BRIEFING PAPER ON AGRIBUSINESS WITHIN NEW ZEALAND SECONDARY SCHOOLS

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St Paul's COLLEGIATE SCHOOL

DairyNZ

beef+lamb new zealand

GALLAGHER | bnz | LIC | zoetis | New Zealand National Fieldays Society | AGMARDT | Greenlea | WAIKATO MILKING SYSTEMS | AGrowQuip | Waitomo | CAMPBELL TYSON

Purpose and Definition:

1. This brief provides a rationale for the introduction of Agribusiness as an Achievement Standards based, University Entrance (UE) accredited and Scholarship subject at NCEA Levels 2 and 3.

2. The subject Agribusiness is defined as a course of study that integrates primary industries and business beyond the farm gate, encompassed by a group of sectors (agriculture, aquaculture, dairy manufacturing, equine, forestry, horticulture, seafood, and sports turf) that form the basis of modern food production. The current Agricultural and Horticultural Science subject is up to the farm gate and is predominately the management practices involved in the production of food.

Current Situation:

3. Agriculture is how New Zealand earns a living and together with forestry generates about 70% of our merchandising export earnings and around 12% of Gross Domestic Product *(Source: Ministry of Primary Industries).*

4. The primary industries and government agencies are telling us they need the brightest and the best students to take up careers in agribusiness.

5. "The government has set an ambitious target of doubling our primary sector exports by 2025. To get there we will need investment, innovation, market development and a skilled workforce. **The government estimates the sector will need to employ another 50,000 people by 2025, half of them requiring tertiary or level 4 qualifications"** *(Source: Honourable Nathan Guy: Minister for Primary Industries).*

6. "DairyNZ estimate an annual need of **1,000 agriculture-related graduates to keep the industry healthy and growing"** *(Source: Mark Paine: DairyNZ Strategy and Investment Leader).*

7. The agribusiness sector in New Zealand has major skill shortages across the value chain now, let alone in the future. "The forecast findings show that across the primary industries there will be a growing demand for professional skills such as

engineering, science, and management. ….. the workforce of the future may look very different. In many cases jobs will be more specialised and will require people with strong educational backgrounds ….. and an increasing demand for more people in occupations with higher qualifications, especially for professional degrees in field of specialisation aligned with the value chain" *(Source: Ministry for Primary Industries – People Powered).*

8. **Agricultural and Horticultural Science numbers at senior secondary school are in decline**. Level 3 NCEA Agricultural and Horticultural Science over the four years since 2010 has averaged around 440 students per year and shows little sign of increasing. This compares with an average of 14,000 students taking Level 3 NCEA English and 7,500 taking Chemistry, while the language subjects; Maori (600) and French (800) had more interest from the country's most senior secondary school students. Scholarship figures are even more alarming with an average of just 36 students actually sitting Scholarship Agricultural and Horticultural Science across the whole country *(Source: NZQA National Statistics Reports 2010 -2013).*

9. Agricultural and Horticultural Science does not have a high profile as a career pathway. The public perception is that agricultural and horticultural courses are for less able students. School and community perceptions of the importance of agribusiness to New Zealand need improving, and the opportunities and pathways that are available are not recognised or well known. In particular there is a need to engage the urban sector with the primary sector which politically is so very important for New Zealand's future.

10. There is an urgent need for initiatives that provide a better link between secondary schools, tertiary institutions and the agribusiness sector.

11. There is currently **no senior New Zealand secondary school course that looks to interest and engage academic tertiary capable students** into careers in the agribusiness sector beyond the farm gate**.**

12. The current Agribusiness (Agricultural Science, Agricultural Commerce etc.) graduate requirements for New Zealand are **1000** annually *(Sources: Mark Paine (DairyNZ, 2014); Andrew West (Lincoln University Vice Chancellor, 2014)*. The 2014 numbers of Agribusiness students graduating from New Zealand universities was approximately **250.** (*Source: Andrew West (Lincoln University Vice Chancellor 2014).* Therefore, there is a **current shortfall of approximately 750** annually**. Future Shortfall = ??**

The Solution:

13. Develop and deliver an Agribusiness programme to secondary schools in New Zealand that meets the industry's long term needs to develop highly skilled and motivated young people, required for a sustainable future of the primary sector. This will be a pioneering programme of national significance that will stimulate careers in agricultural science and business and encourage tertiary capable young people to proactively select career pathways in the sector.

14. Future agribusiness graduate projections based on the successful introduction of Agribusiness as an NCEA Level 2 and 3, UE approved and Scholarship subject in 2017.

Entry Year	Graduation Year	Schools on Board	Projected Numbers	Rationale
2016	2019	1	20	*Based on St Pauls' student numbers in 2015
2017	2020	8	160	8 trial schools in 2016 @ 20 students per school
2018	2021	50	750	Approved for schools in 2017 - 50 schools @ 15 students per school
2019	2022	100	1500	100 schools on board @ 15 students per school
2020	2023	130	2000	130 schools on board

Note: 1. Actual St Paul's Collegiate School students attending Agribusiness universities in 2015 was 17 (following delivery of the Level 3 developmental NCEA Agribusiness course in 2014).
2. * 2015 student numbers in Level 3 developmental Agribusiness course are 45.

15. The subject Agribusiness complements other primary industries programmes but targets a different group of students – tertiary capable academic students. The below table shows how the Agribusiness subject lines up with other educational pathways for senior secondary students wanting careers in the Agribusiness sector.

Primary Industries Programmes	Level	Unit (US) or Achievement (AS) Standards	Where
Proposed NCEA Agribusiness subject	2 – 3	AS	School based
Vocational Pathways Award in the Primary Industries	1 – 2	AS and US	Industry and School
Trade Academies - NZ Primary Industries Trades Academy (Primary ITO) - Primary Industries Trades Academy (Taratahi Agricultural Training Centre)	1 – 3	AS and US	Industry and school based
National Certificates in 29 sectors of Primary Industries	1 – 3	US	Industry workplace
Primary ITO Gateway programmes	1 – 3	US	Industry and school

Recommendations:

16. The Ministry of Primary Industries to support the introduction of Agribusiness as a stand-alone teaching and learning subject in the New Zealand Curriculum at NCEA Levels 2 and 3, that also qualifies as a UE approved and scholarship subject.

17. The Ministry of Education to approve in principle and facilitate through cross agency collaboration with NZQA, Tertiary Education Commission, the University Vice Chancellors (UVC) committee and schools, the introduction of Agribusiness as a stand-alone teaching and learning subject in the New Zealand curriculum at NCEA Levels 2 and 3, that also qualifies as a UE approved and Scholarship subject. The new subject to be accessible to all New Zealand schools by 2017.

18. Agribusiness is a multidisciplinary subject, which adapts the New Zealand Curriculum, in an innovative way, covering both Sciences and Social Sciences. As it covers the business of science, it should be added to the New Zealand Curriculum under Social Sciences.

19. To accommodate Agribusiness in the Qualifications Framework, a new domain under the Primary Sector subfield, in the Agriculture, Forestry and Fisheries Field needs to be set up.

20. The Ministry of Education through NZQA to approve the trialling of achievement standards in Agribusiness in 2016 in the Lead Schools.

21. The Ministry of Education to fund the retraining of existing teachers in the subject Agribusiness; to include the subject Agribusiness in Schools of Education teacher training programmes and to target as an area for TeachNZ scholarships.

22. The Ministry of Education to accept the offer of St Paul's Collegiate School and partners to continue to primarily fund the development of the new Agribusiness Achievement Standards and the accompanying subject resources until the end of 2017.

23. An Advisory Board made up of educationalists from government agencies, schools and representatives from the agribusiness sector to meet three yearly to provide advice and guidance on the contexts and intent of the standards (because of the dynamic nature of agribusiness).

