit. This is to provide you with a digital format for your class's use on a website or wiki or provide them on your interactive whiteboard.

We encourage you to explore ways in which the content can be adjusted to the context in which you are working.

Resource sheets are provided for some activities. Most are for photocopying and distribution to students.

The resource sheets are designed to assist teachers to facilitate learning without having to access a range of other resources.

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Complementary VR Experience

This resource has supporting VR experience that complements the learning objectives of this topic. The VR experiences are represented throughout the resource. To access the VR experiences it is best to download the FarmVR app on your mobile device.

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Industry Contacts

Fisheries Research and Development Corporation http://frdc.com.au/ (http://frdc.com.au/)

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Assessment

The unit provides an opportunity for a range of skills and understandings to be observed. In particular, through the design process and model development. Students are provided an opportunity to assess their peers at the conclusion of the learning experience.

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Length of Unit

This will depend on your school program and classrooms particular circumstances but generally; a few weeks to a term are suggested.

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Learning Sequence

Learning Experience	Activities	Summary
1 1 x 60min lesson	Students will: ▪ Develop a salmon industry inputs/outputs mind map ▪ Understand the mind map as the basis for a life cycle analysis ▪ Develop a list of the technology used at different stages of the salmon life cycle	Investigate how and why food and fibre are produced in managed environments
2 1 x 60min lesson	Students will: ▪ Review the life cycles of both farmed and wild salmon ▪ Identify and make a comparison of the differences between wild and farmed life cycles of the salmon ▪ Understand the timings of both the wild and farmed salmon life cycles	Explore the growth and survival of salmon, affected by the physical conditions of their environment

3 6 x 60min lesson	Students will: ▪ Choose a design challenge (Pen design or ROV) ▪ Using a design process method go through the steps of creating a solution (either a theoretical model or a working model) ▪ Present their design solutions and then re-work and make improvements to their design	Generate, develop and communicate design ideas, creating a design solution either individually or collaboratively.
4 1 x 60min lesson	Students will: ▪ Understand the health benefits of eating sustainably produced salmon ▪ Use salmon to create a healthy meal	Investigate how and why food and fibre are produced in managed environments and prepared to enable people to grow and be healthy

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Teacher Background

In 2010 the Australian Council for Educational Research conducted a food and fibre survey with students in Year 6, Year 10, and Teachers. This survey was written as a report in 2011, called 'Food, fibre and the future'.
While the majority of teachers who responded to the surveys indicated that teaching students about food and fibre production was important, levels of familiarity with issues related to Primary Industries were not high, particularly in Fisheries.
Fisheries, in particular, appears to be an area in which teachers do not feel knowledgeable, with around 20% of teachers surveyed indicating that they were unfamiliar with any issues in the industry.

Grade 10 students were presented with several seafood species and asked to select which of these were farmed in Australia. All of these seafood species are currently farmed in Australia.

- 26% of students identified that eels were farmed.
- 82% of students identified that barramundi were farmed.
- 27% of students identified that salmon were farmed.
- 84% of students identified that prawns were farmed.
- 80% of students identified that oysters were farmed.

While the majority of Grade 10 students were able to identify barramundi, prawns and oysters as species that are farmed in Australia, only around one in four students were aware that salmon and eels are also farmed.

This survey has provided some insight as to the knowledge gaps in primary industries education and how these gaps may be bridged with educational resources such as this one.

Australian Fisheries overview

The Australian Government ensures Commonwealth fisheries are managed sustainably for the benefit of all Australians.

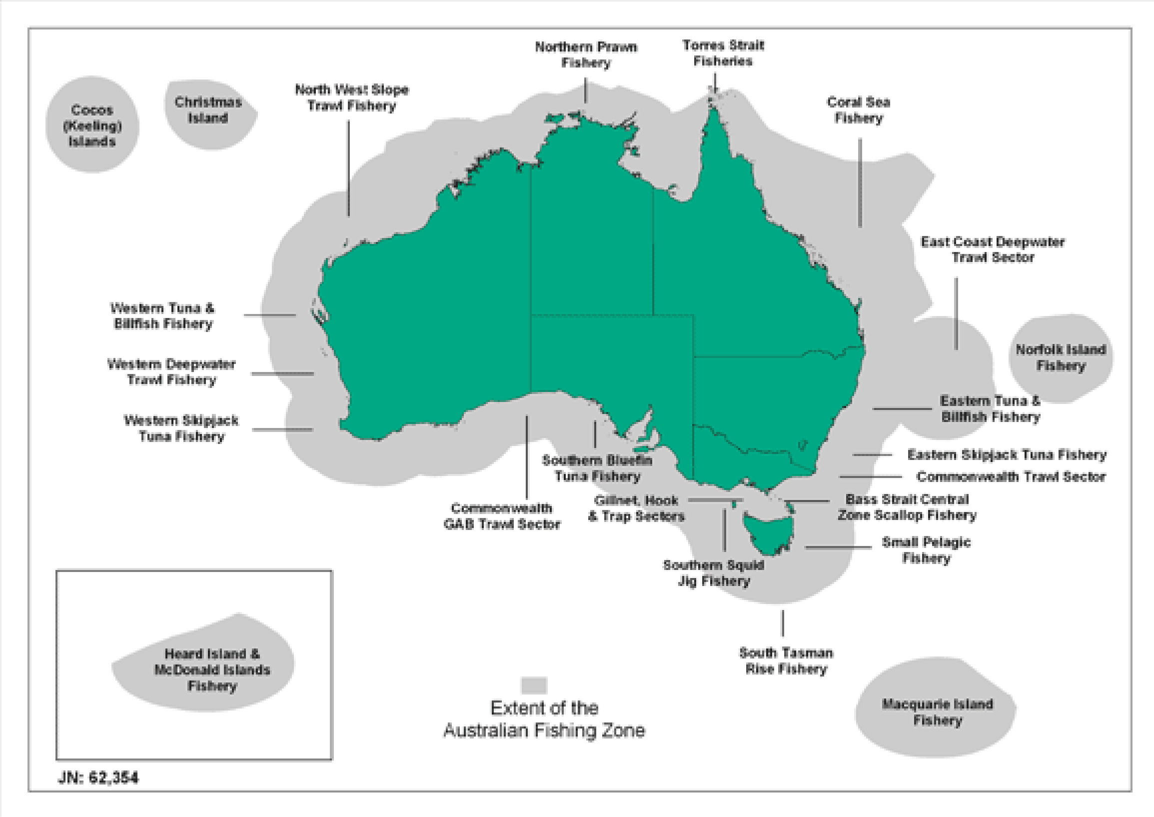
Fisheries are managed under the Australian Government Department of Agriculture and Water Resources. Australian produces a range of seafood products. These include approximately:

- 600 commercial species
- 1000 recreational species and
- 100 species from aquaculture

On a global scale Australia is a minor player in the seafood industry producing less that 0.15% of global seafood. Australia is a net importer of fisheries and aquaculture products, and since 2007/08 the gap between the value of fisheries and aquaculture products imported and exported has widened.

Commercial fishing is the harvesting of wild fish. Aquaculture is the raising of fish for harvest under controlled conditions.

The Australian Government manages commercial fisheries within the Australian Fishing Zone (which generally extends from three to 200 nautical miles off the coast), as well as the activities of Australian-flagged fishing vessels operating on the high seas.



Source: http://www.agriculture.gov.au/fisheries/domestic/managing-australian-fisheries (http://www.agriculture.gov.au/fisheries/domestic/managing-australian-fisheries)

A focus on Aquaculture

Aquaculture is defined by the United Nations Food and Agriculture Organisation as 'the farming of aquatic organisms including fish, molluscs, crustaceans and aquatic plants with some sort of intervention in the rearing processes to enhance production, such as regular stocking, feeding and protection from predators'.

