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

Exemplar for Internal Achievement Standard

Agricultural and Horticultural Science Level 2

This exemplar supports assessment against:

Achievement Standard 91289

Carry out an extended practical agricultural or horticultural investigation

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

New Zealand Qualifications Authority

To support internal assessment

	Grade Boundary: Low Excellence
1.	For Excellence, the student needs to carry out a comprehensive extended practical agricultural or horticultural investigation. This involves justification of the choices made during the sound investigation, i.e. evaluating the validity of the method or reliability of the data, and explaining the conclusion in terms of agricultural or horticultural ideas relevant to the investigation. The student justifies how the method used produced valid and reliable data (1) to support a valid conclusion (2). The student explained the conclusion in terms of the agricultural or horticultural ideas relevant to the investigation (3). For a more secure Excellence, the student could provide more extensive evaluation of how the method used supported a conclusion that was valid and reliable. Consideration could have been given to the variables that must be controlled and repeats or numbers of measurements made for each cutting.

Student 1.

Evaluation.

From the collected data of my practical horticultural investigation I have determined the effect of the number of leaves on the production of roots in stem cuttings. My data gathered on the Tahitian Bridal Veil has shown leaves are not necessary to produce stem cuttings, but that the greater quantity of leaves will produce a greater quantity of roots. Although I predicted that they would be required because leaves are necessary to the plant process of photosynthesis which enables the plant to propagate, and therefore grow leaves, I now understand that photosynthesis can also occur in the stem of the cutting, as this also contains chloroplasts. I also understand that all the biological processes can continue to function and produce roots without the presence of leaves, but by using the stem.

My method provided me with reliable data that was aimed directly at the purpose of my investigation, and therefore enabled me to make a valid conclusion on my investigation. I made it valid and reliable by carrying out a range of measurements on the root growth such as root:shoot ratio, root mass, length, diameter and health. This ensured that I got a larger variety of results from the dependent variable and therefore was able to compare them to conclude a more precise result of root growth theory to the amount of leaves present in stem cuttings. [1] The Dictionary of Plant Sciences (1998) states that "*the root:shoot ratio is the amount of plant tissue that have growth functions. Plants with a higher proportion of roots can complete more effectively for nutrients and water. Plants with a higher proportion of leaves can collect more light for photosynthesis*". Root mass is recommended as a final measurement as the plants must be removed from its growing medium in order to capture accurate data (http://www.sciencebuddies.org/science-fair-projects/project_ideas/PlantBio_measuring_growth.shtml). These measurements of plant growth have made my collected data and therefore the results more accurate and valid to conclude.

Photosynthesis is a biological process which involves the trapping of light by the chloroplast (molecule containing many chlorophyll which exchanges the energy from light to chemical – (glucose) in mainly the palisade mesophyll cells and able to be converted into energy that is more useful to the plant), with the presence of water and carbon dioxide to produce oxygen and glucose (taken from Correspondence School AGS203 notes). As photosynthesis requires the light form the sun, it can only occur during daylight / in sunlight (when in a natural environment). The process of photosynthesis can be simplified in the equation

$H_2O + CO_2$ (+ light) $\rightarrow O_2$ + glucose

In this experiment the fewer number of leaves (e.g. in the trials of 0 and 2 leaves) would produce the least quantities of O_2 and glucose. The greater number of leaves (in the trials of 8 leaves) would produce the greater quantities of O_2 and glucose. This differentiation in production of glucose alters the amount of root growth when in is used in the biological process to follow.

Respiration is a biological process which involves the breaking down of glucose produced in photosynthesis using oxygen, to produce water, energy and carbon dioxide [3]. This occurs in the leaves of the plant, in the stem, in every cell of the plant all the time. The process of respiration can be simplified in the equation below;

O_2 + glucose → H_2O + CO_2 + energy

Some of the energy produced from the respiration process is used to grow roots (backed up from the article from the Correspondence School AGS203 notes). This means that greater quantities of roots are produced by greater quantities of energy (produced in respiration) which are produced from greater quantities of glucose (produced in photosynthesis), which is produced from greater quantities of leaves. So the results and graphs indicate that the trials with 8 leaves average (6.6) a greater amount of roots than the average of the trials with 0 leaves (3.2). This is because of the biological processes which for example with fewer leaves, produce lower amounts of glucose in photosynthesis (as only a certain amount of light can be trapped to convert H_2O + CO_2 into glucose and O_2) which then can only provide that amount of glucose to be converted into small quantities of energy in respiration, which the plants uses to produce roots [3]. It is similar quantity of the required element that is passed through the biological processes to produce the roots. Therefore the production of roots is less with fewer amounts of leaves and is more with greater amounts of leaves. [2]