24. Timeline for the introduction of the subject Agribusiness.

2013	Initial idea proposed by agribusiness sector to St Paul's Collegiate School Board and Management.
2014	Advisory Group established. $2 million dollars of funding raised from private sector to develop and resource a new Agribusiness subject. Rudimentary Agribusiness course developed and taught at St Paul's Collegiate School.
Nov 2014	Official launch of the proposed new teaching and learning subject of Agribusiness. Minister of Primary Industries Nathan Guy attended. Curriculum writers appointed. Seven Lead Schools appointed to give regional recognition across New Zealand.
Jan – Nov 2015	Draft Achievement Standards which have been developed and resourced are being delivered at St Paul's Collegiate School.
May 2015	Ministers of Education and Primary Industries receive proposal for new Agribusiness subject.
June - Oct 2015	Ministry of Education facilitates the introduction of Agribusiness through cross agency collaboration with key stakeholders (NZQA, TEC, UVC, school sectors etc.)
Nov 2015	Lead Schools approved to trial new Achievement Standards in 2016 by NZQA.
Feb 2016	Lead Schools teach new Achievement Standards that are UE approved by UVC.
Apr 2016	National Conference on Agribusiness in New Zealand Schools held for interested schools at St Paul's Collegiate School.
2016	Teacher training in place for both new teachers and experienced teachers in Agribusiness.
2017	Agribusiness available to all New Zealand secondary schools to teach.

Background:

25. In early 2014 the St Paul's Collegiate School Board, in conjunction with a sector Advisory Group (see Appendix A), made the decision to investigate the establishment of new Agribusiness courses at NCEA Levels 2 and 3.

26. The St Paul's Collegiate School Board have since successfully established partnerships with a range of key businesses and organisations from the agribusiness sector who are incredibly enthusiastic about the initiative. These businesses are contributing over $2 million to support the initiative financially.

The three Principal Partners are:

- St Paul's Collegiate School
- DairyNZ
- Beef + Lamb NZ

The ten Business Partners are:

- Bank of New Zealand
- Livestock Improvement Corporation
- Zoetis (Animal Health)
- New Zealand National Fieldays Society
- AGMARDT (Agricultural Marketing and Research Development Trust)
- Greenlea (Meat Processors)
- Waikato Milking Systems (Dairy Equipment)
- AGrowQuip (Farm Machinery)
- Waitomo Petroleum
- Campbell Tyson (Accounting and Advisory Services)

27. Eight Lead Schools, in the major provinces, have agreed to be part of a trial in 2016 for the new Agribusiness standards, **if approved by the MOE**. The schools are Mt Albert Grammar School (Auckland), St Pauls Collegiate School (Hamilton), Feilding High School (Feilding), Lindisfarne College (Hastings), Christchurch Boys High School (Christchurch), John McGlashan College (Dunedin), Southland Boys High School (Invercargill) and Southland Girls High School (Invercargill). The Lead Schools have already met twice, for two days on each occasion, to discuss the Agribusiness initiative. The next meeting is to be held on the 9th and 10th of June 2015.

28. We will be seeking to establish a Community of Schools to better share teacher expertise, resources and leadership skills.

29. **St Paul's Collegiate School**, on behalf of its partners, has employed **specialist MOE experienced curriculum writers and NZQA trained assessors** to produce draft, proposed Agribusiness Achievement Standards at NCEA levels 2 and 3 (see appendices B, C and D for draft matrix and some exemplars of units of work that will form the basis of the standards).

30. The subject Agribusiness will be resourced, through holding Lead Schools meetings, a National Agribusiness Conference, a Moodle site, teaching and learning materials, schemes and lesson plans, residential courses and help with timetabling.

31. Agribusiness tertiary institutions, particularly Massey University, Lincoln University and Waikato University are involved in this initiative and have given their enthusiastic support at Vice-Chancellor level.

32. The writing and resourcing of the draft standards, staff professional development and Lead Schools input are currently being paid for by the private sector partners.

33. St Paul's Collegiate School and partners have contracted the University of Waikato to conduct a longitudinal research project on the impact of the subject Agribusiness on student selections, tertiary entry and graduate careers. Stage one report has been completed.

34. It is further proposed that the principal partners and business partners would take the lead in organising and funding a National Agribusiness in Schools Conference during 2016 and invite interested New Zealand secondary schools to come along.

The Proposed Teaching and Learning Subject – Agribusiness:

35. St Paul's Collegiate School carried out a gap analysis cross the current subject areas and identified a number of key aspects important to the agribusiness sector which are missing. The gaps in agribusiness content knowledge and skills form the basis of the proposed Agribusiness subject under four strands Agriscience, Agri-innovation, Agri-management and finance and Agrimarketing.

36. While some subject areas of the current curriculum can be effectively agribusiness contextualised, the new Agribusiness subject is covering content knowledge and skills that are not currently being covered.

37. The intent of the new subject Agribusiness, is to attract the brightest and the best students into careers in agribusiness up to and beyond the farm gate through developing achievement standards of academic rigour at Levels 2 and 3 NCEA that incorporate both agri-science and agri-business concepts and knowledge.

38. Every teaching and learning unit of work associated with the achievement standard will incorporate both agri-science and agri-business aspects, while having a stronger focus on one or the other.

39. The Agribusiness subject is being designed to be taught across all the primary industry sector contexts i.e. agriculture, aquaculture, dairy manufacturing, equine, forestry, horticulture, seafood, and sports turf etc.

40. Agribusiness as a subject is designed to be attractive to academic students strong in Sciences at Years 12 and 13 (especially Agricultural and Horticultural Science, Chemistry, Biology,) and to those students strong in Commerce at Years 12 and 13 (Accounting, Economics, Business Studies), as our St Paul's Collegiate School experience shows.

41. In 2014, 44 St Paul's Collegiate School students took our developmental agribusiness courses which included the teaching of **tasters** from the proposed new achievement standards. While **only two** St Paul's Collegiate School students had gone to agribusiness universities at the end of 2013, in 2014 after teaching tasters of the proposed subject, **seventeen** students went to agribusiness universities, an increase that we definitely attribute to the engaging teaching and learning programme.

42. In 2015 St Paul's Collegiate School has **84** students taking our developmental agribusiness courses, half at Level 2 and half at Level 3. We envisage a similar positive uptake in many of the nation's schools. All students are taking as well at least one senior Science subject and/or at least one senior Commerce subject i.e. they are academic, tertiary capable students.

43. **However, the new Achievement Standards need to be Ministry approved so students can gain credits, and Agribusiness needs to be accredited as a UE subject if we are to maintain momentum and have other schools offer Agribusiness as a subject.**

44. Experiential learning is a key focus, using sector resources (field trips, speakers, seminars, on line demonstrations) university support, and IT innovation, to bring the agribusiness sector to the classroom – **a key feature if we are to win the support of the urban sector for Agribusiness.**

45. Both the proposed Levels 2 and 3 Agribusiness courses have three external standards and up to six internally assessed standards to allow for flexibility in the use of the achievement standards amongst schools when designing their courses.

46. Specific Agribusiness achievement standards lend themselves to a cross-curricular approach and will easily be incorporated into local secondary school courses, so as to not disadvantage schools that may not have the physical/staffing resources to deliver the full range of standards (at least not immediately).

47. There are underlying themes across the Agribusiness subject which include adding value to products, human resource management, innovation, career pathways and opportunities.

48. All of the Agribusiness Achievement Standards are being designed to be 90% different to existing Achievement Standards.

49. A public domain Moodle site is already operational and will be the vehicle for accessing of resources for both teachers and students. Lincoln, Massey and Waikato Universities have already contributed to the Moodle site www.agribusiness.school.nz.

50. The initiative has received overwhelmingly positive endorsements from the agribusiness sector and we have many secondary schools clamouring to get on board with us.