There are various stages of aquaculture operations including:

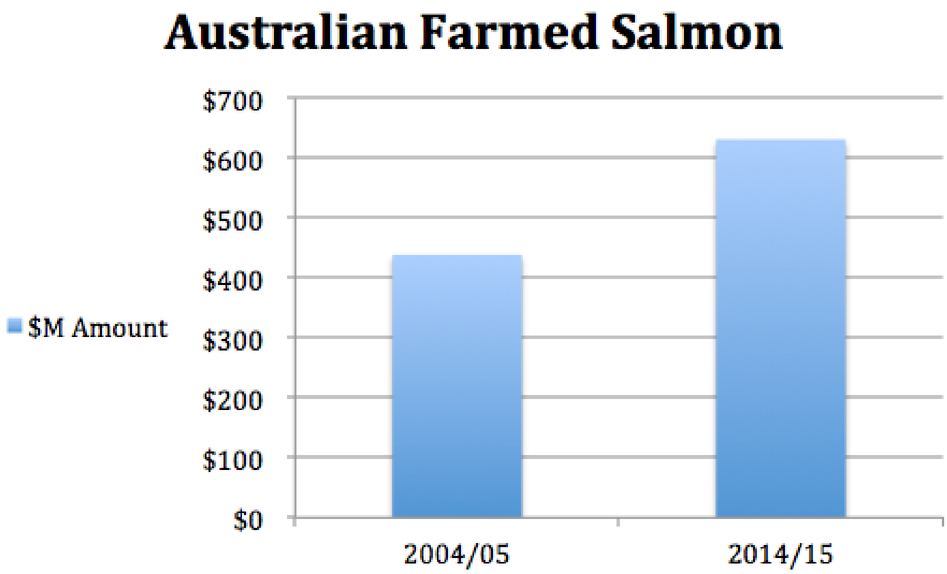
- a hatchery operation which produces fertilised eggs, larvae or fingerlings
- a nursery operation which nurses small larvae to fingerlings or juveniles
- a grow-out operation which farms fingerlings or juveniles to marketable sizes.

Depending on the species being farmed, aquaculture can be carried out in freshwater, brackish water or marine water. There are a number of different systems that can be used for aquaculture, including ponds, tanks, pens and floating cages.

Aquaculture can be extensive, semi-intensive or intensive, depending on the level of input and output per farming area and the stocking density. Intensive aquaculture involves intervention in the growing process, such as with supplemental feeding and water aeration (such as salmon or prawn farming), whereas extensive aquaculture allows the stock to grow on its own, using natural food sources and conditions (such as oyster farming).

Aquaculture can also be operated with other agriculture activities forming an integrated aquaculture–agriculture system. An example of an integrated aquaculture–agriculture system is the farming of fish in a rice field, or an aquaponic system.

Trends in Aquaculture



As a result, Tasmania became the largest Australian producer by value of fisheries and aquaculture products during this period, accounting for 30 per cent of gross value of productionin 2014–15, up from 16 per cent in 2004–05.

Other aquaculture sectors that grew significantly in real terms over this period:

- Prawn (up $20 million),
- Barramundi (up $17 million) and
- Abalone (up $12 million).

The volume of farmed aquaculture products grew at an average annual rate of5% from 2004–05 to reach 89,217 tonnes by 2014–15. Farmed salmonids drove most of this growth, growing by 185 per cent (up 31 551 tonnes) in this period, accounting for 74 per cent of growth in the volume of aquaculture products.

Since 2005, exports of Australia's fisheries and aquaculture products have shifted from Japan, to Hong Kong, China, and Vietnam region with the major export product being rock lobster. Between 2004/05 and 2014/15 Australians consumption of seafood has increased at an average annual rate of 1.2%.

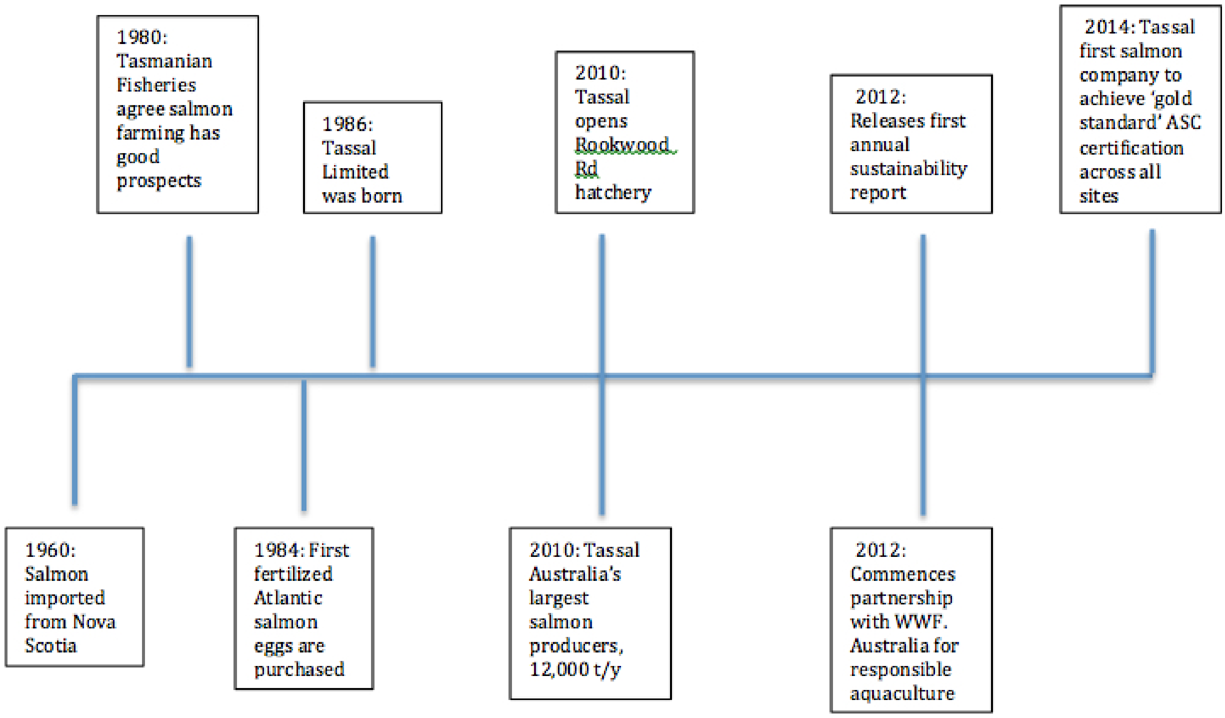
Comparison of actual and projected aquaculture production

Product	2006-2007 Production tonnes	2014-2015 Projection [1] tonnes	2014-2015 Production tonnes	Looking forward	2021-2022 Projection [2] tonnes
Fish					
Salmon and trout	25,253	40,000	48,614	Growth has continued with improved production from existing areas. This is expected to continue at similar rates and may accelerate if additional farming areas, likely to be offshore, are established.	60,000
Tuna	7,486	13,000	8,418	Tuna growth predicted in 2008 was based on a strategy to ranch fish for longer, growing them to a larger size, which would increase overall tonnage. This did not eventuate. No major increase likely other than from slight increases in quotas, allowing more fish to be ranched.	7,500
Silver Perch	322	361	314	Silver Perch likely to continue at similar levels.	350
Barramundi	2,590	7,000	3,772	Barramundi is likely to see more growth in production in the next few years due to new farms and expanded area on existing farms. Growth in production after industry consolidation and improved farming efficiency has already seen good growth, with preliminary estimates putting 2016 production at about 6000 tonnes.	8,000
Yellowtail Kingfish		5,000	1,200	Trials in Western Australia and New South Wales with more favourable growing conditions are expected to increase commercial production in 3-5 years. CleanSeas Tuna in South Australia also plans to increase its current 1200 tonnes production.	5,000
Other (including Kingfish)	450	397	484	Includes: Murray Cod, Cobia, Tropical Groupers. NSW in particular has seen significant growth in Murray Cod production. Cobia and Tropical Groupers may see some growth in coming years with potential new entrants and investment in RD&E through the new and emerging aquaculture subprogram.	600
TOTAL	36,101	65,758	62,802		81,450

Source: FISH, Volume 24, Number 4, December 2016, pg 14. [http://www.frdc.com.au/Media-and-Publications/FISH (http://www.frdc.com.au/Media-and-Publications/FISH)](http://www.frdc.com.au/Media-and-Publications/FISH)

About Tassal

Tassal are the largest producers of Salmon out of the 4 companies operating in Tasmania. Tassal grow Atlantic Salmon, Salmo salar, originating from Nova Scotia in Canada in the 1960's. This is the Tassal timeline for working with salmon:



Source: Modified from http://www.tassal.com.au/our-history/ (http://www.tassal.com.au/our-history/)

Tassal recognises that responsible salmon farming requires the understanding and best practice management of the environment and ecological impacts on biodiversity. Tassal use sophisticated modelling and monitoring programs in collaboration with research groups such as CSIRO and Institute for Marine and Antarctic Science (IMAS), to investigate changes on farm and off farm sites to monitor water quality enabling adaptive farm management, and invest in further research into this area.

