Inanga Restoration Project

Project Outline

Ministry of Education

The NZ Curriculum

Gisborne District Council

Prepared by Amy-Rose Hardy

Nga Mahi Te Taiao

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ENVIRONMENT & NATURAL RESOURCES
Research Education Planning Development

Contents

Inanga Restoration Project

Background

The inanga restoration project focusses on the identification, protection, restoration and enhancement of habitat in our streams and rivers for Galaxias maculatus, the native inanga. Although inanga are widespread throughout the southern hemisphere, in NZ they are considered to be in a state of decline. However inanga play a vital role in freshwater ecosystems, as they not only comprise by far the bulk of the whitebait run, but also provide a significant food source for numerous native fish and bird species, and contribute towards the transfer of energy from the ocean into our rivers and lakes.

Over the years, much has been said about the decline of the whitebait fishery and possible reasons for it. Fishing pressure was the target of a recent study on the Mokau River, however whitebaiters here caught a relatively small proportion of the total run. The loss of habitat through swamp and wetland drainage, stream channelization, the presence of weirs, fords and poorly designed culverts, introduced fish (trout, Gambusia) are all believed to have contributed to reduced inanga numbers. But today however, a reduction is spawning habitat is believed to be the major limiting factor (NIWA, 2016).

Inanga spawn on river or stream banks among vegetation inundated by spring high tides. The eggs remain above the water level until the next spring tide when they hatch and are washed out to sea. Modification of the tidally affected regions of stream and river banks by cattle browsing and trampling, vegetation cleared, artificial bank buttressing and flood control works have thus destroyed much spawning habitat.

The Gisborne District Council has established an inanga project that aims to protect, restore or enhance inanga habitat, and particularly inanga spawning habitat. Education is seen as a critical part of the restoration process, and schools in particular can play a key role in facilitating good environmental information amongst their students and communities. Further, the unique life cycle of the inanga, their place in freshwater food webs and the avoidance or management of the threats to their habitat, provide a rich place-based enquiry learning context.

This workbook outlines a typical inanga program for a class or classes, including the development and implementation of a protection or restoration plan. Although this has been designed with Levels 3 and 4 in mind, we believe it can also be utilised at levels above this. Overall however, the focus is on integrating the work into the students' needs and activities, and the techniques and tools developed (visual assessment, water chemistry, biological indicators, diadromous biology, conservation planning) can be adapted to suit a particular purpose. The Whitebait Connection http://www.whitebaitconnection.co.nz/ contains a rich store of relevant educational resources, and GDC http://www.gisbornedistrictcouncil.co.nz and He Awa Ora, Healthy Rivers Project http://www.nmtt.co.nz can provide sources of local knowledge and technical expertise in assisting with project delivery.

Guideline of Activities and Timeline Summary

This is an outline of the Inanga Restoration Project to indicate the timeline in which the project would be delivered with the assistance from project facilitators. Please refer to the *Inanga Restoration Project - Links to the NZ Curriculum Level 3 – 4 (Year 7 and 8)* document below for a complete outline of Science, Social Science and Physical Education key learning areas and teaching and learning objectives. Learning outcomes and activities are provided for each specific learning objective relating to that topic and reference to resources provided for in-class activities.

Please Note: The *Supporting Activities* reference a variety of resources in the *Learning Outcomes and Activities* section (refer to page 7). These resources will be provided by the Inanga Project Facilitators in the initial meeting to support the *Key Learning Areas* that the teacher selects for their participating students. Therefore, the learning outcomes and activities the teacher selects will determine which resources she/he may or may not use from the resource pack provided.

The *Learning Outcomes and Activities* relate to some of the activities presented below in the outline summary, therefore, all other learning outcomes and activities, assigned with specific resources, are provided as an option for delivery by the teacher (e.g. in-class with no facilitator present).

Timeline Summary	Hours per day	Assistance from Project Facilitators
1. Initial meeting with teachers	*Day 1:* ½ - 1 hour	*Facilitators to discuss resources and project outline with interested parties*
2. First classroom session: Power point presentation	*Day 2:* 1 – 2 hours per class	*Facilitators can present this to the students or the teacher can adapt and present themselves*
3. Field Trip 1: Site 1	*Day 3:* 2 - 3 hours	*Led by facilitators with assistance from teachers*
4. Field Trip 2: Site 2	*Day 4:* 2 - 3 hours	*Led by facilitators with assistance from teachers*
5. Second classroom session: Action Plan	*Day 5:* ± 2 hours	*Led by teachers with assistance from facilitators*
6. Field Trip 3: To site 1 or 2 – Restoration	*Day 6:* ± 2 hours	*Facilitators and teachers*

Inanga Restoration Project

Links to the NZ Curriculum

Level 3 – 4 (Year 7 and 8)

Ministry of Education

The NZ Curriculum

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Overall Science Achievement Aims (All Levels)