A greater quantity of root growth will have an effect to horticultural production in the commercial world. Plants which have more leaves are able to manufacture the glucose with oxygen in their leaves using the respiration process to produce energy which is used in the growth of the plant. More leaves mean more root development. More root mass allows the plant to grow more leaf material. The increase in leaves means that more energy is produced in photosynthesis providing more energy for respiration. This increases the size of the plant allowing harvesting earlier or higher sugar levels in fruit, bringing maturity on earlier. In root crops, when there is an excess of glucose it is converted into starch stored in the roots. So for root crops such as potato, kumara, and taro, they store a lot of starch in their roots ensuring a good harvest [3]. As from the results of my experiment the production of these roots of these crops could be increased with a greater quantity of leaves. My experiment has provided me with this conclusion because of the data I have collected which has shown that more root growth occurs with more leaves present. For example, the trails with 8 leaves produced by average over double the amount of roots.

	Grade Boundary: High Merit

2.	For Merit, the student needs to carry out an in-depth extended practical agricultural or horticultural investigation.
	
	This involves:
	
	• a workable method that describes:
	  • for a fair test: a valid range for the independent variable, the valid measurement of the dependent variable, and the control of other variables
	  • for pattern seeking: collection of valid data with consideration of factors such as sampling, bias, and/or sources of error
	• the recording and processing of data to enable a trend or pattern (or absence) to be determined
	• a valid conclusion that links to the purpose of the investigation.
	• a discussion of the biological ideas relating to the investigation that is based on the student's findings and those from other source(s).
	
	The student provides a valid range for the independent variable (1), provides a valid measurement of the dependent variable (2), describes the control of other variables (3), records and processes data to find a trend (4), provides a valid conclusion that links to the purpose of the investigation (5) and discusses the biological ideas relating to the investigation, based on their findings and those from other sources (6).
	
	To reach Excellence, the student should provide an evaluation of how the method used supported a valid and reliable conclusion.

Student 2.

Method.

1. Get a Tahitian Bridal Veil and get 25 cuttings 5 – 10 cm long, make each cut in on a diagonal just below the node.
2. Split the cuttings into 5 groups of 5 cuttings.
3. For the first group of cuttings; cut all the leaves off the cutting except one and place each cutting in a test tube.
4. Do this for the next 4 groups of cuttings leaving one extra leaf on the cutting per group, e.g. group 2 has 2 leaves per cutting, group 3 has 3 leaves per cutting etc.
5. Place the test tubes in a rack and name each test tube with its correct group number.
6. Put a lamp on opposite sides of the rack at a distance of about ½ a metre, if too close it will dry out the leaves.
7. Observe and record the length of the roots, number of roots and the general health of each cutting. Do this every day for 2 weeks.
8. Collect your findings and collate.
9. Use your findings to generate a report.

Variables.

Independent variables - For this investigation there will be only one independent variable. The independent variable is the variable that is going to be changed. In this case the independent variable will be the number of leaves on each cutting [1], each group as I am trying to find out if the number of leaves on a cutting effects the production of roots.

Dependent variables - For this investigation, there is more than one dependent variable necessary for me to achieve my aim. The dependent variable is the variable/s that will be measured. These variables include the length of the roots, the number of roots and the general health of the roots and the cuttings [2] each of these variables will be recorded daily on a daily report chart.

Controlled variables - For this investigation the controlled variables or the variables that aren't going to change are; the temperature of the room (20°C), the amount of light on each cutting (using a lamp about ½ metre from the rack), and the type of water that the cuttings are cultured in. I will keep these all the same at all times [3]. The type of water is important as different types of water contain different quantities of minerals, e.g. bottled water will have fewer minerals than tap water as bottled water is filtered.

Validity of the investigation.

For this investigation I will be putting five groups of five stem cuttings in a test tube and growing them in water. The aim of the investigation is to find out how the amount of leaves

on a cutting effects the production of roots for that cutting. To help to reduce the biased or incorrect results during this experiment I am setting up five cuttings per group. Each group will have the same number of leaves on the cutting as the group number, e.g. all five cutting in group 1 will have only 1 leaf per cutting. The aim of this is so that the data that I collect on the growth and health of the roots will not be affected if one of the cuttings die, I will be able to judge the outcome much more accurately than if I set up only two cuttings per group.