The salmon industry is strictly monitored and follows the guidelines of the Aquaculture Stewardship Council requirements. Weblink: https://www.asc-aqua.org/what-we-do/our-standards/farm-standards/the-salmon-standard/ (https://www.asc-aqua.org/what-we-do/our-standards/farm-standards/the-salmon-standard/)

Under Principle 2 of the Aquaculture Stewardship (ASC) requirements, Tassal are required to address potential impacts from farming operations on biodiversity and ecosystem function. The criteria focus on benthic impacts, siting, effects of chemical inputs and effects of nutrient loading. In response to the criteria, Tassal have conducted Biodiversity Focused Environmental Impact Assessments (BFEIA) for all of grow out leases.

The assessments include habitat and species that could be reasonably impacted by the farm and incorporate:

- The identification of proximity to critical, sensitive or protected habitats and species

- The identification of potential impacts the farm might have on biodiversity with a focus on those habitats and species, and
- A description of strategies and programs to eliminate or minimise any identified impacts.

As with other food producing industries, Tassal is researching how to sustainably increase production through improved efficiencies. An increase in production does not necessarily require a matching increase in footprint (marine lease space). Tassal have already achieved significant production gains through improved animal husbandry, fish health, wildlife exclusion and selective breeding. The future for the sustainable production of salmon is with emerging and innovative technologies in engineering, selective breeding, and fish welfare. In comparison to other land based farming, salmon is one of the lowest carbon footprint proteins available, with one of the lowest rates of freshwater consumption per kilogram of production. Salmon has one of the highest feed input to growth conversion rates (1.35 to 1), with around 65kg salmon produced for every 100kg feed, compared to an equivalent 13kg of pork and 20kg of poultry.

Terminology:

Egg: unfertilised ovum

Embryo: after fertilisation, before hatching

Alevin: after hatching, before emergence from the gravel, not freely swimming

Fry: newly emerged juvenile, rearing in freshwater, freely swimming

Parr: juvenile, rearing in freshwater, dark pigment banding on body

Smolt: transitional stage to the marine form

Jack: mature male younger than the females

Redd: nest, including one or more egg pockets

Anadromous fish: born in fresh water, then living in sea-water for most of its life, before returning to fresh water to spawn.

Adaptations:

- any alteration in the structure or function of an organism or any of its parts that results from natural selection and by which the organism becomes better fitted to survive and multiply in its environment.
- a form or structure modified to fit a changed environment.
- the ability of a species to survive in a particular ecological niche, especially because of alterations of form or behaviour brought about through natural selection.

References:

Australian Fisheries information:

http://data.daff.gov.au/data/warehouse/9aam/afstad9aamd003/2015/AustFishAquacStats_2015

_v1.0.0.pdf
(http://data.daff.gov.au/data/warehouse/9aam/afstad9aamd003/2015/AustFishAquacStats_2015
_v1.0.0.pdf)

A focus on aquaculture: http://www.agriculture.gov.au/fisheries/aquaculture
(http://www.agriculture.gov.au/fisheries/aquaculture)

Trends in Aquaculture:
http://data.daff.gov.au/data/warehouse/9aam/afstad9aamd003/2015/AustFishAquacStats_2015
_v1.0.0.pdf
(http://data.daff.gov.au/data/warehouse/9aam/afstad9aamd003/2015/AustFishAquacStats_2015
_v1.0.0.pdf)

Terminology:
http://courses.washington.edu/fish450/Lecture%20PDFs/salmon%20introduction.pdf
(http://courses.washington.edu/fish450/Lecture%20PDFs/salmon%20introduction.pdf)
http://www.dictionary.com/browse/adaptation (http://www.dictionary.com/browse/adaptation)

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Learning Experience 1

Lesson overview

This learning experience will allow students to understand how salmon are farmed in a managed environment.

Lesson outcomes

Students will:

- Discuss their prior knowledge of salmon farming
- Understand what happens at the different stages of the salmon life cycle
- Develop a concept map of what do salmon need to be farmed

Teacher Background information

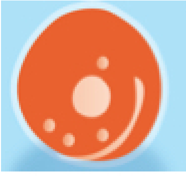
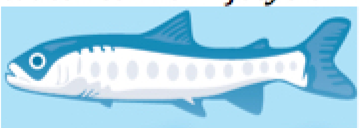
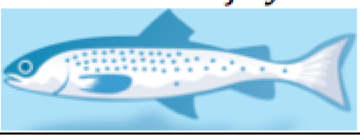
Farmed fish offer a reliable source of protein. With seafood consumption increasing in Australia annually by 1.2%, salmon is an efficient source of protein. It also offers other health benefits including a rich source of Omega 3 (higher than other common terrestrial based protein sources), and other vitamins and minerals.

The following section describes how farmed salmon is produced and found in your supermarket fridge.

Salmon are a fish that can be farmed, growing best in cooler waters (~8-20oC, but ideally 14-16oC). In Australia, Salmon are predominantly farmed in Tasmania, with a smaller operation in South Australia.

Farmed salmon start their life in a hatchery. Salmon farming in recent years have used selective breeding programs, with salmon selected for certain traits, including resistance to diseases, such as Amoebic Gill Disease, overall health and growth.

Salmon farming is an intensive operation, with high labour and scientific input especially in the first year of life. All of the following stages of the salmon life cycle are in water, and they are unique in that their life cycle sees them move from fresh water to salt water. Salmon grow in fresh water from egg to just when they change to smolt (approximately 1 year), and then when salmon have developed in to the smolt stage, they are moved to a salt-water environment, to finish growing (approximately 18-months).

Tassal Salmon Life cycle	What happens at the Tassal hatchery and sea cages?
Eggs/Embryos *Watch Salmon lifecycle: 1* 	Selective breeding to produce fertilised embryos. 'Green eggs' are what salmon start out as, they become 'eyed eggs' when a dark spot appears. The 'eyed eggs' are an embryo at this stage. Embryos are kept in fresh water Embryos are kept in the dark at approximately 8°C They hatch after approximately 6 weeks
Alevin *Watch Salmon lifecycle: 1* 	After embryos hatch, they become Alevins Alevins have a yolk sack which they feed on for approximately 6 weeks (no food at this stage) Alevins stay in fresh water with a temperature of about 11°C
Fry *Watch salmon lifecycle: 2*  	Fry are moved in to larger fresh water tanks They are introduced to feeding on small pellets The water temperature of Fry increases from 12°C to 14°C. Fry have 24hrs of light for 3 months Fry grow from about 2cm up to 10cm, when they are considered Parr
Parr *Watch salmon lifecycle: 2*  	Fry grow into Parr Pellet size of the salmon feed increases in size with salmon Parr start to have light changes especially 10weeks prior to moving to next stage. Parr are exposed to 10hours of light, and then 14hours of darkness
Parr to Smolt *Watch salmon lifecycle: 3* 	To test if Parr have become smolt a small sample of salmon are taken out of fresh water, and placed in salt water. After an hour in salt water, their blood is tested to see if they have become smolt
Smolt to adult *Watch salmon lifecycle: 4* 	Smolt spend up to 2 years in sea water growing to their adult weight of approximately 5.5kg Salmon feed is delivered via a spinning pipe Salmon feed increases in size as the salmons mouth grows in size Seawater is varies in temperature from 8.5°C - 20°C

The water is checked daily when the salmon are embryos and as Alevins for Oxygen saturation and ammonia. In the first 12 weeks, there is little waste because the embryos and Alevins are not feeding on anything, relying on their yolk-sac energy reserves.