Appendix A

The Current Advisory Group

Glen Beal	Campbell Tyson
Dean Bell	Waikato Milking Systems
Jon Calder	New Zealand National Agricultural Fieldays Society
Alan Cottington	AGrowQuip
Jason Cowan	BNZ Business Partners
Tony Egan	Greenlea Premier Meats
Peter Hampton	Deputy Headmaster Academic, St Paul's Collegiate School
David Hemara	Dairy Goat Co-operative New Zealand
Blair Hoad	Livestock Improvement Corporation
John Jackson	Farmer, St Paul's Board member and current parent
Grant Lander	Headmaster, St Pauls' Collegiate School
Doug Macredie	Beef + Lamb New Zealand
Tony Moffat	Lincoln University
Peter Nation	Gallagher Group
Malcolm Nitschke	AGMARDT
William Oliver	Farmer and current parent
James Ormsby	Waitomo Petroleum
Dr Tom Richardson	AgResearch (Chair)
John Reeves	Farmer, St Paul's Board member and current parent
Prof Jacqueline Rowarth	University of Waikato
Jennifer Seed	Zoetis
Michael Spaans	Board of Director at DairyNZ, Board of Director at Fonterra and current parent
Susan Stokes	Dairy NZ
David Walker	Spark
Terry Youngman	*Anexa Animal Health & Cognosco*

Appendix B

Agribusiness Matrix

STRANDS			
Agri-innovation	**Agriscience**	**Agri-management and finance**	**Agrimarketing**
ASXXXXX **2.1** Investigate a significant aspect of technological innovation in primary production **4 Credits** **Internal**	ASXXXXX **2.3** Demonstrate knowledge of the role of plant biology in an agribusiness context **4 Credits** **External**	ASXXXXX **2.6** Demonstrate understanding of cash flow forecasting and operating finance for an agribusiness **4 Credits** **Internal**	ASXXXXX **2.8** Investigate an agrimarketing opportunity for an agribusiness **4 Credits** **Internal**
ASXXXXX **2.2** Demonstrate understanding of how future proofing is used in primary production **4 Credits** **External**	ASXXXXX **2.4** Demonstrate knowledge of food science in an agribusiness context **4 Credits** **Internal**	ASXXXXX **2.7** Demonstrate understanding of the ownership structure of an agribusiness **4 Credits** **External**	ASXXXXX **2.9** Demonstrate knowledge of adding value to the supply chain from consumer to the producer (Glass to Gate scheme) **4 Credits** **Internal**
	ASXXXXX **2.5** Demonstrate knowledge of soil science in an agribusiness context **4 Credits** **Internal**		
ASXXXXX **3.1** Evaluate the impact of technological innovation beyond primary production **4 Credits** **Internal**	ASXXXXX **3.3** Demonstrate understanding of food science in an agribusiness context **4 Credits** **Internal**	ASXXXXX **3.6** Demonstrate understanding of a capital expenditure decision in an agribusiness **4 Credits** **Internal**	ASXXXXX **3.8** Demonstrate understanding of marketing strategies used in agribusiness **4 Credits** **External**
ASXXXXX **3.2** Demonstrate understanding of how future proofing is used beyond primary production **4 Credits** **External**	ASXXXXX **3.4** Demonstrate understanding of soil and fertiliser chemistry (Soil Chemistry and Impact of Fertilisers scheme) **4 Credits** **Internal**	ASXXXXX **3.7** Analyse a human resource decision in agribusiness **4 Credits** **Internal**	
	ASXXXXX **3.5** Demonstrate understanding of microorganisms and / or entomology in an agribusiness context **4 Credits** **External**		

Level 2: 36 Achievement Standard Credits, 3 externally assessed standards, 6 internally assessed standards
Level 3: 32 Achievement Standard Credits, 3 externally assessed standards, 5 internally assessed standards

Appendix C

Agribusiness: Glass to Gate Scheme Duration: 5-6 weeks

Essence statement:	Using knowledge and skills to understand the value chain in primary production to be able to make informed decisions that enhance and add value to any primary product.
Big Picture:	Being able to sell a primary product for a higher return by adding value is important to producers to ensure survival. Producers need to have an understanding of the whole value chain for their primary product to ensure present and future primary production. The following are important ideas within the Big Picture: • Understanding the value chain for both primary and secondary products within the primary sector. • Understanding the background information about the primary sector. • Having knowledge about the careers along the whole value chain - from the glass to the gate.
New Zealand Curriculum Links.	
Business Studies: Level 7	Explore how and why large businesses in New Zealand make operational decisions in response to internal and external factors.
Economics: Level 7 and 8	Understand how the nature and size of New Zealand economy is influenced by interacting internal and external factors.
Agricultural and Horticultural Science Curriculum Level 8:	
• **Contextual Strand: Markets**	**Learning Objective 2:** Examine how scientific and technological principles are applied to the life processes of plants and/or livestock in order to shape the attributes of primary products for specified markets.
• **Contextual Strand: Profitability**	**Learning Objective 4:** Examine a range of factors that influence the profitability of primary production in New Zealand.
New Zealand Curriculum Links.	
Principles:	**Coherence:** Creating links between knowledge and skills gained in business to the primary industry. **Future Focus:** Enterprise and globalisation management decisions that allow farmers to enhance and sustain their businesses in primary production.
Values:	**Excellence,** by aiming high and by persevering in the face of difficulties. **Innovation, inquiry and curiosity,** by thinking critically, creatively, and reflectively. **Integrity,** which involves being honest, responsible and accountable and acting ethically.
Key Competencies:	**Thinking:** Make sense of information, develop understanding, make decisions, and reflect on learning. **Using language, symbols, and text:** To access and communicate information and to communicate this information with others.

Depth of coverage.	Specific Learning Outcomes	Learning Activities.	Resources.
What's The Big Picture?		Possible brainstorming ideas may include. • How does the understanding of glass to gate affect the primary industry? • How does understanding the value chain in primary production, meet producer and customer needs?	• Poster paper. • Pens.
Understanding the Primary Industry **a) New Zealand Primary Sectors.** • 7 primary sectors, agriculture, dairy manufacturing, equine, forestry, horticulture, seafood, and sports turf. • Agricultural main products; dairying, lamb, beef, wool, deer, arable. • Equine – breeding & management of race horses. • Dairy manufacturing from raw milk, processed milk, & dairy substitutes. Products produced are; milk powders, whole-milk, skim-milk & buttermilk powder; cream products, butter, milk fat and ghee; cheese, mainly cheddar, & specialist cheeses; protein products such as casein & caseinates; alcohols. • Sports Turf - sports turf managers and groundskeepers. • Forestry main products; forestry (planning, establishment, silviculture, and harvesting of trees); sawmilling & remanufacturing; wood panels; pulp, paper and tissue; and furniture. • Horticulture main products; fruit – wine grapes, kiwifruit, apples & pears; vegetables – onions, squash, potatoes. • Seafood & aquaculture main products are; harvesting fish from deep-sea or inshore fishing, e.g. rock lobster, hoki, squid, & orange roughy; aquaculture – growing & harvesting fish & shellfish in marine farms, e.g. greenshell mussel, king salmon & oyster farming; processing fish & shellfish (at sea or on shore).	**Students understand for each primary sector:** • The importance of primary industry to New Zealand. • The value of the export earnings • Volume produced and volume exported. • Percentage of world production • National consumption • Employment generated • Briefly cover regions of production for each sector • What products are involved with added value processing or the production of local market products such as cultured foods, liquid milk and ice cream	• Use pg. 9 of Harvesting the Sun to illustrate the difference between volume produced and volume exported (on bananas) • Use pg. 47 on trade flows from Harvesting the Sun. • Notes from New Zealand primary sector notes. • Do careers computers lesson.	• Harvesting the Sun book http://www.harvestingthesun.org/#chapter-0 • New Zealand primary sector notes. • careers computers lesson w/s
b) Economic factors in each sector • Contribution to New Zealand's economy ○ Number of jobs	**Students understand:**		

