National Certificate of Educational Achievement
TAUMATA MĀTAURANGA Ā-MOTU KUA TAEA

Exemplar for Internal Achievement Standard

Science Level 1

This exemplar supports assessment against:

Achievement Standard 91921

Demonstrate understanding of the use of a range of scientific investigative approaches in a context

An annotated exemplar is a sample of student evidence, with a commentary, to explain key aspects of the standard. It assists teachers to make assessment judgements at the grade.

New Zealand Qualifications Authority

To support internal assessment

Grade: Achieved
For Achieved, the student needs to demonstrate understanding of the use of a range of scientific investigative approaches in a context. This involves carrying out a range of investigative approaches that each answer a question and describing the purpose of each approach, supported by evidence. This student has carried out three different investigative approaches to answer the question of stream/awa health. The three investigative approaches used were pattern seeking, exploring and observing, and classifying and identifying. The student has also described the purpose of each approach. For Merit, the student could use their evidence to explain why each approach was or was not appropriate to answer a question.

Kei te hauora te Mimihau | Is the Mimihau Healthy?

The Mimihau stream has been an integral part of the Wyndham Ecosystem. For over the last 150 years, the river has run through land that has been drained and cleared primarily for dairy farming. The Mimihau used to be a source of food for the community to come together and helped sustain life in the repo | wetland that it used to flow through. Today it is a popular spot for people to catch trout and it is a popular site for swimming.

Investigation 1

Pātai | *Research Question*: Whats is around the Mimihau

Describe what you investigated.

We went to the Mimihau and went to have a look around the area and take notes and photos to see what things could affect the health of the river. We mainly looked around a certain spot of the Mimihau that looked good to investigate.

Type of data collected**:** Photos and notes

Describe the purpose (reason) for using this type of investigative approach to collect this type of data

Exploring and observing allows you to get to know an area or an idea as a starting point.
It helps you to discover something new that may lead to more questions and therefore more investigations/investigating.
Can observe lots of factors fast.
Can be used when you aren't given a method or many instructions to follow.

Raraunga/Rangahau | *Results/Data*

Group Name	Site number	Site name	Stream bed type	Algae	Depth (cm)	Clarity (cm)	Temperature (oC)	Oxygen (%)	Average velocity
[redacted]	Site 1: 4-#2	4-#2	Bedrock, mud or silt, large and small cobbles, water plant, gravel	Thin Mat, Short Filaments	70	60.5	10 (30sec)		0.43
	Site 2: 4B	4B	Bedrock, mud or silt, large and small cobbles, water plant, gravel	Thin Mat, Short Filaments	55	43	8 (30sec)		0.33
	Site 3: 2A	2A	Bedrock, mud or silt, large and small cobbles, water plant, gravel	Thin Mat, Short Filaments	35	60.5	8 (30sec)		0.46
[redacted]	Site 2: 2#3	2#3	Large Cobbles, Mud or Silt	Thin Mat, Short Filaments	40	60.5	8.5	16.6	0.26
	Site 3: 5C	5C	Large Coobles, Mud or Silt	Thin Mat, Short Filaments	95	60,5	10	17.2	0.23
	Site 1: 7A.1	7A.1	Large Cobbles, Mud or Silt	Thin Mat, Short Filaments	77	60.5	9	15.2	0.17
[redacted]	Site1: 6#1	6#1	Mud or silt, Water plant, gravel	Thin mat, short filaments	40	59	8	18.5	0.45
	Site 2: 7 B	7 B	Sand, mud or silt, waterplant, small cobbles, gravel	medium mat, short Filiments	57	52	8	18.2	0.3
	Site3: 2C	2C	Sand, small cobbles, water plant, gravel	Medium mat, short filiments	45	59	7	16.6	0.38
[redacted]	Site 1: 5-#1	5-#1	gravel,bedrock	thin mat, short filaments	25	60.5	10	17	0.507
	Site 2: 6-#3	6-#3	bedrock	thin mat, short filaments	25	60.5	8.7	15.5	0.39
	Site 3: 6B	6B	bedrock	thin mat, short filaments	18	60.5	9.8	16.4	0.45
[redacted]	site 1 6A	#VALUE!	small cobbles, mud and slit	none	17	60.5	10	18.5	0.47
	site 2 6C	#VALUE!	large and small cobbles and mud and slit	thick mat and short filaments	13	60.5	11	18.3	0.4
	site 3 2B	#VALUE!	small cobbles, mud and slit	thin mat and short filaments	36	60.5	13	18.5	0.58
[redacted]	Site 1: 2 - #2	2 - #2	Large and Small Cobbles, Gravel, Mud or Silt and Water Plants	Medium Mat and Short Filaments	35	60.5	10	16.6	0.41
	Site 2: 1 - #2	1 - #2	Water plants as the water was quite deep	Medium Mat and Short Filaments	97	60.5	10	15.6	0.21
[redacted]	Site 1: 3 - #1	3 - #1	Bedrock, mud or silt, large cobles, water plants, gravel, man made	Thin mat, Short Filaments	30	11	10	18.5	0.41
	Site 2: 5 A	5 A	Bedrock, mud or silt, large cobles, water plants, gravel, man made	Medium mat, Short filaments	47	11	10	18.3	0.23
	Site 3: 1 - #3	1 - #3	Bedrock, mud or silt, large cobles, water plants, gravel, man made	Thin mat, Short Filaments	55	12	10	18.5	0.27