Achievement Aims: Nature of Science	
Understanding about science	Learn about science as a knowledge system: the features of scientific knowledge and the processes by which it is developed; and learn about the ways in which the work of scientists interacts with society.
Investigating in science	Carry out science investigations using a variety of approaches: classifying and identifying, pattern seeking, exploring, investigating models, fair testing, making things, or developing systems.
Communicating in science	Develop knowledge of the vocabulary, numeric and symbol systems, and conventions of science and use this knowledge to communicate about their own and others' ideas.
Participating and contributing	Bring a scientific perspective to decisions and actions as appropriate.
Achievement Aims: Living World	
Life processes	Understand the processes of life and appreciate the diversity of living things.
Ecology	Understand how living things interact with each other and with the non-living environment.
Evolution	Understand the processes that drive change in groups of living things over long periods of time and be able to discuss the implications of these changes.
Achievement Aims: Planet Earth and Beyond	
Earth systems	Investigate and understand the spheres of the Earth system: geosphere (land), hydrosphere (water), atmosphere (air), and biosphere (life).
Interacting systems	Investigate and understand that the geosphere, hydrosphere, atmosphere, and biosphere are connected via a complex web of processes.
Astronomical systems	Investigate and understand relationships between the Earth, Moon, Sun, solar system, and other systems in the universe.
Achievement Aims: Physical World	
Physical inquiry and physics concepts	Explore and investigate physical phenomena in everyday situations.
Physical concepts	Gain an understanding of the interactions that take place between different parts of the physical world and the ways in which these interactions can be represented.
Using physics	Apply their understanding of physics to various applications.
Achievement Aims: Material World	
Properties and changes of matter	Investigate the properties of materials.
The structure of matter	Interpret their observations in terms of the particles (atoms, molecules, ions, and sub-atomic particles), structures, and interactions present.
Chemistry and society	Make connections between the concepts of chemistry and their applications and show an understanding of the role chemistry plays in the world around them.

Ministry of Education (2014). The NZ Curriculum: Science, Achievement Objectives. Retrieved online from http://nzcurriculum.tki.org.nz/The-New-Zealand-Curriculum/Science/Achievement-objectives

Supporting Activities

Key Learning Areas	Teaching and Learning Objectives	Inanga Korero	Learning Outcomes and Activities
Nature of Science			
Understanding about science	Appreciate that science is a way of explaining the world and that science knowledge changes over time. Identify ways in which scientists work together and provide evidence to support their ideas.	Declines in whitebait: harvest or habitat degradation? How we know about where whitebait come from and where they go to as juveniles.	***Task:*** To gain information on whitebait with a focus on the inanga species. To be able to explain the inanga life cycle and habitat required for breeding and survival. ***Activities:*** Information and knowledge will be shared through an in-class power point presentation to gain initial understanding around whitebait. Please refer to the power point presentation provided in the resource pack. 1. Resources and in-class worksheets are provided to enhance their understanding of inanga and grow their knowledge from information provided in the presentation. Please refer to the *Teaching Activities* folder for a range of different resources, lesson plans and in-class worksheets. More resources can be found on the WBC website: www.whitebaitconnection.co.nz. 2. Please refer to the *Whitebait Run* resource which is a game that students can play outside to show the inanga life cycle and the threats in our catchments that affect them. This can be played after the presentation to reinforce the concepts that they have just been introduced to. Digital resources can be produced from the documents provided such as, the life cycle of inanga, moving each process into the appropriate stage etc.
Investigating in science	Build on prior experiences, working together to share and examine their own and others' knowledge.	Development of knowledge about inanga spawning and juvenile to adult habitat requirements.	***Task:*** Complete an assessment of your river to establish the water quality and habitat and if it is suitable for inanga to spawn. To be able to develop explanations on the habitat, water chemistry and biological assessment results gathered from a site visit. ***Activities:*** A field trip to the proposed site. Initial discussions and questions around the site will instigate the activity as prior knowledge gained can be shared and prompted.

	Ask questions, find evidence, explore simple models, and carry out appropriate investigations to develop simple explanations.	Is your river suitable habitat?	1. Students will need to measure the salinity to determine the salt wedge location, using a hand probe. This is determined when the probe reads freshwater at the surface (e.g. 0.3 ppt) and salinity gradually increases as the probe is dropped to the substrate. This activity could take a few attempts to determine the precise site of the salt wedge, therefore, students could be walking along the bank until they find this site. The site is determined when spring tides are occurring. Please refer to the resource, *Spring Tides* in the *Resources for Curriculum Links* folder. 2. Once the salt wedge is identified, questions and discussions around the visual habitat of the area will be initiated, for example, riparian vegetation, streambank slope, sediment potential and all other habitat factors identified in the power point presentation. Students will record their findings on the *Monitoring Sheet for Schools (level 3-5)* worksheet which is provided in the *Resources for Curriculum Links* folder. 3. Students will then draw a site profile which will show the slope of the banks, vegetation, shade and the width of the river. These profile drawings will provide a visual outlook on the site when referring back to it for in-class activities. A stream profile will also be completed to show wood, rocks, macrophytes and algae that may be present within the water. 4. Once the habitat assessment is complete, the next activity will include gathering water samples and using electronic freshwater probes to collect water chemistry information. a) Students will measure the stream flow velocity using a tape measure and small orange. They will measure out the length (e.g. 10-20m) along the edge of the water with the tape. One student will take the orange to the start (being careful not to disturb the water flow). One student will use a stopwatch to record the time, they will shout GO and the ball will be placed at the start. Once it reaches the end, the time is stopped and recorded. This is then calculated to establish the velocity (m/sec) of the water and if it falls within the preferred velocity for inanga. b) Water samples gathered in containers will be used to test for water clarity where every student can have a turn looking through the clarity tube. Students can record all participants' measurements and calculate the average score to establish the overall clarity of the water.