○ Export earnings ○ Gross Domestic Product ○ Top export destinations	• The importance of primary industry to New Zealand's economy.		
c) Employment opportunities in each sector • Working hours • Working environment • Amount of physical activity • Types of jobs / careers available • Employment requirements ○ Personal attributes ○ Skills and knowledge ○ Training pathways • Training opportunities ○ Full time study ○ On the job training – full time, part time, casual, holiday, seasonal, contracting, self-employment, work experience, modern apprenticeships, gateway, job shadowing, volunteering.	**Students understand:** • The diversity of the primary industry • What sort of jobs are out there? • What are the conditions of employment for each sector? • What is qualifications or skills are needed for different jobs in different sectors? • What are the different training opportunities that are available in the primary industry? • Advantages and disadvantages of full time study and on the job training.	• Watch DVDs on different job opportunities. • Listen to guest speakers from different sectors in different employment talking about their jobs and its requirements. • Read Ch. 4 pg. 35 – 40 of Harvesting the Sun • Go through Occupation Outlook 2015, pgs. 9 – 10, 43 - 52 • Look at dairy role descriptions.	• http://www.justthejob.co.nz/ - 22 videos on the primary sector. • DVD Just the Job. A Career in the Dairy Industry. DairyNZ • DVD Pick of the Crop. Careers in Horticulture. • Guest speakers from different sectors in different employment talking about their jobs and its requirements. • Harvesting the Sun book • http://www.harvestingthesun.org/#chapter-0 • http://www.getahead.co.nz/ • http://landyourdreamjob.co.nz/ • http://www.careers.govt.nz/ • http://www.futureintech.org.nz/ • http://youthguarantee.net.nz/vocational-pathways/ • http://pica.org.nz/ • http://www.youngfarmers.co.nz/ • http://nzkgi.org.nz/media/19946/nzkgi_careers_pathway_infographic.png • http://www.getahead.co.nz/assets/Uploads/Documents/Get-Ahead-Agri-Business-Guide.pdf • http://www.getahead.co.nz/assets/Uploads/Documents/Food-and-You.pdf • http://www.careers.govt.nz/assets/pages/where-to-posters/Where-To-2015-Agriculture-and-horticulture.pdf • Kiwifruit - careers_pathways_-_brochure_v4[1] • Occupation Outlook 2015 document • Dairy Role descriptions.
Adding value and the value chain using the example of Milk. • Added value is the increase in value that a business creates by undertaking the production process, e.g. Fonterra – valued added products, butter, cheese, whole milk powder, skim milk powder, wine production.	**Students understand:** • What adding value means. • What the value chain means. • What is the difference between primary and secondary products	• Read Growing Futures Case Study series 19 and 21. • Go through value chain power point. • Read article 'Producers must adapt to a fast changing world'. • Read article 'Ripe for Development' from KPMG Agribusiness Agenda 2014 pg. 50	• http://www.agmrc.org/business_development/getting_prepared/valueadded_agriculture/articles/ • Value Chain Guide sheet. • Value chain power point. • Growing Futures Case Study series 19 and 21. • Article 'Producers must adapt to a fast changing world'

• Not just a physical product but also includes building a brand, delivering excellence service, product features and benefits, and offering convenience. • What does the value chain mean? A set of activities, services and products that lead to a product that reaches the final consumer. Where value is added to the original product right the way through the production process.	• Adding value to the producer as well as the consumer, such as offering convenience. • Why there are many different milk products? Milk storage. Perishability. Extending perishability (use by dates).	• Do Supermarket scoping activity. • Make a value added product e.g. from milk make butter, cottage cheese or yoghurt. • Past Your Use by Date activity. • Giving the Milk the Treatment activity. • Watch 'Process cheese - Adding value at Pastoral Foods, Eltham'. • Use pg. 10 of Harvesting the Sun to look at the Horticulture Supply Chain. • Supply chain cost structure pg. 32 of Harvesting the Sun. • Visit a grower who markets their own produce. • Adding value to milk A1 and A2, hyper-immune milk, high value proteins. • Crocodile Pit (see sheet) • Value added Executive Summary • Use articles from Value Added Articles and Websites document	• Article 'Ripe for Development' from KPMG Agribusiness Agenda 2014 pg. 50 • Supermarket scoping activity from Mission Dairy Energy (MDE) pg. 46. • Milk storing and perishability from MDE pgs. 48 – 49. • Milk powder product protection - production chain diagram • Past Your Use by Date activity from MDE pg. 51 – 52. • Giving the milk the treatment activity from MDE pgs. 53 – 56. • Dairy SS1 Making your own butter pgs. 47; • Dairy SS2 Project Brief – New method of making yoghurt pgs. 48 – 51. • Making your own yoghurt from MDE pg. 57. • Making cheese – the cottage kind from MDE pgs. 58 – 59 • 'Process cheese - Adding value at Pastoral Foods, Eltham' from Marketing disc of Rural Source DVDs • Harvesting the Sun book (see above) • Field trip to Tip Top factory • http://biotechlearn.org.nz/focus_stories/cheesemaking • http://sciencelearn.org.nz/Innovation/Innovation-Stories/The-FOODBOWL • http://biotechlearn.org.nz/themes/marvellous_milk • Crocodile Pit sheet. • Value added Executive Summary • Cow to Cone Ice-cream https://www.youtube.com/watch?v=FBiCmoSkYPk • Value Added Articles and Websites • DVD Rural Source Breeding and Production – Adding Value to Milk clip. • http://www.lewisroadcreamery.co.nz/choc-milk

What does the market / consumer want? • Market demands. What do we want as a consumer? Market dictates. • Differentiation of the products. • Product features and benefits. • Product innovation. Niche markets targeted at premium markets. Creation of innovative products. Diversifying the range of products. • Building a brand. • Delivering excellent service. • Quality products	**Students understand:** • That the consumer dictates the market. • Why does differentiation occur? • Niche opportunities are used to create value in the short or long term.	• Read article 'Aspiring to be Asia's Delicatessen' from KPMG Agribusiness Agenda 2014 pg. 52 • Find out what consumers want in terms of your value added product e.g. type of butter or yoghurt. • Watch 'Dairy products meeting customer needs' • Branding brings bonanza article with w/s • Read Icebreaker brand article.	• Branding pgs. 84 of Basic Marketing. • Article Read article 'Aspiring to be Asia's Delicatessen' from KPMG Agribusiness Agenda 2014 pg. 52 • Dairy TIS 2 Making butter in the past pgs. 9 – 11; TIS 3 Butter pgs. 12 – 13; TIS 5 Modern Milk fat Processing Technology pgs. 16 – 19; TIS 7 Process Development Project pgs. 23. • 'Dairy products meeting customer needs' from Marketing disc of Rural Source DVDs • Icebreaker brand article. • http://www.plantandfood.co.nz/growingfutures/case-studies/pre-sliced-apples-for-convenience
Primary Industry Marketing • Discuss the factors involved in marketing primary industry products a) within New Zealand b) the export market c) reject produce.	**Students understand:** • What is marketing and markets • Basic principles of marketing. • Export marketing • Factors involved in marketing primary products	• Students brainstorm ideas of what to do with their reject product, then screen so that only viable ideas remain.	
Harvesting including cleaning, trimming, surface coatings, curing or waxing if applicable. • Timing • Methods • Conditions needed.	**Students understand:** • The terms harvesting, cleaning and trimming. • Value added by cleaning, trimming, curing, waxing	• Watch video on the production process of kiwifruit. • Surface coating for fruits and vegetables article.	• Kiwifruit video • Potato Harvesting OHT (from old scheme)
Grading. • Describe the principles of grading of horticultural produce. • Factors which affect the quality of produce for local & overseas markets • Sorting and Grading of products – e.g. export quality, reject produce. • Quality and quality factors such as maturity, ripeness, minimal damage, fresh, sizing. • The need to present high quality produce for a competitive market.	**Students understand:** • Principles of grading fruit and vegetables. Use TIS 8. • Factors which affect the quality of produce for local & overseas markets • The need to present high quality produce • Value added by grading produce	• Interpret data & apply knowledge in developing own grading system for a product such that produce may be designated export quality, or reject produce. Could use their butter or yoghurt. • Read Growing Futures Case Study series 10. • Read pgs. 24 – 28 of 'The Journey to You'	• 'Horticulture' TIS 8 pg. 30 & 31- Grading of fruit and vegetables. • Growing Futures Case Study series 10. • Adapt Apple Quality control, grading, packaging and storage pgs. 18 – 20 and Wool quality control, grading and packaging pgs. 90 – 91 of Marketing Agricultural and Horticultural Products. • 'The Journey to You' – Chapter 3 of Harvesting the Sun. http://www.harvestingthesun.org/#chapter-3