Otinga | *Findings/Conclusion*:

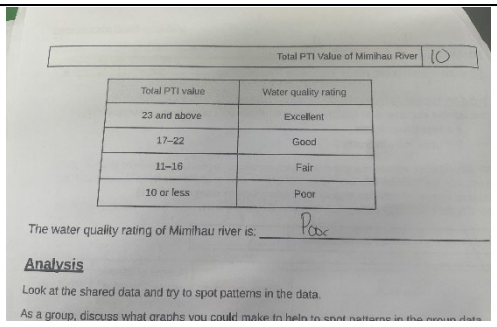
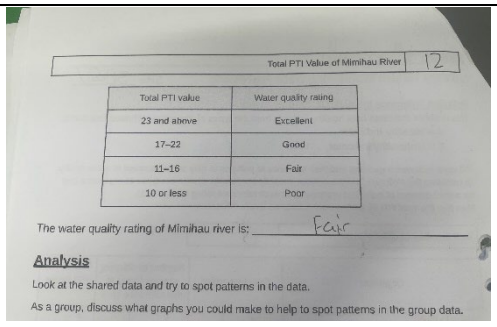
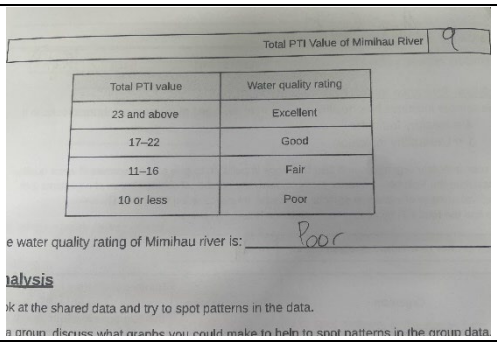
Used exploring and observing because it allowed us to explore different parts of the Mimihau like where farms or buildings were. This tells us where the runoff and the pollution might have come from because that's where the river mainly flows past. We would have struggled to find the other results/data because there are simply just so many, different and changing variables that would ruin the investigations with certain types of investigations.

Investigation 2

Pātai | *Research Question*: How good is the water in the Mimihau?
Momo Mātai | *Type of Investigative approach*: Classify and identify
Whāinga | *Purpose/Aim*: To see what specific things there were in the Mimihau
Describe what you investigated.
We investigated Certain species of underwater life to see if we could calculate a Total PTI (pollution tolerance index) number. This is done by catching some of the riverbed in a net then putting it into a tray of water and counting the Invertebrates in the tray, different invertebrates had different scores, you only counted the different species not the amount. This would allow us to get a water quality rating to see if the Mimihau was healthy. We tested this in three parts of the Mimihau.

***Type of data collected*:** Naming and heratical data.
Describe the purpose (reason) for using this type of investigative approach to collect this type of data.
Classifying allows you to identify features that objects, events or living things have in common or features that they may have that makes them different. Using these features allows you to identify the name of things that may be used in further final results.

Raraunga/Rangahau | *Results/Data*.

		 Total PTI Value of Mimihau River 10 Total PTI value / Water quality rating 23 and above / Excellent 17–22 / Good 11–16 / Fair 10 or less / Poor The water quality rating of Mimihau river is: Poor Analysis Look at the shared data and try to spot patterns in the data. As a group, discuss what graphs you could make to help to spot patterns in the group data.
		 Total PTI Value of Mimihau River 12 Total PTI value / Water quality rating 23 and above / Excellent 17–22 / Good 11–16 / Fair 10 or less / Poor The water quality rating of Mimihau river is: Fair Analysis Look at the shared data and try to spot patterns in the data. As a group, discuss what graphs you could make to help to spot patterns in the group data.
		 Total PTI Value of Mimihau River 9 Total PTI value / Water quality rating 23 and above / Excellent 17–22 / Good 11–16 / Fair 10 or less / Poor e water quality rating of Mimihau river is: Poor alysis k at the shared data and try to spot patterns in the data. group, discuss what graphs you could make to help to spot patterns in the group data.