			c) The temperature of the water, pH level, dissolved oxygen and conductivity are all recorded on probes that need to be placed into the water and held there until the measurements stabilise, so one number can be taken for each test and recorded on the *Monitoring Sheet for Schools (level 3-5)* worksheet. 5. Lastly, students will complete a biological assessment of the river. They will work in small groups of up to 5 per group, each group having a container and net to share collecting invertebrates and fish from areas within the river. a) They will 1/4 fill up their container with some water and place on the riverbank. This will be used to keep their animals until their collection is complete. b) If the river is a hard bottom, students can pick up rocks and shake into the bucket to collect the invertebrates living underneath. If there are plants under or emerging from the water's surface, the nets can be used to push up against the plants (moving from bottom to top) to gather invertebrates that are attached. c) Students will collect their invertebrates and fish until they have a variety of animals in their bucket to identify. d) Containers will be brought to a shady location to identify animals against the Wai Care Invertebrate Field Guide Identification Sheet, please refer to the WIMP ID booklet in the *Resources for Curriculum Links* folder. All invertebrates will be separated into compartment containers to identify different species and their populations. All invertebrates found have a score assigned with them to identify their sensitivity. All invertebrates and fish found will be recorded on their worksheets. A macroinvertebrate community index (MCI) score can then be calculated, this is the average score from an absence/presence identification of invertebrates. To extend this further, a quantified macroinvertebrate community index (QMCI) score can be calculated which is when students count the total number of each species that they have collected. Please refer to the MCI and QMCI Calculations document for full details on how to calculate these scores. e) Once every group has recorded all their data, all the animals can be placed back into the river and equipment rinsed. A resource used to identify native fish is, The Reed Field Guide to New Zealand Freshwater Fishes written by R.M. McDowall (2000). This can be found in libraries or as an online resource through

			the NIWA website: https://www.niwa.co.nz/freshwater-and-estuaries/nzffd/NIWA-fish-atlas/reading-list ***Further Activities***: In-class discussion and analysis of their findings. 1. What the habitat looked like and was it suitable for inanga to spawn, why or why not? From our site visit, students will have a site profile drawing that they completed where they can discuss the vegetation, slope of the banks, and if there are any areas to prevent inanga from moving upstream and thriving. 2. Students can compare and categorise their water chemistry results with the *Explanation of Scores* document where they will match up their result with the explanation for that category/measurement. Students can work in groups to determine the results of each test, what it means, what can be done, and if it is appropriate for inanga to survive and breed. These can be produced into a table. 3. Students would have recorded their invertebrates and fish at the site visit so they can now calculate the MCI and/or QMCI. This can be done using the *MCI and QMCI Calculations* document. Using the score categorising table at the bottom of the document, students can then see where their score lies in relation to water quality and come up with explanations for their results. ***Please note:*** All documents referred to can be found in the *Resources for Curriculum Links* folder. Additionally, there are a range of different resources and documents to provide further learning to the students. These can be found in the *Teaching Activities* folder.
Communicating in science	Begin to use a range of scientific symbols, conventions, and vocabulary. Engage with a range of science texts and begin to question the purposes for which	Monitoring and assessment tools.	***Learning Outcome:*** To be able to explain meanings of various water quality values and the purpose or significance of habitat factors, water chemistry and biological indicators for stream health and for animals e.g. inanga to thrive and spawn. ***Activities:*** In-class activities: 1. Students can produce some flip cards with each water quality test (e.g. dissolved oxygen, pH, temperature, salinity, velocity, conductivity) with their meanings on the other side to play memory in small groups. For example, velocity = the velocity needs to be slow

	these texts are constructed.	Science papers.	flowing as inanga find it hard to swim upstream in a strong current. They will also find it hard to swim over any obstacle when the water is flowing at a high speed which will prevent them from reaching freshwater in which to grow. These can also be used for meanings to all new words introduced in this project, e.g. diadromous. These can be used in the form of digital resources where students could pull the meaning (touch screen) to the appropriate term. 2. Individual or group research: Students can compare different writings provided. For example, WBC documents available online, inanga papers, books, journals and all online resources to consider the best for understanding whitebait and what they believe will be suitable to use, drawing parts out from a range of different science papers.
Participating and contributing	Use their growing science knowledge when considering issues of concern to them. Explore various aspects of an issue and make decisions about possible actions.	Importance of land management in freshwater fisheries wellbeing. Action planning and implementation.	***Task:*** To brainstorm and develop a restoration plan for spawning sites and the river where whitebait grow. To be able to identify inanga habitat and water quality requirements. ***Activities:*** The information and knowledge students have gained from the power point presentation, research, in-class activities and a site visit will be stimulated. 1. The whole class can work together to brainstorm issues of concern to them. Questions are to be prompted around issues that inanga face and what they identified at the site visit. Are there any issues of concern? For example, stock access, sedimentation, vegetation, slope of the banks, shade, water chemistry results, and MCI or QMCI results? 2. Once the students have identified issues of concern to them, split the class into groups and let each group choose an issue to brainstorm ways for improvement and possible actions to take to restore, protect or enhance this spawning site. For example, issue = stock access, a possible action could be to gain land owner approval for fencing off the spawning area as a whole or just over the spawning season. These can all be put into an action plan with a prioritised list of action projects and steps to take to restore, protect or maintain the site. Please refer to the resources provided under the