Trends and patterns.

One of the obvious patterns that I have noticed about this investigation is that, the number of roots that a stem cutting produced increased as the number of leaves on that plant went up [4]. By this I mean that because the group 1 had 1 leaf per cutting and group 2 had two leaves per cutting, group 2 produced more roots than group 1 because all the cuttings in group 2 had 1 more leaf per cutting than group 1, therefore they produced more roots per cutting than group 1 did. As we can see in graph A, over the period of 14 days only 16 roots grew in total for all five cuttings in group 1, whereas in group 5 33 roots grew this show the trend of the investigation really well, because as we can see it is an upward trend that shows that the more leaves a cutting has the larger the quantity of root growth will be. In my second graph there is also an upward trend that shows that the total number of roots on a plant increase greatly over a period of 14 days and rise with a rather steep gradient.

Conclusion.

From the results of my investigation, I think that I can safely conclude that I have met the aim of my investigation, "To determine the effect of the number of leaves on the production of roots in stem cuttings", and to generate a report on the findings of my investigation. From the investigation, I have found out that the number of leaves that a plant or a cutting has does indeed have an effect on the number of roots that this plant or cutting produces [5]. Further confirmation of this is if we look at graph A on page fourteen, we can see that the root the number of roots one each cutting did increase because of the number of roots. As well as satisfying my aim, I have also discovered that the hypothesis that I made in my statement of purpose was also accurate.

Discussion of biological ideas.

From my findings, I discovered that the biologically the plant needs more leaves to grow more roots faster, this is because the plant grows its leaves to photosynthesis and catch the sun's rays to produce energy so it can use its energy to grow roots. Photosynthesis is the process the uses to turn carbon dioxide from the air and water from the soil to make its food, which is sugar, photosynthesis also needs energy to occur, this energy is light from the sun, the green colour in leaves called chlorophyll traps the light energy for the leaf to use, the sugar that is produced is used for plant growth. I learnt from another source other than my findings that "plants with a higher proportion of roots can compete more effectively for soil nutrients, while those with a higher proportion of shoots can collect more light energy" (A Dictionary of Plant Sciences | 1998 | Michael Allaby) [6].

	Grade Boundary: Low Merit

3.	For Merit, the student needs to carry out an in-depth extended practical agricultural or horticultural investigation.
	
	This involves:
	
	• a workable method that describes:
	  • for a fair test: a valid range for the independent variable, the valid measurement of the dependent variable, and the control of other variables
	  • for pattern seeking: collection of valid data with consideration of factors such as sampling, bias, and/or sources of error
	• the recording and processing of data to enable a trend or pattern (or absence) to be determined
	• a valid conclusion that links to the purpose of the investigation.
	• a discussion of the biological ideas relating to the investigation that is based on the student's findings and those from other source(s).
	
	The student provides a valid range for the independent variable (1), provides a valid measurement of the dependent variable (2), describes the control of other variables (3), and records and processes data to find a trend (4). The student provides a brief but valid conclusion based on their interpretation of their processed data, links it to the purpose of the investigation (5) and briefly discusses the biological ideas relating to the investigation, based on their findings and those from other sources (6).
	
	For a more secure Merit, the student could provide a more in-depth conclusion that is based on their interpretation of the processed data, provide better linkage to the purpose of the investigation, and provide more discussion of the biological ideas based on their findings and those from other sources.

Student 3.

Method.

This is my method that I went by and made some changes which I have stated.

1. Take 25 cuttings in between 10 – 15 cm long, from the mother plant and dip the cuttings in rooting hormone gel / powder (controlled variable) [3].
2. Remove all leaves from 5 of the cuttings.
3. Remove all leaves except 2 from 5 of the cuttings.
4. Remove all leaves except 4 from 5 of the cuttings.
5. Remove all leaves except 6 from 5 of the cuttings.
6. Remove all leaves except 8 from 5 of the cuttings.

These are my independent variables [1]

7. Fill each test tube with 15mls of water [3].
8. Put one cutting per tube and then place into test tube holder in rows.
9. Place all tubes in the same place. This is so all you will have a fair test [3].
10. Each day check the cuttings for; number of roots, water level, and what the plant looks like.
11. Record this in a log book and take photos.
12. Some of the factors that I will keep the same are the water level. I will make a mark in the tube on all of the tubes and when the water level gets below this mark I will add more water bringing the level back up. This is so all the cuttings have the same amount of water.
13. Keep the cuttings in a sunny shady place for maximum root and plant growth [3].