From the fry stage onwards, the water needs to be closely monitored. The water filtration system for Fry and Parr is quite specialised. The water is tested daily and is continually filtered every 45 minutes. The water is tested for the following:

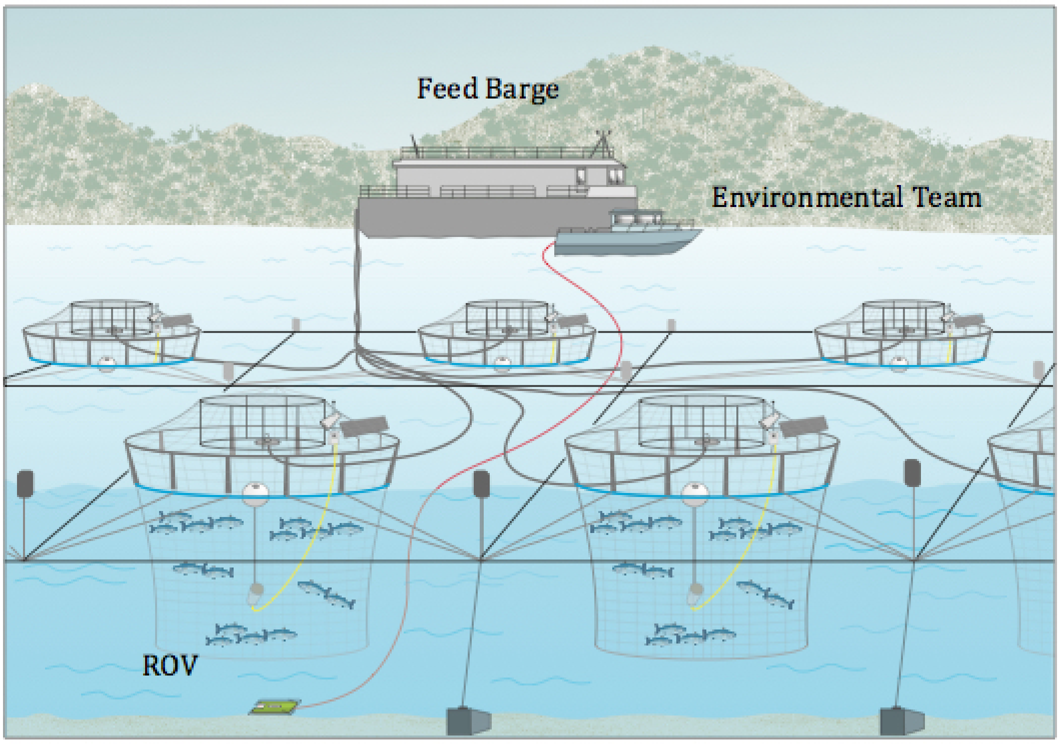
- Dissolved oxygen
- Ammonia
- Nitrate
- Nitrite
- CO2
- Heavy metals

All solid waste from the Salmon (at Fry and Parr stages) are collected continually, with the solid waste being converted onsite to a product that will then form part of an agricultural fertiliser. Water recirculation technology at the hatchery ensures that 99% of bore water is filtered and re-used each day.

At sea, the water quality is tested every two weeks in summer and monthly during winter. These are the things they are testing in the water:

- Nitrogen
- Nutrients
- Algae and Phytoplankton (microscopic organisms, that convert nutrients and light into energy (photosynthesis) like plants)
- Salinity
- Turbidity (water clarity)

Feed is delivered to each salmon sea cage via pipes from a central feed barge. Each sea cage contains 2 cameras (1 above water and 1 at approx. 5m depth). This camera vision is sent to monitors at the feeding station where the feeder observes fish feeding response to minimise feed waste and maximise fish growth.



All salmon are fed using feed that is size appropriate for their mouth gait (how wide their mouth opens). Pellet size increases as the salmon grows and the mouth gait grows wider.

Advantages to farming salmon

- Salmon in sea circle have reduced stressed, as they are not under natural threat of survival from predators.
- Healthy and efficient growth from egg to adult
- Excellent survival rates
- Reducing pressure on wild caught fisheries
- Employment
- Community participation
- Local providence – knowing where your food comes from

Equipment:

- Print worksheet 1 and 2
- Plickers – download app, and print answer cards for students
- Kahoot – download app, and enter questions into program
- 3 x Large print out (A3 or bigger) of salmon
- Print Tassal processing salmon worksheet
- Ipad and/or Virtual Reality Goggles
- Download Farm VR

- Download VR experiences:

  - Salmon Lifecycle : 1. Egg to Embryo to Alevin

  - Salmon Lifecycle : 2. Fry and Parr

  - Salmon Lifecycle : 3. Smolt

  - Salmon Lifecycle : 4. Smolt to Adult

  - Salmon Weighing

  - Salmon Hatchery Water Treatment

Student worksheet 1 (pdf/Tassal/Resource 2/2. Student worksheet 1_Tassal Salmon processing.pdf)

Student worksheet 2 (pdf/Tassal/Resource 2/3. Student worksheet 2_Concept map Salmon.pdf)

Student worksheet 1 - Answer Ex1 (pdf/Tassal/Resource 2/4. Worksheet 2 Ex 1.jpeg)

Student worksheet 1 - Answer Ex2 (pdf/Tassal/Resource 2/5. Worksheet 2 Ex 2.jpeg)

Session 1

Lesson steps

1. Discuss with the students about salmon farming. In the discussion gain an understanding from the students what they understand about salmon farming
2. Using the following questions set up an interactive quiz about what they know. You can either develop the questionnaire on an app like 'Plickers' or 'Kahoot' which are quiz apps that you can use with your class. Alternatively you can set the quiz so that the students will answer using 'head, bottom, knees' signals.

   NB: Plickers is great with classes if they don't have mobile phone

   Questions:

   a. Can salmon that we eat be farmed? (Yes, No, Don't know)

   b. Do salmon live in fresh water? (Yes, No, Don't know)

   c. Do salmon live in salt water? (Yes, No, Don't know)

   d. The natural diet of a salmon is meat? (Yes, No, Don't know)

   e. Farmed salmon take 1 year to reach adult? (Yes, No, Don't know)

   f. When salmon are Alevins they do not need to eat? (Yes, No, Don't know)

   g. Salmon eat food pellets at all lifecycle stages when they are farmed? (Yes, No, Don't know)

   h. Salmon like to live in warm water (above 20 deg C) (Yes, No, Don't know)

i. Salmon have special adaptations that allow them to live in both fresh and salt water (Yes, No, Don't know)

j. Salmon get the pink colour in their meat from what they eat? (Yes, No, Don't know)

k. Salmon have the highest amount of edible meat to eat compared to chicken and pork (Yes, No, Don't know)

l. Salmon do not have teeth (Yes, No, Don't know)

3. Read the above background information and provide the students with worksheet 1 about Tassal Salmon processing. At each of the stages of the life cycle, provide the student with time to watch the VR video.
4. Using worksheet 2 ask the students to brainstorm and develop a concept map of 'what do salmon need to be farmed?'

Supporting resources:

http://www.miramichisalmon.ca/education/atlantic-salmon/ (http://www.miramichisalmon.ca/education/atlantic-salmon/)

http://www.asf.ca/life-cycle.html (http://www.asf.ca/life-cycle.html)

https://www.marine.ie/Home/site-area/areas-activity/fisheries-ecosystems/salmon-life-cycle (https://www.marine.ie/Home/site-area/areas-activity/fisheries-ecosystems/salmon-life-cycle)

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Learning Experience 2

Lesson overview

This learning experience will provide students with an ability to understand the salmon industry inputs and outputs, and develop a basic life cycle analysis.