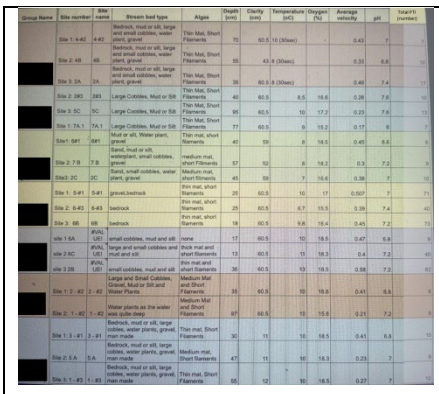
Otinga | *Findings/Conclusion*:

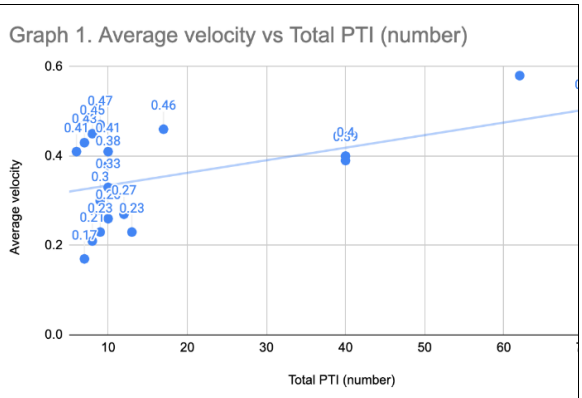
We found out that the water quality was at a poor to a fair standard.. By using classifying and identifying we were able to classify the invertebrates into their different ranking for the total TPI number and we identified that this Mimihau might not be the best to collect food from. This task had a lot of factors so it would be hard for other types of investigations to get a good, accurate result. We were not limited on tools and gear.

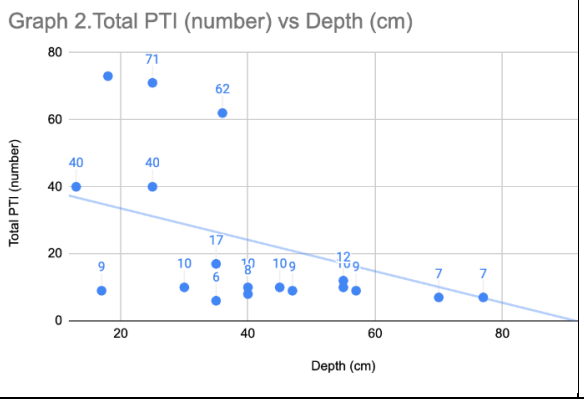
Investigation 3

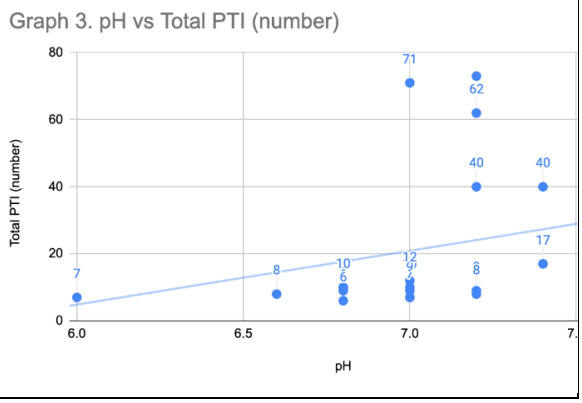
Pātai | *Research Question*: What are some relations between different factors of the Mimihau.
Momo Mātai | *Type of Investigative approach*: Pattern seeking.
Whāinga | *Purpose/Aim*: To see what some relationships are in the Mimihau.
Describe what you investigated.
We used some results from the table and put them into some graphs. We Looked at the graphs and tried to come up with conclusions on what the relationships could be between two factors of the table of results.
***Type of data collected*:** Relational data.
Describe the purpose (reason) for using this type of investigative approach to collect this type of data.
We did pattern seeking because there are lots of variables and lots of many different forms of data to be able to say that the effect of one variable is due to another variable changing so we just see the relation between sets of data. Also a fast investigation as you are not necessarily having to repeat the investigation.