• Criteria for grading. • Methods • Disposal of inferior products			
Packaging and packing. • Functions of packaging • Retail packaging of fresh produce • Types of packaging, factors to consider. • The principles of packaging design • Packaging design and integrity – does it meet the consumer and the producer's needs? Protect from shock, compression, and vibration. Evaluate package design using package integrity tests. Suggest improvements / modifications.	**Students understand:** • Background information on packaging design • Functions of packaging. • Different types of packaging for dairy products. • Value added by packaging and packing	• Fieldtrip to supermarket to look at different packaging of primary products or bring in various different packaging. Study 3 types of packaging for fruit and vegetables and give advantages and disadvantages for each when storing or transporting the produce. Or look at their product studied e.g. butter or yoghurt. • Design & construct packaging for their product – prototypes from Horticulture or pg. 70 from MDE • Integrity tests to evaluate their package design, use w/s • Redesign & make an improved prototype • Pack it activity. • Read pgs. 28 – 29 of 'The Journey to You' • Why packaging? article	• Range of common packaging materials • 'Horticulture' SS 2 Package Integrity Tests pg. 52 – 54 • 'Horticulture' TIS 11 & 12 pgs. 35 – 37 – Packaging Design and Integrity • Pack it from MDE pgs. 64 – 66. • Design a package pg. 70 of MDE. • Use pgs. 2 – 3, 13 – 17, 30 – 35, 38 - 41 from 'The Complete Package for background, functions on packaging. • 'The Journey to You' – Chapter 3 of Harvesting the Sun. http://www.harvestingthesun.org/#chapter-3
Labelling. • Describe the relevant labelling requirements for packaged fresh fruit & vegetables	**Students understand:** • Give background information on labelling requirements • Facts on labelling (from MDE) • Bar codes (from MDE) • Value added by labelling	• Design a label for their package, taking into account the above requirements and the end use and which meets all the relevant labelling requirement. • Facts on Labelling	• 'Horticulture' TIS 13 pg. 38 – Labelling • Facts about labelling from MDE pgs. 67 – 68. • Growing Futures Case Study series 19. • 'What's on a food label w/s

Cooling and storage
• Reasons for storage - Respiration, ethylene, moisture loss, rot organisms, injuries, temperature control, increased shelf life, controlled ripening, control of perishability.
• Principles of storage.
• Product deterioration
• Environmental control
• Quality checking
• Use of control measures for deterioration.
	Students understand:
	• Value added by using cool storage
	• Types of product deterioration
	Internal processes
	• Over ripening
	  ○ Water loss
	  ○ Continued growth.
		• Read pgs. 29 – 31 of 'The Journey to You'
		• Read 'Storage' from 'Horticulture'.
		• Packaging and its effect on cool storage sheet.
		• Cooling techniques applied after harvest article.
		• Measure changes during fruit ripening e.g. Brix test in kiwifruit, loss of starch
			• 'Horticulture' TIS 9 pg. 32 -33 – Storage
			• 'The Journey to You' – Chapter 3 of Harvesting the Sun. http://www.harvestingthesun.org/#chapter-3
			• Investigations on fruit ripening pgs. 11 – 12 of Product Processing and Storage Teachers Guide (PPSTG).
			• Investigations on flower senescence pgs. 13 – 14 of PPSTG.

• Storage life.	• Effects of other living things
	  ○ Yeast fermentation
	  ○ Bacterial breakdown
	  ○ Fungal infection
	  ○ Pest attack
	• Control measures
	  ○ Cooling
	  ○ Heating
	  ○ Water removal
	  ○ Controlled atmosphere
	  ○ Chemical treatment
	  ○ Irradiation
		in apples using iodine, the effect of ethylene.
		• Investigations on flower senescence e.g. response to ethylene, effect of preservations.
		• Measure water loss by weighing.
		• Investigate the fermentation of honey.
		• Make yoghurt or cheese.
		• Observe diseased fruit, e.g. brown spot in stone fruit.
		• Observe pest damaged products.
		• Investigate pest resistant packaging in selected products such as wheat.
		• Compare the rate of product deterioration at different temperatures.
		• Investigate milk pasteurisation.
		• Investigate salt or smoke preservation of meat.
		• Compare deterioration rates of a product stored in sealed containers with different atmospheres, e.g. 100% CO_2, air, high O_2, $KMnO_4$ crystals to remove ethylene.
		• Investigate seed viability comparing fungicide treated seeds with untreated seeds.
			• Background notes on honey pgs. 15 – 18 of PPSTG.
			• Background notes on wheat pgs. 19 – 20 of PPSTG.
			• Background notes on meat pgs. 21 – 23 of PPSTG.
			• Background notes on wool pgs. 24 – 27 of PPSTG.
			• Background notes on commercial seed production pgs. 28 – 30 of PPSTG.
			• Background notes on kiwifruit pgs. 31 – 32 of PPSTG.
			• Background notes on milk pgs. 33 – 40 of PPSTG.

Distribution Plan • Explain the principles of distribution of horticulture produce. • Reasons for the distribution of specialized horticultural activities thorough out New Zealand. • Traceability - Tracing a horticultural product from grower to final consumer. • Shipping and Distribution - Different places the product ends up. • Principles of distribution. Distribution plan for the exporting of produce. How are they transported? • Reducing damage and spoilage in transit. Transportation, temperature control, mixed loads, wholesalers and retailers, problem in distribution.	**Students understand:** • Background information on storage & distribution of horticultural produce. • The dependence of these various horticultural specialisations upon location, aspect, soil, climate, plant & cultivar selection & proximity to users or markets. • Value added by having a distribution plan.	• Brainstorm factors for distribution • Formulate a written distribution plan for export of a primary product, including how the product will be stored & transported. • Read Growing Futures Case Study series 11. • Read Traceability pg. 32 of 'Harvesting the Sun'	• 'Horticulture' TIS 10 pg 34 – Distribution • Growing Futures Case Study series 11. • Distribution pg 97-110 of Basic Marketing. • Field Grown tuber Dahlias OHT (see old scheme) • Harvesting the Sun book http://www.harvestingthesun.org/#chapter-0

Perishability. Logistics and handling of food products. • Quality - Quarantine clearance – control of pests and diseases, residues			
Incorporation of The Big Picture by bringing it altogether as a group.	• How does the understanding of glass to gate affect the primary industry? • How does understanding the value chain in primary production, meet producer and customer needs?	• In groups using a large concept map, students draw their understanding of the links and ideas throughout the topic. This is supported by the concepts learnt throughout the unit.	• Paper or a large white board. • Pens.
Assessment:	ASXXXXX **2.9** Demonstrate knowledge of adding value to the supply chain from consumer to the producer. 4 Credits Internal		

Appendix D – Agribusiness: Soil Chemistry and Impact of Fertilisers Scheme

Duration: 5-6 weeks

Essence statement:	Using scientific knowledge and skills to make informed decisions that enhance and sustain soils for any primary production.
Big Picture:	Soils are the basis of the primary industry. Soils provide a foundation for plant growth and support primary production. Producers need to manage soil as a sustainable resource for present and future primary production. The following are important ideas within the Big Picture: • Apply soil knowledge and concepts to the primary industry. • Apply knowledge of soil chemistry to explain aspects of soil and how soil chemistry in terms of fertilisers are used in primary production to meet producer needs, resolve their issues and develop new technologies.
New Zealand Curriculum Links. Science Curriculum Level 7 and 8:	
• **Nature of Science: Investigating in Science**	Develop and carry out investigations that extend their science knowledge, including developing their understanding of the relationship between investigations and scientific theories and models.
• **Material World: Chemistry and society**	Apply knowledge of chemistry to explain aspects of the natural world and how chemistry is used in society to meet the needs, resolve issues and develop new technologies.
• **Chemistry: Properties and changes of matter**	Investigate and measure the chemical and physical properties of a range of groups of substances, for example, acids and bases, oxidants and reductants, and selected organic and inorganic compounds.
• **Chemistry: The structure of matter.**	Relate properties of matter to structure and bonding; Develop an understanding of and use the fundamental concepts of chemistry (for example, equilibrium and thermochemical principles) to interpret observations.
• **Planet Earth and Beyond: Earth systems and interacting systems**	Develop an in-depth understanding of the interrelationship between human activities and the geosphere over time.
• **Living World: Life processes, ecology and evolution**	• Understand the relationship between organisms and their environment. • Explore the diverse ways in which animals and plants carry out life processes.
Agricultural and Horticultural Science Curriculum Level 8:	
• **Contextual Strand: Life Processes**	**Learning Objective 2:** Critically examine how the soil management practices used in production processes ensure marketable primary products.
• **Contextual Strand: Sustainability**	**Learning Objective 3:** Critically examine the impact of soil management and processes on the environmental sustainability of a primary production.
• **Contextual Strand: Profitability**	**Learning Objective 4:** Critically examine the impact of soils on the profitability of primary production in New Zealand.
Principles:	**Coherence:** Creating links between knowledge and skills gained within the soil science unit and the Agribusiness industry. **Future Focus:** Sustainability and soil conservation management decisions that allow farmers to enhance and sustain soils for primary production.
Values:	**Ecological sustainability,** which includes care for the environment. **Community and participation** for the common good.
Key Competencies:	**Thinking:** Make sense of information, develop understanding, make decisions, and reflect on learning. **Using language, symbols, and text:** To access and communicate information and to communicate this information with others.