Lesson outcomes

Students will:

- Develop a salmon industry inputs/outputs mind map
- Understand and develop a simple life cycle analysis for salmon
- Develop a list of the technology used at different stages of the salmon life cycle

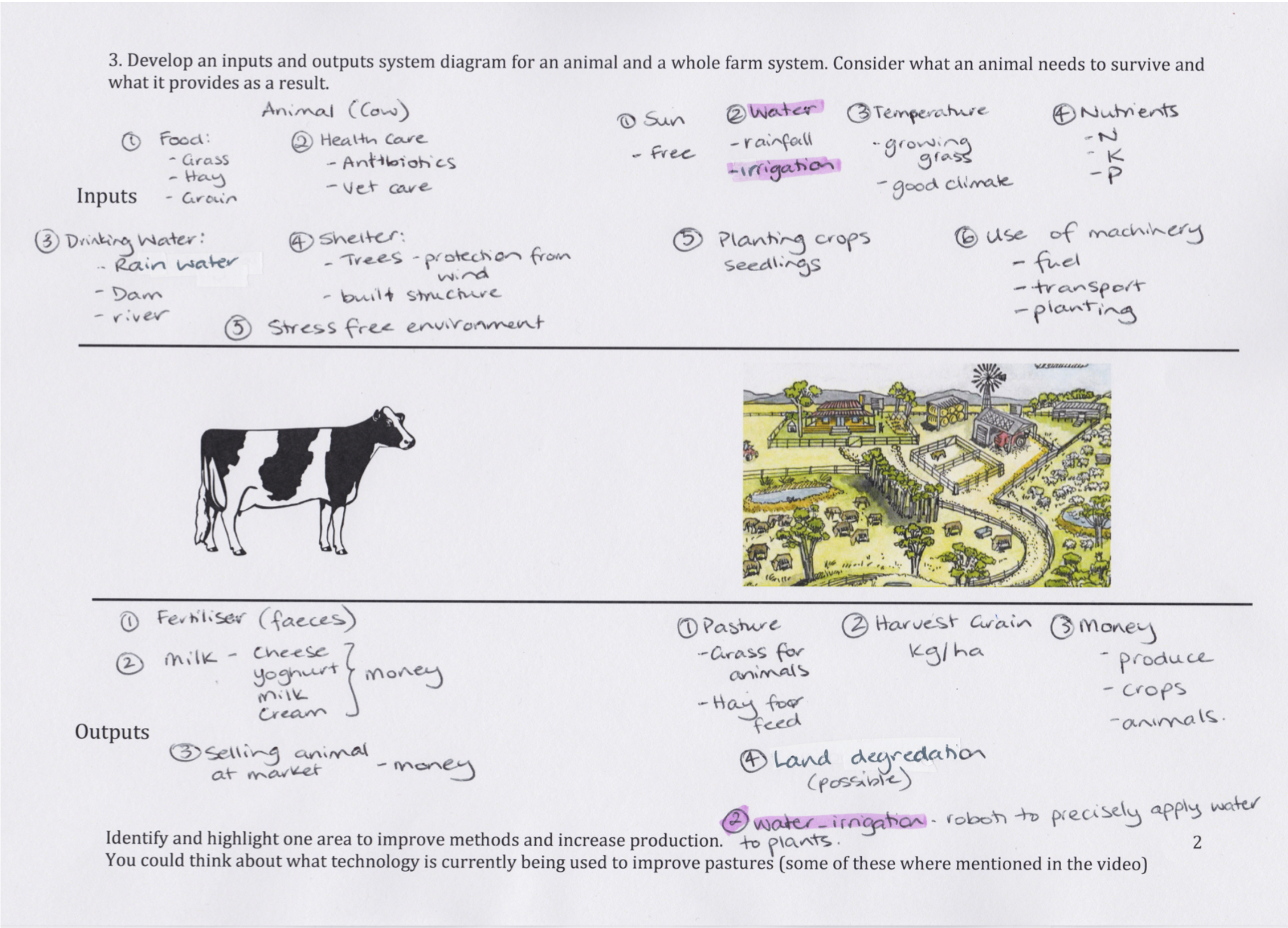
Teacher Background information

To produce any of our food and fibre, there are inputs and outputs. When we analyse the effects of these inputs and outputs, it is called a 'life cycle analysis'. This is looking at a product from 'pen to plate', and in the case of salmon egg to plate.

Life cycle analysis enables industries to identify inputs and outputs associated with growing the product. This is a valuable tool for industries to see how they are managing their resource and identify possible areas that can be improved. These improvements may come in following areas:

- Economical (money, employment/salaries)
- Environmental (techniques use to farm, changes to inputs for a positive effect, improved animal welfare) or
- Social (employment, community morale, lifestyle)

Here is an example of a basic dairy cow and farm life cycle analysis:



Equipment:

Cow lifecycle analysis (pdf/Tassal/Resource 2/6. Cow life cycle analysis example.pdf)

- Print Tassal feed input (pdf/Tassal/Resource 2/7. Tassal Feed Inputs infographic.jpg)

Download Worksheet 3 (pdf/Tassal/Resource 2/8. Student worksheet 3 Salmon LCA.pdf) out of cow and farm life cycle analysis (1 between 2)

- Print out of ‘Tassal Feed input’ infographic (1 between 2)
- Print out student **worksheet 3**
- Internet
- IPad and/or Virtual Reality Goggles
- Download Farm VR
- Download VR experiences:

  - Salmon Hatchery Water Treatment

Lesson steps

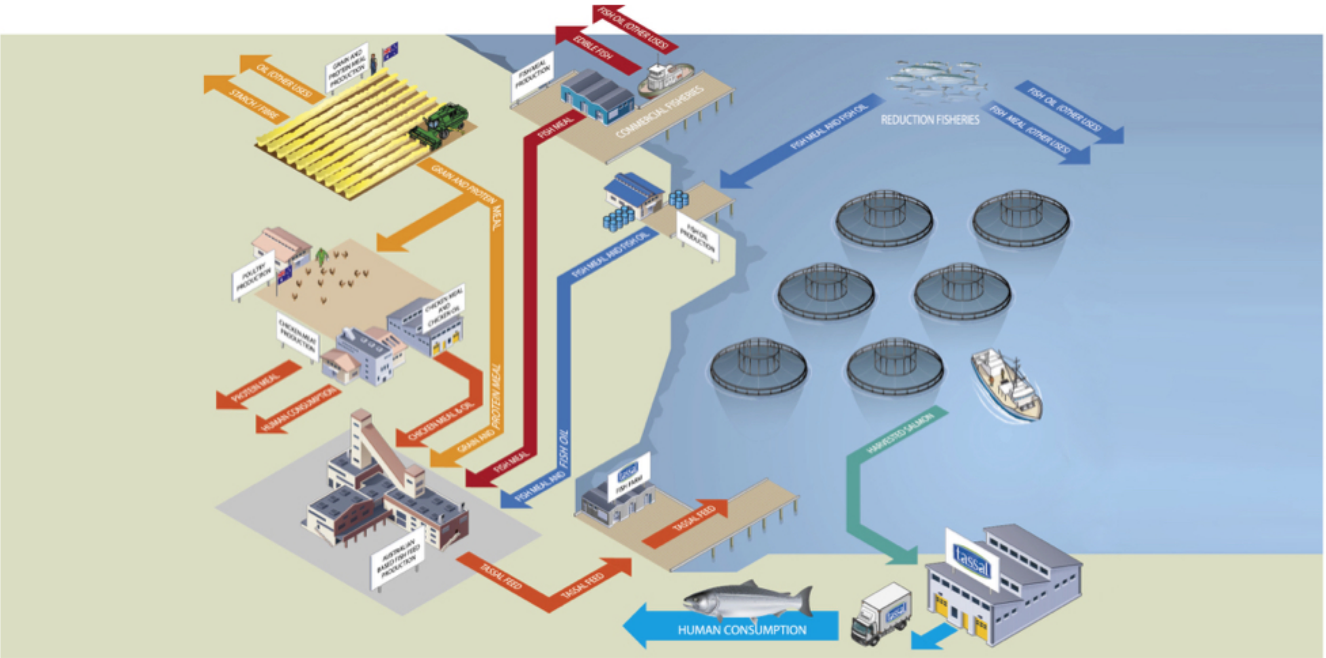
1. Review with the students what salmon need to survive on a salmon farm
2. Provide an opportunity for students to view the Salmon Hatchery Water Treatment VR experience
3. Provide the students with a copy of the ‘Feed input’ infographic
4. Review the diagram and get students to identify on the diagram all the inputs to salmon feed.
5. Ask the following questions: a. What is needed to produce chicken meal? Think about environmental, human and economic inputs

   b. What is needed to produce grain? Think about environmental, human and economic inputs

   c. What is needed to produce fish oil? Think about environmental, human and economic inputs
6. In pairs ask the students to complete student worksheet 3
7. With the students discuss the technological side of salmon farming. What do they understand are the technological aspects of salmon farming?

   a. Ask the students about the technology at different stages of the life cycle

   b. Have the students fill in the table



Poultry Production	***Grain and Protein meal production***	***Commercial fisheries***	***Reduction Fisheries***	***Tassal Salmon***
Chicken meal Chicken oil Protein Meal	Grain and protein meal Oil Starch fibre	Fish oil Edible fish Fish meal	Fish oil Fish meal	Tassal feed Harvested salmon

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Learning Experience 3

Lesson overview

This lesson experience will provide students with the opportunity to develop and design a model. The students will be able to choose between two industry challenges, and provide some technical solutions.