Raraunga/Rangahau | *Results/Data:*









Otinga | *Findings/Conclusion:*

Graphs 1. The Bigger/faster the velocity of the water would wash away the pollution much easier and faster therefore giving it a bigger/ better of a Total PTI number.
Graph 2. When the water is deeper the current will just float on the top leaving the pollution to float or sit on the riverbed. When the water is shallower the current will hit the river bed and wash the pollution away much easier therefore getting a Bigger/better Total PTI number.
Graph 3. When the pH is 7 (neutral) it's not acidic or basic so the invertebrates won't die as easily and have a better home to live in therefore giving a bigger/better Total PTI number.
This helps us figure out the question by showing the data that we need. Its like the total PTI number shows us the result of the water and the Velocity, Depth and pH level basically shows us why the total PTI number is like that. This can help solve other problems like what makes the Mimihau unhealthy/healthy.
This investigation was better than others because the data was easily observed, tested and collected, didn't have to worry about having too much data, was easy to understand and we didn't have to rely on too much personal data.

Grade: Merit
For Merit, the student needs to explain the use of a range of scientific investigative approaches in a context. This involves giving an evidence-based reason why each investigative approach was or was not appropriate to answer a question. This student has explained why pattern seeking, exploring and observing, and classifying & identifying were used to investigate the plants in their area. For Excellence, the student could validate their findings by using evidence from the three investigation approaches.

Merit

NZQA Intended for teacher use only

“What is going on in our native plant area,”

Exploring and Observing

What did we notice?
We noticed that our native garden area was full of our native plants that we planted the previous year as well as invasive weeds that seemed to have creeped their way in. During the summer months there were flowers appearing on the weeds and the native plants.
The first thing we could tell is that we had a large range of plants and weeds spread out around the garden.

What did we observe when we looked more closely?
When we looked more closely we could tell that as well as invasive species of weeds we also had a lot of Native plants. We also noticed the parts of the leaves and what a leaf consisted of. We also observed the environment that the native plants were living in and noticed the weeds and insects.

What questions did we have?
- What plants are problematic?
- What can we do to help the plants?
- What can we do to improve the environment of the plants?

Classifying and Identifying

How did you identify plants and/or invertebrates?
We first Started identifying using an app on our phones called seek by Inatralist. The App allowed us to identify the plants in the Native area, and get an idea of what they are and what other plants they relate to.
After using the App we did some further investigating by using a random sampling technique which we achieved by myself throwing a square piece of nylon netting in sections A - J.
We then documented on a quadrant map by drawing the plants on the quadrant square on the sheet and ticking off the species in the area, the number and the dominant species in the quadrant.

What plants did you identify? invertebrates? - what was their common name and scientific name?
- Black Nightshade - Solanum nigrum
- Bramble - Rubus fruticosus
- Broadleaf dock - Rumex obtusifolius
- Bristly oxtongue - Helminthotheca echioides
- Creeping Buttercup - Ranunculus repens
- Fennel - Foeniculum vulgare
- Grey Field Speedwell - Veronica polita
- Hedgebinweed - Calystegia Sepium
- Henbit Deadnettle - Amplexicaule
- Mothplant - Araujia sericifera
- Thistle - Cirsium
- Daisy - Bellis perennis

What are some of the classifications we made?
We made several classifications on the plants, the general ones were Native plants and weeds. We also made other classifications such as prickly plants and invasive weeds, as well as plants that were not such a problem.

How did identifying and classifying help us work out how to help our native planted area?
Classifying and Identifying allowed us to work out which weeds were the ones that were most invasive and what needs to be removed in order for our planted area to thrive.

Pattern Seeking
After using the App we did some further investigating by using a random sampling technique which we achieved by myself throwing a square piece of nylon netting in sections A - J.
We then documented on a quadrant map by drawing the plants on the quadrant square on the sheet and ticking off the species in the area, the number and the dominant species in the quadrant.

Our Data
Are there any patterns?
We noticed that all of our sampled areas were thoroughly spread out and that we didn't have a large amount of plants concentrated in one area.

How many different plants are there?
Overall there were 25 different plants in our planted area that we were looking out for when doing our random sampling.

How many plants total did we sample?
We sampled 13 different plants in our sections which three of the species were invasive weeds.

How many areas did we sample?
We sampled 10 different sections of the planted area.

Which plants appeared the most?
We found out that the most common species in our sampled areas was Hedgebinweed, with a tied second between Broadleaf dock and Black Nightshade.