Depth of coverage.	Specific Learning Outcomes	Learning Activities.	Resources.
What's The Big Picture?		Possible brainstorming ideas may include. • How does the understanding of soil chemistry affect the primary industry? • How does the knowledge of soil chemistry explain aspects of soil? • How is soil chemistry used in primary production to meet producer needs, resolve their issues and develop new technologies?	• Poster paper. • Pens. • http://soils4teachers.org/role-of-soils

Soil Chemistry
Understand the chemical characteristics of soil.
 	
1. Soil pH.
• acidity, basic soils, parent material,
• macronutrients and micronutrients,
• mineral / nutrient uptake
• ions, common ions and their charges, ionic bonding, cations, anions, salts, cation exchange capacity (CEC), base saturation (BS),
• effect on nutrient and element availability, soil structure and organisms (microorganisms and earthworms) and plant growth tolerances.
• Soil acidification
	Students understand:
	• Chemical bonds between atoms in molecules such as H_2, CH_4, NH_3, H_2CCH_2, N_2, Cl_2, and many large biological molecules are covalent.
	• Acids are hydrogen-ion-donating and bases are hydrogen-ion-accepting substances.
	• How to use the pH scale to characterise acid and base solutions.
	• How to calculate pH from the hydrogen-ion concentration.
	• The concepts of CEC and BS.
	• How to calculate the concentration of a solute in terms of grams per litre, molarity, parts per million, and percent composition.
	• Why soil pH is important in terms of available macro and micronutrients.
	• That soil acidification is damage to the soil resulting on pH of the soil dropping below 6.6.
		• Practical – Measuring pH of plots or gardens and soils from the local area using a pH meter and / or students to carry out pH tests in the laboratory.
		• Brainstorming:
		  ○ Why is soil pH and nutrient status important for the primary producer?
		  ○ What effect does pH have on soil properties?
		  ○ How does different pH in the soil affect plant growth and therefore productivity?
		• Define the following terms – calcifuges (lime hating plants e.g. rhododendrons) and calcicoles (lime loving plants).
		• Watch Mineral weathering animation http://courses.soil.ncsu.edu/resources/soil_classification_genesis/mineral_weathering/elemental_change.swf
		• What is your pH? Practical http://www.cfaitc.org/lessonplans/pdf/404.pdf
		• Exploring parts per million activity (on pg 31 of Nitrogen Dynamics in the Environment book).
		• Absorbing Minerals and Water: How roots work. Chapter 7 of The Life of Plants by Martin Hanson.
			• Diagrammatic representation of the pH scale - neutrality, acidity and alkalinity.
			• Graph to show relationship between soil texture and lime to raise pH.
			• Table to show soil acidity and crop tolerance.
			• Graphs to show the effect of soil pH on nutrient availability.
			• Picture showing limiting factors.
			• Diagram to show nutrients in the soil being held by ions.
			• Optimum pH range for growing various crops.
			• Worksheet on pH and plants.
			• Neutralizing value of lime materials.
			• http://www.dairynz.co.nz/publications/farmfacts/fertiliser-and-nutrient-management/farmfact-7-15/
			• http://www.soils4teachers.org/chemistry
			• http://soils4teachers.org/mineralogy
			• Ion exchange information (on pg 41 of Nitrogen Dynamics in the Environment book).
			• PowerPoint Soil Chemistry with student notes

2. Reactions. • Sorption and Precipitation • Soil Organic Matter Interactions • Oxidation and Reduction Reactions	**Students understand:** • The difference between the reactions of sorption, precipitation,		• http://www.soils4teachers.org/chemistry • http://soils4teachers.org/soil-and-food

• Hydrolysis
  ○ of organic matter
  ○ of minerals
	oxidation, reduction, hydrolysis and soils organic matter interactions.		

3. Macro and micro nutrients
• soil fertility,
• role of macro and micronutrients in plant processes,
  ○ elements in plant growth (C, H, O, N, P, K, Ca, S, Mg, Co, Mo, B, Cl, Cu, Fe, Mn, Zn)
  ○ mineralisation and nitrification of organic nitrogen
  ○ water and nutrient (ion) uptake by roots (diffusion, osmosis)
• health of plants and animals (including earthworms),
• mineral deficiencies in plants and animals
• nutrient toxicity in plants and animals,
• nutrient retention and availability,
• nutrient cycles (carbon, phosphorus, nitrogen)
	Students understand:
	• The difference between macro and micro nutrients.
	• What minerals and trace elements that are important to New Zealand primary production
	• What soil fertility means.
	• What nutrients do plants need?
	• What the role of macro and micronutrients is in plant processes.
	• The two processes of nitrification and denitrification of the nitrogen cycle.
	• How water and nutrients are taken up by plants.
	• Nutrient retention and availability.
	• The problems that mineral deficiencies or toxicities have on plants and / or animals.
	• Nutrient cycles for nitrogen, carbon, and phosphorus.
		• Brainstorming:
		  • Why are some soils in New Zealand deficient in minerals and trace elements that are important to New Zealand primary production? (The parent rock has mineral deficiencies due to the high proportion of silica or ash from volcanoes).
		  • What are two factors that chemical fertility in a soil depends on? (Parent rock material, mineral material, amount of organic matter, fertiliser history).
		  • How does organic matter help with chemical fertility in soils? (Releases nutrients when decomposing, holds nutrients in soil due to electrical or chemical attraction).
		  • How does clay help with chemical fertility in soils? (Helps hold nutrients in soil due to electric or chemical charges, contains many essential soil minerals).
		  • What is the difference between macro and micro nutrients?
		• Play the 'Travelling Nitrogen' game http://www.windows2universe.org/teacher_resources/teach_nitrogen.html
		• Nitrogen cycle http://www.cfaitc.org/lessonplans/pdf/404.pdf
		• Matter of Fact worksheet on Nitrogen http://www.cfaitc.org/lessonplans/pdf/404.pdf
		• What goes around, comes around activity http://www.cfaitc.org/lessonplans/pdf/404.pdf
		• Nitrification and denitrification activity (on pg 12 of Nitrogen Dynamics in the Environment book).
		• Complete activities on cobalt and the Central North Island
			• http://www.ballance.co.nz/Our-Science/Library/Articles/Dairy/Foliar-uptake-of-nitrogen
			• http://www.ballance.co.nz/Our-Science/Library/Articles/Sheep-Beef/The-importance-of-sulphur
			• http://www.ballance.co.nz/Our-Science/Library/Articles/Arable/Managing-cereal-crop-N
			• http://www.ballance.co.nz/Our-Science/Library/Articles/Horticulture/Growing-good-wine
			• http://www.ballance.co.nz/Our-Science/Library/Articles/Horticulture/Phosphate-and-potatoes
			• http://www.ballance.co.nz/Our-Science/Library/Articles/Lifestyle/Molybdenum
			• http://www.ballance.co.nz/Our-Science/Library/Articles/Sheep-Beef/Hill-country-fertility
			• http://www.ballance.co.nz/Our-Science/Library/Articles/Lifestyle/Soil-fertility-for-lifestyle-farmers
			• http://www.ravensdown.co.nz/nz/Documents/animal-health-brochure.pdf
			• http://www.agresearch.co.nz/our-science/land-environment/nutrient-management/Pages/pasture-requirements.aspx
			• Graphs to show the nutrient availability of nitrogen and phosphorus in the soil.
			• The nitrogen and carbon cycles diagram.
			• Nutrient availability and uptake for potassium sheet.
			• Essential elements for soil, plant & animal health information sheet.
			• The main functions of the essential minerals in plants information sheet.
			• Key to mineral deficiency symptoms sheet.
			• Mineral uptake sheets.