			Information Resources for Students and Teachers folder. These resources allow students to select solutions to problems they have identified in their restoration process.
Living World			
Life processes	Recognise that there are life processes common to all living things and that these occur in different ways.	E.g. different native fish	***Learning Outcome: :*** To compare inanga with other whitebait Galaxia species and native fish life cycles. To be able to identify and explain differences between inanga and these different native fish. ***Activities:*** This will be an in-class activity, working in groups of 5 per group. All the information gained around inanga can be the base for these activities where students will work with a comparative whitbait galaxia species to identify differing life cycle stages. 1. On an A3 piece of paper, students need to draw a catchment, from water coming off the mountains and eventually leading out to sea, showing sub-catchments and the river mouth inlet. This process can also be in digital form where students can draw this using touch screen tools. 2. Once the drawing is complete, students can add specific elements that inanga require for their life process. For example, the salt wedge, bank vegetation, slow flowing water, culverts that are under the water and accessible for inanga to swim through, no obstacles e.g. waterfalls, the locations in the river where adult inanga live and all other factors that the students think are significant to their life processes. These will all be shown with arrows directing to the next stage in their life cycle. The end result should be a complete life cycle of the different processes and requirements that this species needs to survive, leading from freshwater to the ocean and back. 3. Using different colour pens, comparisons can be made with other whitebait species documenting life processes on the drawing. Each group can have an assigned species to work with and document. For example, koaro are very good climbers so a river sub catchment can be shown with the koaro passing through a waterfall or weir to their

			preferred habitat of forest and tussock riparian. Their life cycle can then be drawn and compared with the inanga. Research will need to be conducted in order to gain more information on the comparative species, and information gained from prior research or reading science papers.
Ecology	Explain how living things are suited to their particular habitat and how they respond to environmental changes, both natural and human-induced.	Degradation and restoration of inanga and other fish spawning and juvenile to adult habitat. Potential impacts of climate change on diadromous fish.	***Learning Outcome: :*** To Identify human impacts on inanga spawning and adult habitat and their effects, whether they will not be able to survive or breed, or can adapt to these changes successfully. Identify likely climate change scenarios, and potential changes to the natural environment, and what effects these will have on inanga spawning and adult habitat. ***Activities***: These will be in-class activities, with students working in groups for research activities. Refer to the *Teaching Activities* folder for helpful resources and documents. 1. Human Impacts, for example, clearing riparian vegetation, culverts that do not allow fish passage (especially for poor climbers like inanga), spraying around the river site, introduced fish e.g. Gambusia Affinis (mosquito fish) and stock grazing and trampling over these sites. a) Building on the student's prior knowledge and information that has been provided, they will have ideas of the human impacts that can effect these spawning and adult habitat areas. Complete a brainstorm with the class to record all their ideas of human impacts. b) Once a list is completed with all the human impacts identified, further discussions and thoughts should be recorded about how inanga would respond to these conditions. For example, culverts that are above the water's surface, requiring fish to leap up to get access to the other side, will be a barrier for inanga. If they have not reached the salt wedge (spawning site) they will be forced to lay their eggs in habitat that is not suitable for egg survival and/or being taken out to sea. c) A comparison can be made using an A3 piece of paper folded in half, showing the appropriate habitat for inanga spawning and survival on one side, compared with a human impacted habitat on the other. The differences can then be visually identifiable. For example, the ideal habitat would have appropriate vegetation along

			the riparian banks, the riparian gradient will also be flatter, no obstacles in the stream e.g. perched culverts on weirs, and suitable water velocity shown with arrows and text. On the other side, human impacts could include cattle grazing the banks and in the water, spraying for weeds along the banks, culverts in the water that are not below the water's surface (creating a small waterfall), and a digger clearing the stream which creates an entire loss of habitat. d) Complete this activity with questions and discussions around the requirements that inanga need in order to survive and breed, revealing how inanga are dependant on their particular habitat and what these human impacts can do to their survival and health abundance. 2. Students should have an understanding of how inanga are suited to their particular habitat and the significance of their life cycle process. Once students have knowledge on the local human impacts that can effect inanga habitat, they can then begin to explore and document wider environmental impacts such as climate change, and how these may affect the life cycle of fish. a) Students can research potential climate change effects and select the scenarios that could affect inanga in their particular habitat. This can be in the form of a table with one heading listing the climate changes and a parallel list of the effects or their adaptations to these changes. For example: Sea level rises = a complete change in ocean dynamics and the spawning site (salt wedge) is now located further upstream where inanga will have to move to these new sites to spawn.
Evolution	Begin to group plants, animals, and other living things into science-based classifications. Explore how the groups of living things we have in the world have	Galaxia as part of wider native fish taxa. Alga and macrophytes. Macroinvertebrates.	***Learning Outcome: :*** Consider and identify similarities of the galaxias. Identify the differences in macrophytes and algae. To be able to identify what fish are endemic to New Zealand and how they are different from other fish e.g. inanga (that are widespread across the pacific). To be able to classify macroinvertebrates into their sensitivity levels and identify individual species. ***Activities:*** These activities range from in-class tasks and incorporating information and data from site visits.