Which ones seemed to be the most widely distributed?
The distribution of hedge bindweed seemed to be the most well spread across 6 different sections. This allowed us to come to the conclusion that Hedge Bindweed is a very invasive species of weed as it was found spread throughout the planted area which showed us how invasive they were.

Class data
Are there any patterns?
Yes, there is a large variety of plants that are concentrated and some that are widely distributed. Fennel was found 5 times in section g and was largely concentrated in one area, whereas broadleaf dock was found 17 times across almost all the sections so it was largely dispersed.

How many different plants are there?
All together we sampled 41 different plants in the planted area.

How many plants total did we sample?
In our class data we managed to sample all 41 plants.

How many areas did we sample?
We sampled all section through A – J.

Which plants appeared the most?
The plant that appeared the most in our random sampling was broadleaf dock. It was found 17 different times throughout section A - J but not in section G.

Which ones seemed to be the most widely distributed?
The plant that seemed to be most distributed was broadleaf Dock because it was found 17 times in almost all of the sections.

Assessing the usefulness of each investigation.

Exploring and Observing.
(Question: What is going on in our native planted area?).
Describe the type of investigation.
Exploring and observing is when you use your senses to make observations about objects. To observe is to look closely at the features/characteristics of that object. We achieved this by exploring our planted area and looking at the different parts of leaves and creating drawings. We also looked into the details of the plants, on the surface as well as under the microscope. Exploring and observing helped us get our first close look at the plants and understand the differences.

Give an evidence based reason to explain whether this type of investigation was useful to answer our question.
Exploring and observing was a good investigation type to start with as it allowed us to have a first look at what was in the planted area and help us find where the plants were and what was in and surrounding the planted area. This investigation type did not allow us to find out a whole lot more information about the planted area as we were limited to exploring and observing which was good to start with but did not allow us to investigate further and find out more about the plants until we got to the classifying and identifying.

Identifying and Classifying.
(Question: What are the new plants that are in here and which ones might be a problem?).
Describe the type of investigation.
Classifying and identifying is when you group objects and categorise them. This allows us to identify the objects/things. We achieved this by using an app on our phone called Seek by a naturalist which allowed us to identify the plants.

Give an evidence based reason to explain whether this type of investigation was useful to answer our question.
Classifying and Identifying was a good investigation type for us to learn more about the plants that we have in the planted area. The timing of this investigation allowed us to get further knowledge with the help of exploring and observing. We were able to find out the classification of the plants and their scientific names, we were also able to find what plants they were related to. This investigation type was useful in a way that allowed us to investigate deeper and to find the plants that were invasive and native. Due to this investigation type, we would now be able to tell which of the plants are invasive and what would need to be removed for us to protect our native species.

Pattern Seeking.
(Question: How are the plants distributed in the planted area?).
Describe the type of investigation.
Pattern seeking is when you look for patterns when you can't control all variables. You can use the random sampling technique to collect data. The data is to be collected in the same way each time. The data also gets collected over time. We did this by throwing a square nylon net in a set quadrant for random sampling and creating a plot map and seeing what we had in those areas.

Give an evidence based reason to explain whether this type of investigation was useful to answer our question.
Pattern seeking allowed us to explore the distribution of the plants and insects and if they were concentrated or dispersed. The timing of this investigation allowed us to use a more systematic way of finding out the distribution of these plants and weeks to see how far they have spread. We were also able to find which plants were dominant in different places, for example, Fennel was found 13 times, and 5 of those times it was found in section G showing that it was most dominant there. We can tell that the broadleaf dock was the most dispersed, being found 17 times across all sections. This investigation type was useful to narrow down where the invasive species were and what plants needed protection. For example, Scotch thistle and bristly oxtongue were found in the same area as Manuka which means it may need some protection. Due to the pattern seeking we would be able to narrow down what needs to be removed in each area and what plants need removing first.

Validation of our investigation types.
Pattern seeking.
When we started using the pattern-seeking investigation type we were able to make a table to input the distribution of the plants. From our individual data we could tell fennel was only found in 3 different sections which were sections E, G, and H. Once we had put all of our class data together we were able to validate that Fennel was concentrated in a single area.

Classifying and identifying.
We were able to validate our findings by classifying and identifying using the Seek app by I-naturalist. This allowed us to make early assumptions and then validate our answer using the app which assisted us with additional research.

Exploring and observing.
When we started classifying and identifying we were able to get a first look into what plants were weeds and what were native. Using prior knowledge we could predict what some plants were and could validate it once we moved on to our classification and identification investigation process.