		http://scienceonline.tki.org.nz/Nature-of-science/Nature-of-Science-Teaching-Activities/Trace-elements-and-land-use-Why-the-Kaingaroa-Forest-isn-t-grassland	• Examples of mineral deficiency symptoms sheet. • http://www.dairynz.co.nz/publications/farmfacts/fertiliser-and-nutrient-management/farmfact-7-12/ • http://www.dairynz.co.nz/publications/farmfacts/fertiliser-and-nutrient-management/ • http://www.dairynz.co.nz/animal/health-conditions/trace-element-supplementation/ • http://www.dairynz.co.nz/publications/farmfacts/fertiliser-and-nutrient-management/farmfact-7-1/ • http://www.waikatoregion.govt.nz/PageFiles/30016/factsheets/CNM%20factsheet%20managing%20soil%20fertility_3.pdf • http://www.waikatoregion.govt.nz/PageFiles/30016/factsheets/CNM%20factsheet%20soil%20management_1.pdf • www.sciencelearn.org.nz/Contexts/Soil-Farming-and-Science/Science-Ideas-and-Concepts/The-nitrogen-cycle • www.sciencelearn.org.nz/Contexts/Soil-Farming-and-Science/Science-Ideas-and-Concepts/The-phosphorus-cycle • www.sciencelearn.org.nz/Contexts/Soil-Farming-and-Science/Sci-Media/Interactive/The-terrestrial-nitrogen-cycle • http://soils4teachers.org/biology-life-soil

Soil Testing
1. Reason for testing
• Crop and nutrient logging
• Diagnostic approach
• Routine monitoring
• Formulation fertiliser programmes
• Animal health
• Changing land use
2. Nutrients available
• contribution to soil fertility,
• target fertility levels
  ○ optimum level for property
  ○ soil type
  ○ type of enterprise
3. Sampling method
• suitability of property to method
4. Sampling procedure
	Students understand:
	• The reasons for testing of soil.
	• That different sampling methods are required for different nutrient testing.
	• What are the different tests and what they test for.
	• How to interpret test results.
		• Brainstorming:
		  • What will the results of testing for nutrient levels help with? (Correct fertiliser application).
		  • To check the fertility levels of a soil, what tests should be done? (Soil test and herbage test).
		• Practical – Soil collection. Take a series of core samples in a zigzag across an area to be analysed using either a chisel or screw auger.
		• Practical - students to carry out soil tests of Olsen P and sodium fluoride allophane in the laboratory or teacher to demonstrate. Olsen P soil tests can be conducted on a variety of samples such as; the change in Olsen P with soil depth, the variation in Olsen P values
			• http://www.ballance.co.nz/Our-Science/Library/Articles/Dairy/Time-to-think-about-soil-testing
			• http://www.ballance.co.nz/Our-Science/Library/Articles/Arable/After-the-harvest
			• http://www.ballance.co.nz/Our-Science/Library/Fact-Sheets/Fertiliser-for-fodder-beet
			• http://www.ballance.co.nz/Our-Science/Library/Fact-Sheets/Fertiliser-for-home-gardens
			• http://www.ballance.co.nz/Our-Science/Library/Fact-Sheets/Fertiliser-for-maize
			• http://www.ballance.co.nz/Our-Science/Library/Fact-Sheets/Fertiliser-for-radiata-pine
			• http://www.ballance.co.nz/Our-Science/Library/Fact-Sheets/Fertiliser-for-small-blocks

• Basic soil test e.g. pH, P (Olsen P), K (Quick test), Ca (Quick test), S, Mg (Quick test), Na • CEC and BS • Volume weight (bulk density) • Additional testing e.g. sulphate sulphur, organic matter (OM), soluble salts, phosphate retention (PR), available nitrogen and total nitrogen, boron, aluminium and trace metals. **5. Interpreting soil test results**		across a paddock, the levels of Olsen P observed in paddock gateways, around water troughs and in horticultural soils. • Field trip – go to a soil testing facility to see soil testing being carried out such as Hill Laboratories or Soil Fertility Services. • Using soil test results – interpret results. Suggest possible fertilisers to use in response to the results. • 'Know your Nitrogen' practical testing. http://www.cfaitc.org/lessonplans/pdf/404.pdf • Measure the bulk density and porosity level of a soil sample (see Beacons School folder).	• http://www.ballance.co.nz/Our-Science/Library/Fact-Sheets/Nutrient-requirements-of-maize • http://www.ravensdown.co.nz/nz/Documents/soil-testing-prices.pdf • Olsen P procedure. • pH testing pg. 89 in Enterprising Agriculture. • Field trip question sheet. • Growing media analysis sheet. • Sampling sheet. • Soil test results. • http://www.dairynz.co.nz/publications/farmfacts/fertiliser-and-nutrient-management/farmfact-7-2/ • http://www.dairynz.co.nz/publications/farmfacts/fertiliser-and-nutrient-management/farmfact-7-3/ • http://www.dairynz.co.nz/publications/farmfacts/fertiliser-and-nutrient-management/farmfact-7-5/ • Bulk density of mineral soils information page
Herbage Tests 1. Reason for testing - crop & plant analysis 2. Collection of samples 3. Interpreting herbage nutrient results	**Students understand:** • The reasons for testing of plants. • That different sampling methods are required for different nutrient testing. • What are the different tests and what they test for • How to interpret test results.	• Brainstorming: • What is the purpose of carrying out herbage testing? • Field trip – go to a herbage testing facility to see herbage testing being carried out such as Hill Laboratories or Soil Fertility Services. • Using herbage test results – interpret results. • Using a petiole analysis kit analysis, test grape vine leaves for nutrient deficiencies. • Suggest possible fertilisers to use in response to the results.	• http://www.ravensdown.co.nz/nz/Documents/plant-testing-prices.pdf • http://www.dairynz.co.nz/publications/farmfacts/fertiliser-and-nutrient-management/farmfact-7-4/

Nutrient Budgeting
1. External
• Inputs e.g. fertiliser, purchased feed, biological nitrogen fixation, effluent, atmospheric, supplements, irrigation
• Outputs e.g. products, residues, transfer to non-productive areas,
	Students understand:
	• The external and internal inputs and outputs of nutrient budgeting.
	• How to produce a nutrient budget.
	• How to use nutrient management programmes.
		• Brainstorming:
		  • What is the purpose of nutrient budgeting?
		  • What are the external inputs and outputs and the internal inputs and outputs of nutrient budgeting?
			• http://www.ballance.co.nz/Our-Science/Library/Articles/Environment/Research-update-phosphorus-run-off
			• http://www.ballance.co.nz/Our-Science/Library/Fact-Sheets/Cool-season-ammonia-loss
			• http://www.ballance.co.nz/Our-Science/Library/Fact-Sheets/NGuru