Lesson outcomes

Students will:

- Choose a design challenge (Pen design or Remotely Operated Vehicle (ROV))
- Using a design process method go through the steps of creating a solution (either a theoretical model or a working model)
- Present their design solutions and then re-work and make improvements to their design

Teacher Background information

This unit of work is to investigate how and why food and fibre are produced in managed environments. The key to this curriculum area is that we are looking at food and fibre in a ‘managed environment’. Within all managed environments whether it be a cattle farm, a carrot farm, or a salmon farm, there are inputs and outputs that have to be managed to ensure the sustainable production of the end product. As with each of the above mentioned managed environments there are challenges to ensuring a quality product is produced in an environmentally sustainable way.

Tassal is dedicated in sourcing alternative technologies that consider the environmental benefit, fish welfare, carbon footprint, commercial viability and human safety. Science, innovation and design will play an important role in the continuing improvements to the salmon industry.

The first section of the background information describes two design challenges students can choose from to design or create a model based on the information provided. The second part of the background information describes the design process that students will undertake to create or design the model to provide a solution.

Two design challenges

1. Pen design

Just like when farming cattle, pigs, or some other land-based animals, when farming salmon, you need to be able to contain the individual somehow. Salmon need to be housed in water, and needs both fresh and salt water at different times of their life.

For salmon producers, Tassal, the welfare of both the salmon and the marine mammals and birds that interact with the farms are of critical importance. Tassal have a Wildlife Management System (WMS) that encompasses bird and marine mammal strategies for all marine operations.

The WMS has a focus on reducing detrimental outcomes that include:

- Injury to wildlife adversely affected by Tassal farming operations that result in close interactions or contact
- Potential injury to Tassal employees, contractors, and visitors when undertaking day to day activities on Tassal Marine leases, and
- Attacks on fish pens causing loss of fish, reduced growth rates and damage to equipment, which affects the profitability of the operation.

Tassal have reported a higher number of male seals visiting the sea cages compared to female seals (due to natural migration from the north to the south of Tasmania overlapping the breeding season, as well as general increases in Australian Fur Seal populations). This may be something to consider in designing a solution.

What does Tassal do to limit or deter seal interactions?

1. Relocation of problem seals (approved locations under wildlife regulation and permits)
2. Improve on previous net technology and design to prevent seal interaction with salmon and people

Finally, to try and reduce interactions, seals are physically kept away from Salmon through use of nets. Nets are continually being improved and include:

- good strength netting
- heavily weighted netting
- Small mesh size (115mm) to prevent seals entering cages
- Removal of any salmon mortalities to reduce attraction to seals

Tassal has set about to try and limit the interactions and impacts of farming between the salmon, wildlife and humans. Part of this is in the on-going research and innovation in pen design. Tassal is implementing its latest technology pen design across all operational areas impacted by seal incursion in-line with its zero-harm policy.

2. ROV (remotely operated vehicle) for underwater in Sea cages

The Tasmanian salmon industry and Tassal has a long history of compliance with environmental regulation. The use of ROV is one area in which monitoring is being assisted with the use of new technologies. The future of ROV has great potential, going beyond camera recording and monitoring of benthic zones, but moving into the collection and analysis of samples and environmental data. The following information is taken from the Tassal sustainability report (pg35) on the use of the ROV:

All video work is carried out using a Remote Operated Vehicle (ROV) by Tassal's dedicated environmental team. Tassal also contributes data obtained through ROV surveys to collaborative projects with industry and research institutions, as well as the Environmental Protection Authority (EPA) - the industry's independent regulatory authority. Recent work focuses on sediment characterisation around different farming regions, including differentiating between Tasmania's south east and western Salmon growing regions to gain an understanding of how the current visual component of the benthic regulation needs to be modified to suit the unique biophysical conditions of Macquarie Harbour.

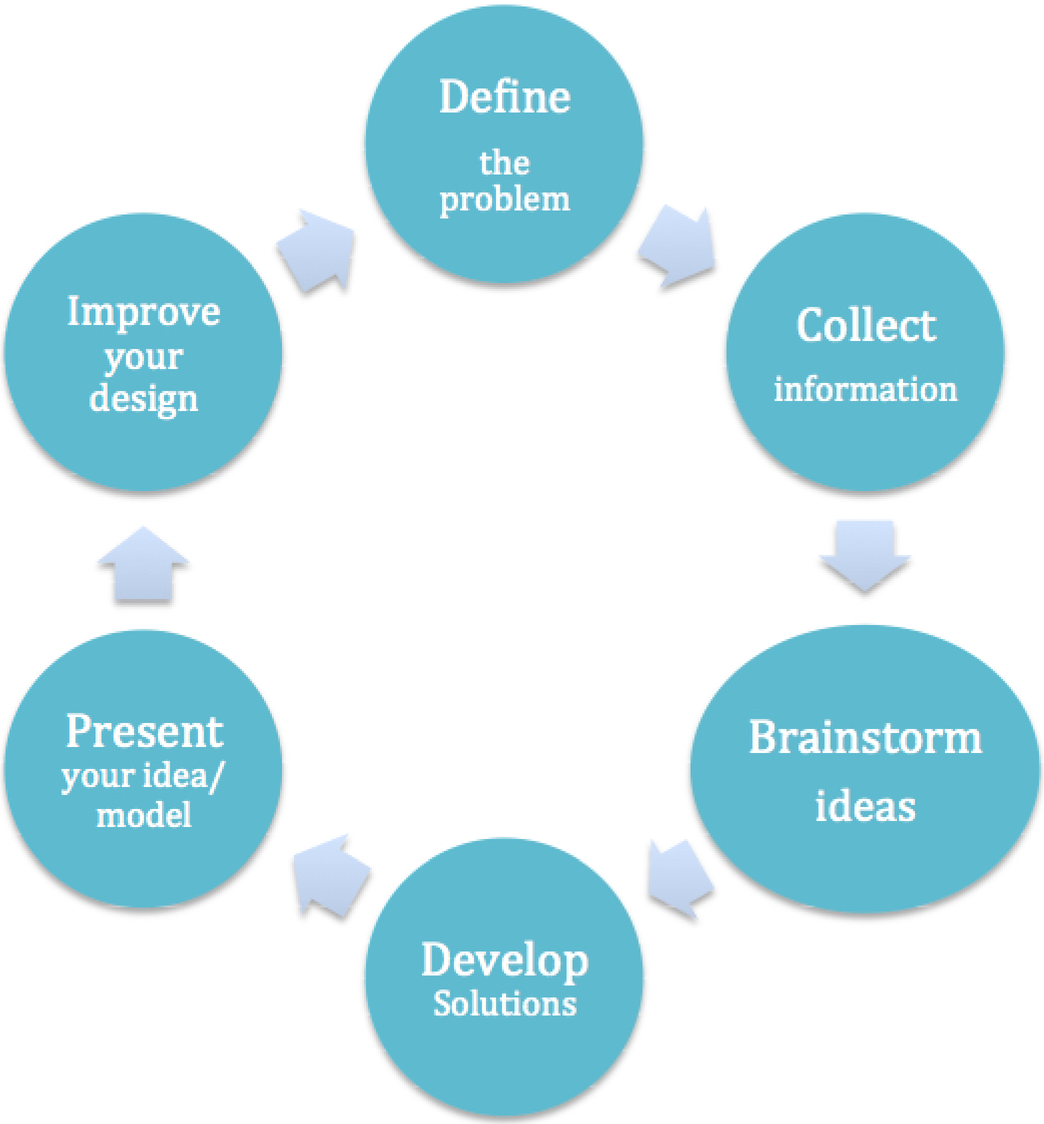
Tassal conducts ROV work in line with current regulation requirements and uses this information in combination with netwash, feed inputs, stocking and fallowing data. Internal intermediate survey work is also conducted. This work informs Tassal's adaptive management of farming leases in changing environmental conditions.