Dependent variable

I will measure the amount of roots grown in the test tubes during every school day and record this in the log book. I will write down the time I measured them also [2].

The average root growth for the cuttings range from 11 to 22.8. The averages for the cuttings are:

Leaves on cuttings	0	2	4	6	8
Average	11	15	15.1	18.7	22.8

My aim was to find out if the number of leaves affect the amount of root growth in the cuttings. The trend in the graph above has helped me to come to a conclusion about my aim. The lines are horizontal for the first 3 days and then they go up steadily until nearly the end of the experiment where they start to level off apart from the cuttings that have 4 leaves [4]. From looking at the table and the graph I now know that when doing cuttings the amount of leaves on the cuttings does affect root growth [5]. I know this because the 5 cuttings that had no leaves still grew leaves. The root growth was slower compared to the rest of the cuttings because of the lack of leaves and no photosynthesis was carried out. The only nutrients that the leave less cuttings had was what was in the stem. When the cutting is dipped in the rotting hormone gel, what it does speeds up the process of root growth. The cuttings are sitting in water which is slowly being absorbed up through the xylem to the leaves. On sunny days I put the cuttings on the window sill where they were in direct sunlight, I did this as the cuttings need maximum light for the roots to grow. I looked up in my last year's horticulture book, Growing Plants by G.K Mortiarty, page 122 and I found 'cuttings need enough light for their leaves to carry out photosynthesis and make food to grow' [6]. Before I took the cuttings I made sure that I had the entire test tubes ready, filled up with water, in the test tube holder. I did this as the longer the cut is exposed the quicker the cut will dry up and cell it off. Once the cut has done this the chance of water getting into the cutting is very slim. By following my method I was able to gather valid information by checking then whenever I could, once I had counted the total number of roots I recorded this in my log book. I took photos of the cutting at the start and then at the end.

	Grade Boundary: High Achieved

4.	For Achieved, the student needs to carry out an extended practical agricultural or horticultural investigation.
	
	This involves:
	
	• a statement of the purpose – this may be an aim, testable question, prediction, or hypothesis based on a scientific idea
	• a method that describes:
	  • for a fair test: the independent variable and its range, the measurement of the dependent variable, and the control of some other variables
	  • for pattern seeking: the data that will be collected, the range of data/samples, and consideration of other factors.
	• the recording and processing of data
	• a valid conclusion based on the processed data
	• identifying and including relevant findings from another source.
	
	The student provides a clear statement of purpose (1), a method that describes a fair test (2), provides the independent variable and its range (3), describes the measurement of the dependent variable (4), describes the control of some other variables (5), records and processes data (6), provides a valid conclusion based on their processed data (7), and identifies and includes relevant findings from another source (8).
	
	To reach Merit, the student could discuss the biological ideas relating to the investigation, based on their findings and those from other sources.

Student 4.

Aim: To investigate the best number of leaves to produce the most roots [1].

Hypothesis: I predict that the more leaves there are the more roots will grow.

Independent variable: The number of leaves should be the only thing that is changed. The will be 0, 2, 4, and 6 leaves on each 6 cuttings [3].

Dependent variable: The dependent variable is the number of roots that have grown after 2 weeks of sitting in test tubes with 50ml of water in each tube [4].

Other variables:

- Water – I will keep the amount of water in each test tube exactly the same and fill each tube each day.
- Temperature, air, light – These will be kept the same by putting them at the same window that is exposed to the sunlight and oxygen from the wind.
- Type of plant – the type of plant will be kept the same – Tahitian Bridal Veil [5].

Equipment needed: Ruler, 24 test tubes, test tube stands, 50ml of water per tube, scissors, Tahitian Bridal Veil plant.

Method. Buy the plant from the garden shop.

Place the 24 test tubes into the test tube stand.

Pour 50ml of water in each test tube.

Cut 24 cuttings from the plant.

Remove all leaves from 6 cuttings.

Remove all but 2 leaves from six more cuttings.

Remove all but 4 leaves from six more cuttings.

Remove all but 6 leaves from the last six cuttings.

Place each of the six cuttings into test tubes and place in their stands.