	changed over long periods of time and appreciate that some living things in New Zealand are quite different from living things in other areas of the world.	Native trees and ferns. Flightless birds.	1. To identify similarities of galaxias, students can use large outlined drawings of the five galaxias and draw on the characteristics for each. They can use colour codes for similarities and differences to reveal the related characteristics of these species. For example, slimy bodies with no scales, similar markings (star like markings), diadromous life cycles and similarities and differences in spawning processes. Students will need to do some research on the other galaxia species to gain more information on their life cycles and how they differ from inanga. 2. Identification and differences between macrophytes and algae using the *Algae Identification Card, Categories of Periphyton for Visual Assessments* and the *Quick Guide to NZ Macrophytes* resources to categorise the differences between these plant groups. When visiting a site, students can use this information to identify and classify the macrophytes or algae that are present. They can then look at their role in a river in relation to identifying stream health. Additionally, students can then create a document with identification images of macrophytes that are present within inanga spawning habitat using the *Macrophytes Associated with Inanga Spawning* resource found in the *Resources for Curriculum Links / Macrophytes and Algae* folder. All resources referred to regarding macrophytes and algae or periphyton can also be found in this folder. 3. Identify what fish are endemic to New Zealand and how they might be different from other fish, such as inanga. Students will need to research what fish are endemic to NZ and create a classroom list. Students can then break into small groups of 5 to classify the differences of one or two of these endemic species to exotic fish. Each group can produce their own small report on their findings and present it back to the class so everyone can gain the knowledge of the different species. This can be in the form of a poster or power point presentation. 4. Identify and classify macroinvertebrates into their sensitivity categories: a) In-class: Students are to be introduced, if they haven’t already, to the Wai Care Invertebrate Field Guide Identification Sheet (WIMP ID Booklet) provided in the *Resources for Curriculum Links* folder. This ID sheet categorises a wide range of

			invertebrates into a scale from 1 – 10, 1 = very low sensitivity and 10 = very high sensitivity. These scales are associated with a colour reference (green = high, orange = moderate, red = low sensitivity) that works great for visual learners. Students can choose one invertebrate from each classification level (3 in total) to produce their own summary of findings which will reveal the in-depth understanding of their absence or presence in a river. These findings can be produced using the key at the bottom of each page on the Wai Care Invertebrate Field Guide ID sheet. This field guide can be reproduced electronically through word or power point or in the form of a poster or booklet. Each invertebrate has their preferred habitat which is identified using the key, the students can then align this with the preferred inanga habitat to indicate if these invertebrates would be likely to be present or absent within the inanga environment. b) Site visit: Students will participate in a site visit to the spawning area to undergo a wide range of activities outlined in the, *Activities: Investigating in Science* achievement. One of these activities will be collecting the invertebrates from the river and identifying them. Students will then go a step further into classifying them into their specific categories of sensitivity. When students correctly identify a species, questions to be asked should include: What sensitivity score does that invertebrate have? What does its presence tell us about this river? What is its preferred habitat? Where does it live in the river?
Planet Earth and Beyond			
1. Earth systems	Appreciate that water, air, rocks and soil, and life forms make up our planet and recognise	Look at the different types of resources used on our planet, focusing	***Learning Outcome: :*** To identify what happens in different parts of a catchment and how we use different areas and resources of our planet.

<table>
<tr><td></td><td>that these are also Earth’s resources.</td><td>on activities around water catchments.

Effects of young sedimentary geology on land use patterns.</td><td>Activities: This task includes in-class activities that can be supported with resources in the Teaching Activities / Environment Investigators Resources & Activities / Freshwater Ecosystems folder.

1. Students will use their knowledge of water systems to draw and design a catchment map on an A3 paper or in a digital format. This catchment will be from the mountains, coming down with a range of sub-catchments and eventually leading out to the ocean.
a) Discuss all the earth’s resources and brainstorm a range of different ways that we utilise freshwater on a daily basis. For example, farming, plantation forests, industrial and recreational uses. Included in this should be the requirement for a reliable water source within close proximity of most towns and cities. These activities can be drawn or written next to the specific locations where they take place.
b) Allow students to work in pairs to determine the resources from the top of the catchment to surrounding areas as you move from hill country to flat land. There should be a noticeable difference in the activities and resources being used from the top to the bottom of their posters or in a digital format.
c) Students will then be able to identify what happens in different parts of these areas and compare them with the different habitat for galaxias species, and hence the importance of these areas to the fish species and other forms of life.</td></tr>
<tr><td>2. Earth Systems</td><td>Appreciate that water, air, rocks and soil, and life forms make up our planet and recognise that these are also Earth’s resources.</td><td>Experiment with different types of rocks from the Tairawhiti region</td><td>Learning Outcome: : To identify characteristics and differences between a range of different geological forms from the Tairawhiti region. Identification and explanation of the effects geology can have on water quality and how it can be used for different land use and management practices.

Activities: In-class experiment:

1. Some types of geology are more prone to erosion or solution in water and those particular types can create water that’s more turbid adjacent to them. Some of the rock types are higher in salts and soluble minerals, and some are acidic or alkaline. The range of different types of geology can effect water quality and the soil regular which is what the experiment will conclude. Tairawhiti has typically young sedimentary geology, which can have a distinct effect on water quality and how it can be used for different land use</td></tr>
</table>