The Design Process

The Design Process is a flexible and adaptable tool that utilises a systematic approach, or process to collaboratively generate ideas and formulate a plan of action.

Widely used in lots of challenging situations, the Design Process provides an objective formula to apply to any challenge. It is an iterative process of design-test-redesign until students reach a satisfactory solution. It enables innovative approaches to a range of situations and can be adapted to suit any group of participants.

The value of the process is that it applies objectivity to problem-solving at any level. The 'empathising stage' is a vital step in the process. It ensures that the needs of the end-user are identified and are carefully considered in the development of the prototype further along in the process.



Design challenge teacher notes (pdf/Tassal/Resource 2/Design Challenge Teacher Notes.pdf)

P - Designing a salmon pen (pdf/Tassal/Resource 2/Salmon_Farming_Booklet.pdf)

I - Designing a salmon pen (pdf/Tassal/Resource 2/salmon_farming_interactive.pdf)

P - Designing an underwater ROV (pdf/Tassal/Resource 2/ROV_Leaper_Solution_Booklet.pdf)

I - Designing an underwater ROV (pdf/Tassal/Resource 2/Leaper_Solution_interactive.pdf)

Equipment:

- Download Design Challenge Teacher Notes
- Workbook (Printable (P) or Interactive (I)):
  1. Designing a salmon pen
  2. Designing a ROV for environmental monitoring at sea
- Sustainability report (For ROV design challenge: Environmental section)
- IPad and/or Virtual Reality Goggles
- IPad
- Download Farm VR
- Download VR experiences: - Salmon Sea Pens: Introduction to Shepherds Lease

  - Salmon Sea Pens: Diver Experience

  - Salmon Environmental Monitoring Experience

Lesson steps

1. Provide an opportunity for students to view the following VR experiences:

   - Salmon Sea Pens: Introduction to Shepherds Lease

   - Salmon Sea Pens : Diver Experience

   - Salmon Environmental Monitoring Experience
2. Discuss with the students the two 'challenge' ideas

   a. Design a method to reduce the interaction between salmon and seals

   OR

   b. Design a ROV to measure and monitor environmental parameters at sea.
3. Ask the students to divide into groups of 2-4 (depending on the design challenge they wish to take on.
4. Provide students with a workbook for their design challenge.
5. Use the 'Design Challenge Teacher Notes' as a guide to assisting the students with the design challenge they have chosen.

6. Explain what you would like the students to present at the end of the design challenge.
   a. Time constraints:
   i. You might have time to develop a full model
   ii. If you are time poor, then it might be a conceptual model/sketch with details of how it would work
7. Each design challenge is provided in the workbooks with the steps in the design process outlined. Explain each of the steps to the class.

Problem	There is a problem – try and understand it. Try and look at the problem from all different angles
Collect	Start to research and collect information about the problem. Look at the information from all the angles outlined in the problem section
Brainstorm	No idea is silly! Using the information you have collected, brainstorm all options to provide possible solutions to the problem
Develop Solutions	Design away The design may be a theoretical or a model/actual solution to the problem
Present	Using a model/drawings present the solution to your peers Each student will have a feedback sheet to provide you with their comments
Improve	After receiving feedback, incorporate ideas and improve your design

Supporting resources

This resource is a good resource for active learning methods to help students in the 'brainstorming' stage:

http://www.nicurriculum.org.uk/docs/key_stage_3/altm-ks3.pdf (http://www.nicurriculum.org.uk/docs/key_stage_3/altm-ks3.pdf)

Links to robotic information

These are resources to review in order to direct your students to developing a model robot for underwater monitoring.

Education Services Australia supporting teachers of digital technologies:

https://www.digitaltechnologieshub.edu.au/ (https://www.digitaltechnologieshub.edu.au/)

First Lego League usually have a theme or topic each year:

https://firstaustralia.org/programs/first-lego-league/ (https://firstaustralia.org/programs/first-lego-league/)

Code club Australia: https://codeclubprojects.org/en-GB/ (https://codeclubprojects.org/en-GB/)

(resources) https://codeclubau.org/ (https://codeclubau.org/)(General info)

Project orientated educational initiative that supports robotic events in Australia:

http://www.robocupjunior.org.au/home (http://www.robocupjunior.org.au/home)

The University of Adelaide's CSER project will loan robots out (Australia wide) as part of their lending library:http://csermoocs.adelaide.edu.au/library/ (http://csermoocs.adelaide.edu.au/library/)

Datta Vic has a large amount of resources:http://www.datta.vic.edu.au/content/resources (http://www.datta.vic.edu.au/content/resources)

STEM Activities: http://stem-works.com/activities (http://stem-works.com/activities)

Scootle: https://www.scootle.edu.au/ec/p/home (https://www.scootle.edu.au/ec/p/home)

Videos to inspire: http://www.vea.com.au/secondary-school/design-and-technology.html#?op=-availableDate&ro=false&st=Program:true,Package:true&p=0 (http://www.vea.com.au/secondary-school/design-and-technology.html#?op=-availableDate&ro=false&st=Program:true,Package:true&p=0) (Targeted at secondary students, but they may inspire

ABC Splash is great: http://splash.abc.net.au/home#!/stem (http://splash.abc.net.au/home#!/stem)

Damien Kee is a technology education expert with great resources for teachers and students: http://www.damienkee.com/home/2011/8/20/domabot-classroom-robot-design.html (http://www.damienkee.com/home/2011/8/20/domabot-classroom-robot-design.html)

Have a look at the following resources:
Chapter 4 http://splash.abc.net.au/home#!/digibook/2351782/robots-in-the-present (http://splash.abc.net.au/home#!/digibook/2351782/robots-in-the-present)
http://splash.abc.net.au/home#!/media/2269214/using-mechatronics-to-build-a-robot-fish (http://splash.abc.net.au/home#!/media/2269214/using-mechatronics-to-build-a-robot-fish)

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Learning Experience 4

Lesson overview

This lesson experience will provide students with the opportunity to enjoying the healthy part of producing salmon