leaching, volatilisation, and runoff, gaseous losses to the air **2. Internal inputs and outputs** • Mineralisation / immobilisation • Adsorption of P and S • Slow release K and P • Nutrients required for growth **3. Production of a nutrient budget.** **4. Use of computer programmes** **5. Fertiliser management plan**	• Why a fertiliser management plan is required. • How to produce a fertiliser management plan.	• Demonstrate computer programmes such as Overseer – a specialist fertiliser management programme; or NGuru – designed to improve the use of N in New Zealand pastoral systems. • Using information from soil test results, make fertiliser recommendations and outline them in a fertiliser programme. • Nitrogen fixation in legumes activity (on pg. 17 of Nitrogen Dynamics in the Environment book). • Nitrogen reactions in soil (on pg. 101 of Nitrogen Dynamics in the Environment book). • Show PowerPoint Reducing Nitrogen Losses from Agriculture Using a Nitrification Inhibitor (eco-n).	• http://www.ballance.co.nz/Our-Science/Library/Fact-Sheets/Tiered-Fertiliser-Management-System • Diagram to show the gains and losses of available soil nitrogen. • Diagram to show soil nutrient balance under agriculture. • Gains and losses of soil nutrients. • http://www.dairynz.co.nz/publications/environment/ • http://www.dairynz.co.nz/environment/land-and-nutrient/ • http://www.dairynz.co.nz/publications/farmfacts/fertiliser-and-nutrient-management/farmfact-7-20/ • http://www.dairynz.co.nz/publications/farmfacts/fertiliser-and-nutrient-management/farmfact-7-21/ • http://www.dairynz.co.nz/publications/farmfacts/fertiliser-and-nutrient-management/farmfact-7-23/ • http://www.dairynz.co.nz/publications/farmfacts/fertiliser-and-nutrient-management/farmfact-7-24/ • http://www.waikatoregion.govt.nz/PageFiles/30016/factsheets/CNM%20factsheet%20nutrient%20management%20plans_10.pdf • http://www.waikatoregion.govt.nz/Environment/Natural-resources/Land-and-soil/Managing-Land-and-Soil/Managing-farm-nutrients/Nutrient-management-plan-guidelines/ • www.sciencelearn.org.nz/Contexts/Soil-Farming-and-Science/NZ-Research/Managing-nutrients • PowerPoint Reducing Nitrogen Losses from Agriculture Using a Nitrification Inhibitor (eco-n).
Fertilisers **1. Why use fertilisers?** **2. Common fertilisers types and their nutrient content (N, P, K, Mg, S)** • inorganic: superphosphate, urea, ammonium nitrate, ammonium sulphate, potassium sulphate; and • organic: manures (dairy, pig, poultry), seaweed, blood and bone,	**Students understand:** • The reasons why fertilisers are used. • The different fertiliser types and their nutrient content. • The properties and characteristics of fertilisers.	• Brainstorming: • Why do we use fertilisers? • Fertiliser activity – See TA fertiliser activity. • Understand the concepts of dilution and concentration in fertilisers of "Parts per Million', do activity 'One in a Million' http://www.cfaitc.org/lessonplans/pdf/404.pdf • Explain that soil sample results from the school farm indicate areas with different	• http://www.ravensdown.co.nz/nz/Documents/liquid-fertiliser-brochure.pdf • www.sciencelearn.org.nz/Contexts/Soil-Farming-and-Science/Looking-Closer/Fertiliser • http://sciencelearn.org.nz/Contexts/Soil-Farming-and-Science/Sci-Media/Video/Fertilisers • Fertilisers hand out. • http://www.dairynz.co.nz/publications/farmfacts/fertiliser-and-nutrient-management/farmfact-7-10/

legumes and their symbiotic relationships, compost, **3. Properties and characteristics of fertilisers.** • ionic bonding – in a crystal lattice • pH – measurement, release of H+ ions • solubility – relationship to polarity of water molecule, effect on formulation for application (e.g. slow release fertilisers) • melting point and boiling point • percentage composition • availability of ions to plants.		nutrient deficiencies. Students will need to determine which fertilizer to use in order to remedy these deficiencies. http://www.cfaitc.org/lessonplans/pdf/404.pdf • Concentrate on the Solution worksheet http://www.cfaitc.org/lessonplans/pdf/404.pdf • Graphing fertiliser pg. 402 in Enterprising Agriculture. • Fertiliser label information activity (on pg 63 of Nitrogen Dynamics in the Environment book). • Comparing fertiliser activity.	• http://www.dairynz.co.nz/publications/farmfacts/fertiliser-and-nutrient-management/farmfact-7-11/ • http://www.dairynz.co.nz/publications/farmfacts/fertiliser-and-nutrient-management/farmfact-7-12/ • http://www.dairynz.co.nz/publications/farmfacts/fertiliser-and-nutrient-management/farmfact-7-13/ • http://www.dairynz.co.nz/publications/farmfacts/fertiliser-and-nutrient-management/farmfact-7-14/ • http://www.waikatoregion.govt.nz/PageFiles/30016/factsheets/CNM%20factsheet%20get_most_fertiliser_effluent_nitrogen_8.pdf • http://www.waikatoregion.govt.nz/PageFiles/30016/factsheets/CNM%20factsheet%20phosphorus_use_9.pdf • http://www.waikatoregion.govt.nz/Environment/Environmental-information/Environmental-indicators/Land-and-soil/Soil/fertiliser-use-key-points/ • RNZIH Fertiliser Bulletin: The use of Fertiliser in Horticulture. (See Beacons School folder). • Comparing Fertiliser Activity from Grow It.
4. The effects of fertilisers • effect on primary production. • soil particle charge in holding and releasing ions • ions in pollution and eutrophication.	**Students understand:** • The effect that fertilisers have on primary production in New Zealand. • The effect that fertilisers can have on the environment.	• Investigate the effect of fertilisers on plants growing in your soil. (See pg 200 of Enterprising Agriculture).	• Lysimeter facility notes
5. Fertiliser compounds, granular, blends, liquids, slow release, solutions, suspensions, organic. • usage – fertiliser requirements for primary production and land use. • chemical and physical compatibility • manufacturing and production • quality control e.g. Fertmark fertilisers and Spreadmark operators administered by the Fertiliser Quality Council • Implications for handing, transport, storing and spreading	**Students understand:** • The difference between fertilisers and their makeup and their use. • What quality controls are in place when using and spreading of fertilisers. • The implications for handling, transport, storing and spreading.	• Fertiliser scavenger hunt (on pg 98 of Nitrogen Dynamics in the Environment book). • Carry out the investigation 'Does Foliar Feeding really work?' • How are fertilisers made? activity. • Make your own lawn fertiliser practical. • Formulate a complete fertiliser practical.	• Does foliar feeding really work? Practical investigation from Horticulture worksheets 75. • How are fertilisers made? activity from Grow It. • Make your own lawn fertiliser practical from Grow It. • Formulate a complete fertiliser practical from Grow It. •

6. The application of fertilisers – both organic and inorganic • code of practice • method of application • timing of application e.g. weather conditions, soil type, plant growth curves. • calculating application rates • costs of fertilisers • toxicity of fertilisers on animal and plant health • environmental implications.	**Students understand:** • The code of practice for fertilisers. • The different methods, and timing of application of fertilisers. • How to calculate application rates and costs of fertilisers.	• Compare the cost and nutrient content of different types of fertilisers in order to make the best recommendations for purchase of different fertilisers. http://www.cfaitc.org/lessonplans/pdf/404.pdf • Determining the nitrogen content of fertilisers (on pg. 68 of Nitrogen Dynamics in the Environment book). • Fertiliser spreadsheet (on pg. 72 of Nitrogen Dynamics in the Environment book). • Determining the amount of nitrogen in compost (on pg. 87 of Nitrogen Dynamics in the Environment book). • Effluent evaluations (on pg. 92 of Nitrogen Dynamics in the Environment book). • Lawn fertiliser application (on pg. 99 of Nitrogen Dynamics in the Environment book).	• http://www.ballance.co.nz/Our-Science/Library/Fact-Sheets/Aerial-application-of-elemental-sulphur • http://www.ballance.co.nz/Our-Science/Library/Fact-Sheets/Aerial-topdressing-safety • http://www.ballance.co.nz/Our-Science/Library/Fact-Sheets/Post-drought-fertiliser-use • http://www.ballance.co.nz/Our-Science/Library/Fact-Sheets/Trace-elements-application-guidelines • http://www.ravensdown.co.nz/nz/Documents/media-testing-prices.pdf • http://www.ravensdown.co.nz/nz/Documents/fertiliser-prices.pdf • http://www.ravensdown.co.nz/nz/Documents/spreading-brochure.pdf • http://www.ravensdown.co.nz/nz/Documents/pgp-brochure.pdf • Nitrogen application and nitrogen fixation graph.
Incorporation of The Big Picture by bringing it altogether as a group.	• How does the understanding of soil chemistry affect the primary industry? • How does the knowledge of soil chemistry explain aspects of soil? • How is soil chemistry used in primary production to meet producer needs, resolve their issues and develop new technologies?	• In groups using a large concept map, students draw their understanding of the links and ideas throughout the topic. This is supported by the scientific concepts learnt throughout the unit.	• Paper and Pens. • Or a large white board. • http://www.ballance.co.nz/Our-Science/Library/Fact-Sheets/Improving-Pasture-Productivity • http://www.ballance.co.nz/Our-Science/Library/Fact-Sheets/Improve-pasture-improve-profit • http://www.ravensdown.co.nz/nz/Documents/optimiser-brochure.pdf • Yield and profitability of adding nutrients for nitrogen. • http://www.dairynz.co.nz/feed/pasture/pasture-growth-data/
Assessment:	ASXXXXXX 3.4 Demonstrate understanding of soil and fertiliser chemistry. 4 Credits Internal		