			management. To gain a greater understanding of this, students can complete a *Solubility Experiment of Tairawhiti Geology.* If students would like to participate in this experiment, please refer to the experiment tasks and outline resource in the, *Teaching Activities / Lesson Plan Activities / Experiment* folder.
Interacting systems	Investigate the water cycle and its effect on climate, landforms, and life.	Describe a river catchment in this context.	***Learning Outcome: :*** To understand and explain the water cycle process. To be able to draw all components of a water cycle and have explanations on how it can effect a river catchment, in particular, its landforms, life and effects on climate. ***Activities:*** In-class activities that can be supported with resources found in the *Teaching Activities / Lesson Plan Activities / Water Cycles* folder. 1. If this is the first time students are being introduced to this concept, brainstorm their current knowledge of the water cycle model and allow them to work as a class to determine the stages that occur. Teachers should provide arrows for each step and allow students to recognise what occurs at these steps. 2. Once students have knowledge of water cycle concepts such as precipitation, evaporation, transpiration and condensation then they can work individually or in pairs to draw or digitally create their own water cycle. a) Included in their water cycle will be the process of surface run off leading into the river catchments. This is where they can identify areas that may be affected from this process. For example, if there is a lot of precipitation and floods occur where banks without tall vegetation is present, erosion will occur. This will then damage or destroy riverbank environments, decreasing successful living and spawning habitat. Erosion can also create new landforms and build up in depository locations where this could limit the access for fish, such as the inanga, to swim upstream. These can be text box ideas written in the area that is being effected and/or pre-written ideas that they can match up with the potential locations. b) On the other hand, if the precipitation levels are very low and the evaporation is high, the climate is going to be a major factor for survival for a range of different life

			forms. These can be written or typed in different colours to signify climatic change and its effects, compared with the landforms in 2. A). For this situation, with the climate becoming warmer and less moisture from evaporation, without suitable shelter the eggs laid on the banks will struggle to survive. This effects inanga and a whole range of different species that require adequate moisture and precipitation to survive. These ideas and situations can also be in a text box format written in the area that is being effected and/or pre-written ideas that they can match up with the correct location. If these are in a touch-screen digital format, students could match up the different effects with the areas that they relate to. The water cycle process itself could be broken into stages and put together by the students, allowing for a written/typed explanation of what is occurring at each step.
Physical World			
Physical inquiry and physics concepts	Explore, describe, and represent patterns and trends for everyday examples of physical phenomena, such as movement, forces, electricity and magnetism, light, sound, waves, and heat. For example, identify and describe the effect of forces (contact and non-contact) on the motion of objects; identify and describe everyday examples of sources of energy,	Spring tides and inanga use of the salt wedge. Transfer of energy from ocean plankton to river fish.	***Learning Outcome: :*** To explore the tides and describe the effect of the moon on (spring) tides. To identify and describe the effect of forces when these tides occur. To be able to explore, describe and represent sources of energy and energy transformations through a freshwater food web. ***Activities:*** In-class activities: 1. Encourage a brainstorming exercise for students to reveal their knowledge of how the ocean tides work and what they can remember from the power point presentation given in the first activity of this project. Allow students to explore and research information from online resources and school library books to be able to describe the forces that occur amongst our planet, the moon and the sun. In addition, let the students examine the *Spring Tides* resource found in the *Teaching Activities / Resources for Curriculum Links* folder. a) Relating the tides to inanga, students should have some prior knowledge on the significance that these tides play in their life cycle. They can create a life cycle of the inanga and identify where tidal energy is used for transfer of objects or materials. For example, the tidal energy to transport larvae to sea.

	forms of energy, and energy transformations.		b) Students should then describe the effect of these tidal forces on the motion of the larvae and realise its role in the inanga life cycle. 2. Ask students to design a freshwater food web and to incorporate as much life in the river as possible, including macrophytes and algae, invertebrates, fish, and birds. Refer to the example provided, *Freshwater Food Web* in the *Resources for Curriculum Links* folder. This example shows the inanga in the middle of the food web to reveal their significance within the freshwater ecosystem. a) Once they have drawn their food web or digitally produced one, let students work in groups to identify and describe sources of energy. For example, the Tuna Sandwhich (refer to the resource *Tuna Sandwhich* in the *Resources for Curriculum Links* folder). Prompt their thoughts towards life cycles of these animals, including the inanga, and if there are any other transfers of energy occurring elsewhere? For example, juvenile inanga consume zooplankton at sea as a source of energy, and transferring this energy from the ocean back into the freshwater ecosystem.
Material World			
Properties and changes of matter	Group materials in different ways, based on the observations and measurements of the characteristic chemical and physical properties of a range of different materials. Compare chemical and physical changes.	Site monitoring and assessment.	***Learning Outcome:*:** To be able to compare chemical and physical properties of a range of different materials that students observed and measured in the first site visit from the, *Activities: Investigating in Science* achievement objective. ***Activities***: In-class activities and site visits: 1. Students would have completed their first site visit and have measured and observed the characteristics of chemical and physical properties of water at the site. Students will have their information and data from these measurements and tests and be able to complete an assessment from these to indicate the water quality of that site. Students can write up a summary of their findings in a small report type format, either a table or graphs to show the thresholds of excellent, good, fair or poor. 2. We will initiate another site visit to either a different river or stream or in a different section of the river investigated for activity 1. The same chemical and physical properties will be investigated and measured in order to compare differences between the two.