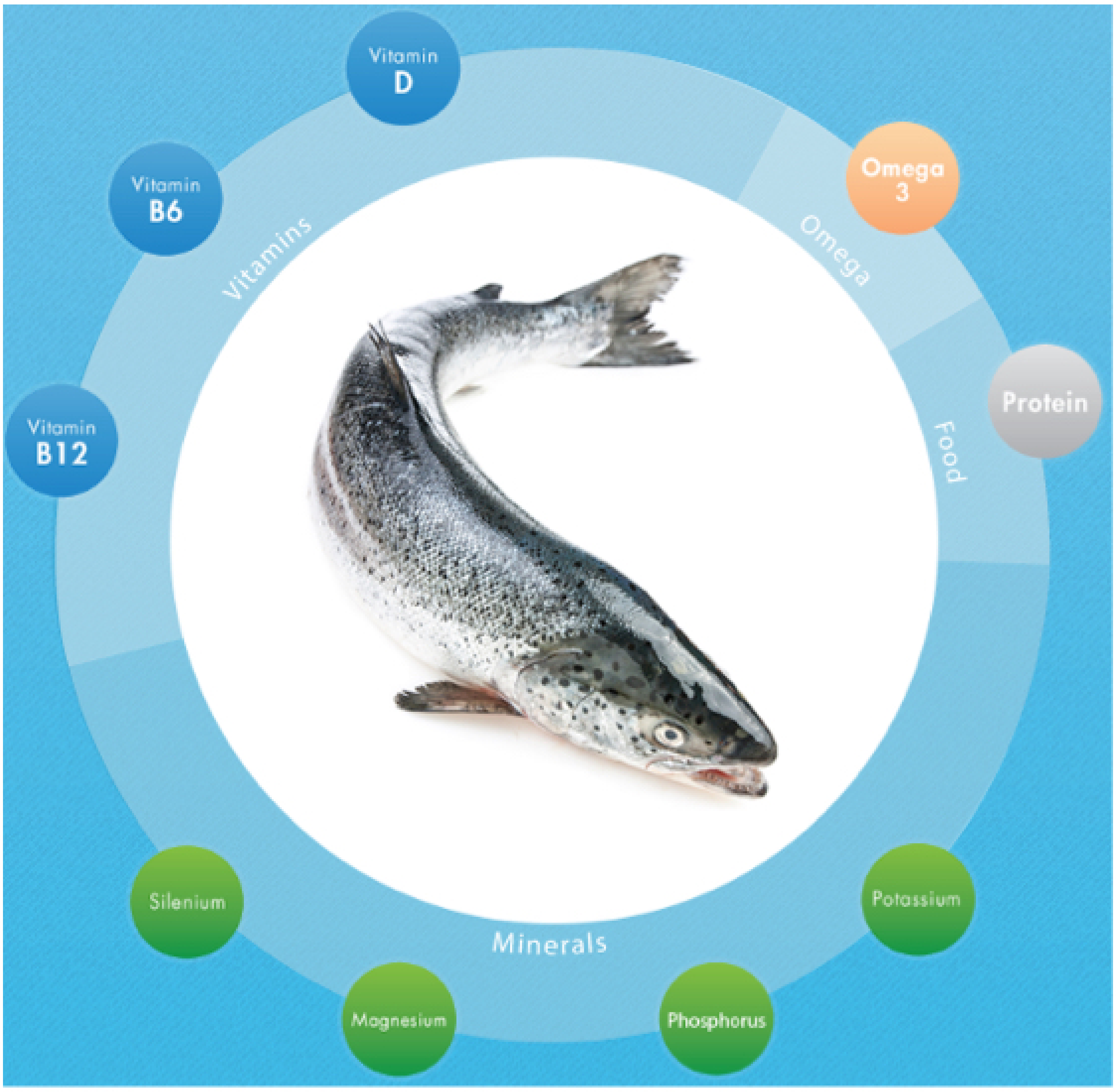
Lesson outcomes

Students will:

- Understand the health benefits of eating sustainably produced salmon
- Use salmon to create a healthy meal

Teacher Background information

Salmon Health Benefits Atlantic Salmon grown in Tasmania is a highly nutritious food. A 150g salmon portion provides you with a good source of essential fatty acids, protein, vitamins and minerals (B3, B12, E, phosphorus and selenium). It is also a source of anti-oxidants (vitamin D), magnesium and vitamin B1 all of which are vital ingredients for a healthy balanced diet.



Salmon while being a healthy choice is also an excellent source of protein, high in Omega 3 (EPA & DHA), ideal for the whole family. Just three 150g serves per week provides the recommended intake of EPA & DHA which contributes to many health benefits including heart health.

Omega3

Omega-3s are called 'essential' fatty acids because they're critical to good health, but cannot be produced naturally by the human body. They need to be obtained from food. Atlantic salmon is one of the richest naturally occurring sources of Omega-3 fatty acids. Omega-3s are called 'essential' fatty acids because they're critical to good health, but cannot be produced naturally by the human body. They need to be obtained from food. There different kinds of Omega-3 – those from plant sources (known as ALA) and those from marine sources (called EPA & DHA). While both kinds of Omega-3 are important for good health, the marine Omega-3s are more potent and provide wide ranging health benefits throughout our bodies and brains.

> Everyday Faves - SalMON to Sun (pdf/Tassal/Resource 2/14. Wholesale Everyday Faves Recipe Booklet-Web.pdf)

Equipment:

- Internet
- Copy of 'Everyday Faves – SalMON to Sun'
- Salmon (cooked/uncooked)
- Access to appropriate cooking facilities

Lesson steps

1. Students review different recipes that incorporate Salmon
2. Discuss with students some cooking challenges – most nutritious meal, best tasting, best appearance/plate up, best description of meal
3. Provide students some guidelines, for example an upper limit on the budget for the recipe, time to prepare the meal (i.e. 60mins)
4. Students can work individually or in a pair.
5. Students will need to keep a written record of the activity. This will help with planning and purchasing of items
6. Students will need to provide a verbal description of the meal they will be creating
7. Once students have chosen a recipe, it will be time to go shopping. This could be a homework task or a class task.
8. In approved cooking facilities, provide equipment and space for students to create their meals
9. Time to judge, and then….eat!!!
10. Provide some time for clean up

Supporting resources

http://www.tassal.com.au/kitchen/recipe/?search_recipes=&ingredient_val=&cat_val=&what_val=&who_val=&when_val=&embeds=&order=DESC&orderby=date (http://www.tassal.com.au/kitchen/recipe/?search_recipes=&ingredient_val=&cat_val=&what_val=&who_val=&when_val=&embeds=&order=DESC&orderby=date)

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Overall supporting resources

Comparison of the natural life cycle of the Salmon to the Tasmania pen produced salmon.

http://animaldiversity.org/accounts/Salmo_salar/ (http://animaldiversity.org/accounts/Salmo_salar/)

Australian Fisheries Management Authority (AFMA) responsible for commonwealth fish resources

http://www.afma.gov.au/about/about-afma/

http://www.agriculture.gov.au/fisheries/aquaculture (http://www.afma.gov.au/about/about-afma/ http://www.agriculture.gov.au/fisheries/aquaculture)

CSIRO

https://www.csiro.au/en/Research/AF/Areas/Aquaculture/Diseases/salmon-gill-disease-AGD (https://www.csiro.au/en/Research/AF/Areas/Aquaculture/Diseases/salmon-gill-disease-AGD)

UN FAO

http://www.fao.org/fishery/statistics/en (http://www.fao.org/fishery/statistics/en)

http://www.fao.org/3/a-br186e.pdf (http://www.fao.org/3/a-br186e.pdf)

Tasmanian salmonoid growers association

http://www.tsga.com.au/salmon-farming/ (http://www.tsga.com.au/salmon-farming/)

Tassal video

https://www.youtube.com/watch?v=dWtNZ5xUNNY (https://www.youtube.com/watch?v=dWtNZ5xUNNY)

https://www.youtube.com/watch?v=IV4zF4biK38 (https://www.youtube.com/watch?v=IV4zF4biK38)

Salmon feeding

https://www.skretting.com/en-AU/faqs/whats-in-fish-feed/ (https://www.skretting.com/en-AU/faqs/whats-in-fish-feed/)

https://www.youtube.com/watch?

v=CKQU8ex8ric&feature=results_video&playnext=1&list=PL6DB85A607BFA4B58 (https://www.youtube.com/watch?v=CKQU8ex8ric&feature=results_video&playnext=1&list=PL6DB85A607BFA4B58)

North American sites

https://www.ncbi.nlm.nih.gov/books/NBK223897/ (https://www.ncbi.nlm.nih.gov/books/NBK223897/) http://www.bcsalmon.ca/wild-bc-salmon/biology-lifecycle (http://www.bcsalmon.ca/wild-bc-salmon/biology-lifecycle) http://www.adfg.alaska.gov/index.cfm?adfg=invasiveprofiles.atlanticsalmon_characteristics (http://www.adfg.alaska.gov/index.cfm?adfg=invasiveprofiles.atlanticsalmon_characteristics) http://www.fisheries.noaa.gov/pr/species/fish/atlantic-salmon.html (http://www.fisheries.noaa.gov/pr/species/fish/atlantic-salmon.html)

http://animaldiversity.org/accounts/Salmo_salar/ (http://animaldiversity.org/accounts/Salmo_salar/) https://nas.er.usgs.gov/queries/factsheet.aspx?SpeciesID=926 (https://nas.er.usgs.gov/queries/factsheet.aspx?SpeciesID=926)

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