			This will allow them to identify noticeable differences, they can then involve experts from WBC team to brainstorm what type of factors (materials) might be influencing the differences. They can then add this second lot of data into their report and record changes and differences, ultimately coming up with a water quality assessment of the two. The *Explanation of Scores* resource may be helpful for this process which can be found in the *Resources for Curriculum Links* folder.
Chemistry and society	Relate the observed, characteristic chemical and physical properties of a range of different materials to technological uses and natural processes.	Importance of these to freshwater fish health and abundance.	***Learning Outcome:***: To compare chemical and physical properties from a freshwater environment to an estuarine environment. To characterise the chemical and physical properties at each site to inform every one of what they can relate to in terms of technological uses and natural processes. ***Activities***: These activities will comprise of in-class tasks and using information gained from site visits. 1. Initial research will need to be collected to gain more understanding of estuarine environments and the chemistry results that you would be likely to find. These would include all the testing we have completed at the first site visit, such as the temperature, pH, clarity, dissolved oxygen, salinity, and conductivity. Students can compare the two and discuss the differences that would occur in freshwater and estuarine environments. 2. Further research needs to be collected to gain knowledge on technological uses of water (freshwater and estuarine water) and natural processes to relate the observed characteristics into the appropriate use or process. Allow them to search the requirements needed for these purposes to compare freshwater or estuarine water as an option. For example, students may come across irrigation into one of their technological uses for water and that a requirement is water low in salt whereas estuarine water will usually always be high in salt. Therefore, students can relate these chemical properties to technological uses and state why they can or can't be used. Other examples could include power (hydroelectricity) or drinking

			water, considering the chemical and physical properties that would be required for this process to occur.

Ministry of Education (2014). The NZ Curriculum: Science, Achievement Objectives Levels 3 and 4. Retrieved online from http://nzcurriculum.tki.org.nz/The-New-Zealand-Curriculum/Science/Achievement-objectives

Social Science Achievement Objectives: Level 3

Key Learning Areas **Teaching and Learning Objectives**	**Inanga Korero**	**Task and Activity**
Understand how groups make and implement rules and laws.	E.g. Spawning habitat for inanga has a mention in the freshwater plan and those sites are to be protected	***Learning Outcome:***: To describe and identify the rules and laws in New Zealand around whitebait fishing and how these are made and implemented. ***Activities***: Students will work in-class to pull together research on the rules and regulations around whitebait. 1. Students can work individually or in groups to collect this information with some key questions including: What are rules around catching whitebait? How are they enforced? Have they changed over time? 2. In addition to this research, inform students of the Proposed Gisborne Regional Freshwater Plan (PGRFP) and that it includes inanga spawning sites to be protected. Students can research further into this component of the plan and identify the rules around these. a) Students can research if the spawning site they are investigating is named as a protected site with the PGRFP. If it is not, the students can research how they can, as a class or school, implement the regulations around protecting this site. They can then work as a group to write letters and

		inform the council of the spawning site identified to become a protected area. This will give them a wider understanding of how groups make and implement rules and laws, based on decisions such as the need to protect whitebait, a declining natural resource.
Understand how cultural practices vary but reflect similar purposes.	E.g. Maori put a rahui on fisheries to conserve whitebait in the same way that western management has closed seasons	***Learning Outcome::*** To understand the difference between cultural practices and how these vary when relating to freshwater conservation, in particular, to conserve whitebait. ***Activities***: In-class activities: 1. Discuss with students the meaning of rahui, and ask for examples when this may be used. This concept will be used to help the students understand the maori concept of kaitiakiatanga. 2. In contrast, students will research stewardship and relate it to some methods used by western cultures for the same purpose. These include, trespass notices, closed seasons, and long term closure of sites. 3. Students should have an understanding of the two different cultural practices and how they aim to protect important areas and protect or restore cultural and environmental values.
Understand how people view and use places differently.	E.g. A farmer might view a stream as providing stock access to water where as a scientist will view it as a habitat for fish e.g. inanga	***Task***: To understand how people view and use places differently through a debate in relation to water resources. ***Activities***: In-class activity: 1. Split the class into two groups, one group on either side of the classroom to work together. Give each side a group of people to focus on. For example, one group could discuss/research about farmers and how they may view a river as providing stock access to water, or as irrigation for a crop grower. On the other hand, one group could focus on freshwater ecologists who may view it as habitat for fish, and in need of different management.

		a) Each student group can come up with their ideas and thoughts around why their focus person/group use these resources and their views around this. They can then share their ideas back to the other students to gain an understanding of the differences in how places, in particular water resources, are used and viewed by different people.
Understand how people make decisions about access to and use of resources.	E.g. When a decline in the whitebait fisheries was identified, initially it was thought that this was caused solely by overfishing, but now it has been identified as strongly affected by how the land adjacent to rivers and streams is being managed.	***Learning Outcome:***: To understand that decisions need to be based on knowledge and information around access to and use of resources, focusing on rivers, streams and whitebait as resources. ***Activities***: Research collected in-class: 1. Considering the example in the left column, this has contributed to a range of different decisions around access to and use of these resources such as regulatory protection for certain areas. For example, protection of identified inanga spawning sites from damaging land managaement practices. Water as a resource is highly valued and decisions are made based on knowledge of certain areas, research and testing and studies completed to inform conclusions on access to and use of these water resources. a) Students can research decisions made relating to our water resources and if access to, and use of these resources, informed any regulations that are now in place. For example, the PGRFP / WPSFM.
Understand how people remember and record the past in different ways.	E.g. The past for maori is recorded orally through stories, songs, carving and other art forms whereas in western society history tends to be more recorded in written and numerical form.	***Learning Outcome:***: To compare and contrast how the past has been recorded in different ways, relating to your site of investigation. ***Activities***: In-class and homework/discussion with family and friends: 1. The site that the students are investigating will have a lot of history around it. Initiate this activity with questions around this awa and if they have heard any stories about it or activities and events in the area. These would derive from Maori traditions and from people who have lived in the area and heard the stories from their parents or grandparents, also records of waiata and moteata

		may have been passed down. This creates a base for discussion around how these move orally through generations. Students can go home and ask their parents/guardians and/or friends if they know of any information around the site or river as a whole. 2. Students can then collect more information from online resources and books to gather records of this site and the area. These could include statistics of the water quality (if it has been monitored by NIWA or GDC), and history of the area in relation to populations etc. These two comparisons of how people remember and record the past signifies history being passed through to each generation in differing methods and traditional forms. A range of different books and online sources will provide a wealth of knowledge, one book in particular that students may want to research is, Splendid Isolation – recent history.

Ministry of Education (2014). The NZ Curriculum: Social Sciences, Achievement Objectives Level 3. Retrieved online from http://nzcurriculum.tki.org.nz/The-New-Zealand-Curriculum/Social-sciences/Achievement-objectives

Social Science Achievement Objectives: Level 4

Key Learning Areas **Teaching and Learning Objectives**	**Inanga Korero**	**Task and Activities**
Understand how the ways in which leadership of groups is acquired and exercised have	E.g. Through learning about inanga and initiating an action project, improved connection is implemented amongst members of the community and a change in practice	***Learning Outcome:***: To work collectively as a class or school to show leadership as a restoration plan around the proposed site is produced. Leadership is acquired through this process and the class or school initiate change within the community through the restoration phases.

consequences for communities and societies.		***Activities***: In-class and on site activities. Throughout the whitebait project, a conclusion for protecting, restoring or enhancing the spawning site is an overall objective and therefore this action project needs leadership. The students and/or participants become the leaders of this project as they design the restoration action plans that are implemented, with help from others in the community. 1. At the end of this project, students are to come together with all the information and data gained from site visits and classroom activities. They can then use this information and knowledge to create an action plan and come up with a list of restoration activities that may be needed to enhance inanga habitat. These activities will inevitably involve the community, landowners and managers, friends and family and people from within the area. For example, if planting is required there could be a community planting day. The Students acquiring this leadership role, leads to consequences for the community where they become participants of their project due to the significance of these rivers in the community's area.
Understand how exploration and innovation create opportunities and challenges for people, places, and environments.	E.g. Innovation using straw bales for inanga spawning can enhance the eco system of the stream or river and bring opportunities for those fishing regionally	***Learning Outcome:***: To identify the opportunities and challenges for people involved, the site proposed and the environment in which this project is taking place. ***Activities***: In class activities from knowledge and information gained from site visits and resource activities. 1. Students will have a strong base of knowledge to identify a range of challenges and opportunities for this project. Students can work in groups of 5 to identify a range of different challenges and opportunities for people, places and environments. Allow for some research to extend their answers, for example, the innovative use of straw bales for inanga spawning (in areas where natural habitat may be unsuitable).

Understand how people participate individually and collectively in response to community challenges.	E.g. Challenge=decline in inanga, individuals have a range of options to respond and collectively can find ways of identifying and restoring these inanga sites	***Learning Outcome:***: To identify the decline in inanga and the community challenges that coincide with this. To be able to identify and explain their own response to this challenge and collective responses that they have been a part of. ***Activities***: In-class activities: 1. Students can work individually to identify the decline in inanga and the community challenges that derive from this. This can be from prior knowledge and research found. 2. Students can work individually to write up a summary of their individual response to this challenge. For example, they could have collected individual research and communicated with friends and family about the history of the area and sharing knowledge of these issues. This summary reflection report will involve the responses that they have individually undergone throughout the whole project to reveal how they have participated in response to the decline in inanga. 3. Students can then work in groups or as a class to identify their collective responses to this challenge. For example, compiling information and data together as a class or school, collective research, posters or reports, and working collectively towards the restoration stages.

Ministry of Education (2014). The NZ Curriculum: Social Sciences, Achievement Objectives Level 4. Retrieved online from http://nzcurriculum.tki.org.nz/The-New-Zealand-Curriculum/Social-sciences/Achievement-objectives

Personal Health and Physical Education Achievement Objectives: Level 3

Key Learning Areas	Inanga Korero	Task and Activities

Teaching and Learning Objectives		
Identify risks and their causes and describe safe practices to manage these.	Health and safety forms e.g. RAMS that can be completed by the students for each site visit to identify risks and then come up with ways to prevent or eliminate these. Researching the impacts that contaminated water can have on human health.	***Learning Outcome:***: To complete a Risk Analysis and Management System (RAMS) form to identify risks involved, their causes and what can be done to eliminate these or prevent them from occurring. ***Activities***: In-class activity: 1. Students can work individually to complete a RAMS form to identify risks involved in a site visit to the river. These will be focused around three foremost factors, including people e.g. physical injury, environmental factors and equipment/gear. This will include a range of the potential risks and risk reduction strategies. For example, skills as a potential risk and to reduce this risk, there will need to be experienced and skilled people leading the group. 2. Students will then complete an emergency procedure where they will need to collect contact details and information for all parties that are emergency contacts, allowing a precise procedure to be in place. 3. Students can then research the health and safety risks when working in and around contaminated water. Students can then come up with ways to eliminate these risks and prevent them from occurring. Specific equipment may be required to have on-hand if any student is exposed to this contamination. Please refer to the *WBC INstream RAMS template* document for students to use as a template or example document. This can be found in the *Teaching Activities / Resources for Curriculum Links* folder.

Ministry of Education (2014). The NZ Curriculum: Health and Physical Education, Achievement Objectives Level 3. Retrieved online from http://nzcurriculum.tki.org.nz/The-New-Zealand-Curriculum/Health-and-physical-education/Achievement-objectives