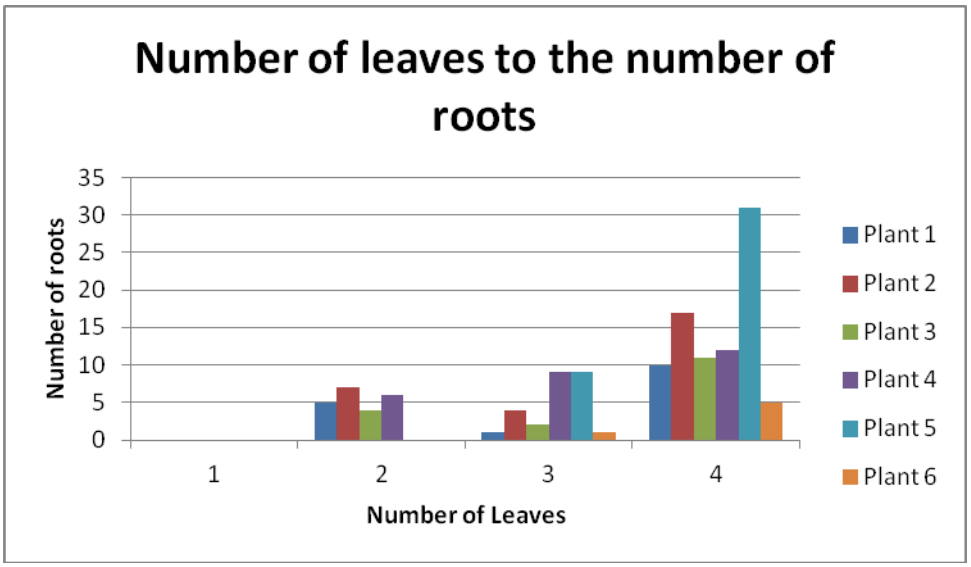
Place the stands with the test tubes and cutting onto a window sill where the sun can easily reach the leaves of the cuttings.

Take observations every 3 -4 days and refill the tubes back to 50ml if osmosis has occurred [2].

Results: The graph shows that the more leaves you have on your plant, the more photosynthesis can take place which therefore means more roots. The average number of roots produced be the cuttings with no leaves is zero. The average number of roots on the cuttings with 2 leaves is 3.66 roots per plant. The average number of roots with the cuttings

that have four leaves is 4.33 roots per cutting. The number of roots per cutting that has six leaves is 14.33 roots per cutting [6].

Number or leaves on each cutting	Number of roots on each cutting
0	0,0,0,0,0,0,
2	5,7,4,6,0,0,
4	1,4,2,9,9,1
6	10,17,11,12,31,5



Conclusion: In conclusion, my hypothesis was proved to be correct. The more leaves you have on a cutting, the more roots will grow. I found that if you want roots to grow on a plant. You must have as many leaves on the cutting as possible because the more leaves you have on a cutting, the more photosynthesis can take place [7].

So the plants with more roots can get more water and the plants with more leaves get more energy from the sun. The carbohydrates supplied by the leaves influences root growth. One resource that proved that my hypothesis was correct was http://www.tekura.school.nz/departments/horticulture/ht105_p2.html, it states "If a cutting is to survive it must grow its own roots, otherwise it cannot take up water and will die. To encourage root development on cuttings you need to provide moisture, high humidity, warmth and light. Cuttings need enough light for their leaves to continue to carry out the process of photosynthesis to make food. The food is then broken down during respiration to provide energy for root growth. The cuttings need plenty of light to carry out photosynthesis, but not direct sunlight as that could cause high water loss"[8].

	Grade Boundary: Low Achieved

5.	For Achieved, the student needs to carry out an extended practical agricultural or horticultural investigation.
	
	This involves:
	
	• a statement of the purpose – this may be an aim, testable question, prediction, or hypothesis based on a scientific idea
	• a method that describes:
	  • for a fair test: the independent variable and its range, the measurement of the dependent variable, and the control of some other variables
	  • for pattern seeking: the data that will be collected, the range of data/samples, and consideration of other factors.
	• the recording and processing of data
	• a valid conclusion based on the processed data
	• identifying and including relevant findings from another source.
	
	The student writes a statement of purpose (1), identifies a range for the independent variable (2), provides a measurement for the dependent variable (3), describes the control of some of the other variables (4), records and processes data (5), writes a valid conclusion based on the interpretation of the processed data (6), and identifies and includes relevant findings from another source (7).
	
	For a more secure Achieved, the student could provide a more detailed connection between their findings and relevant findings from another source.

Student 5. **Are Leaves Really Necessary?**

Aim: I want to find out if leaves are really necessary for cutting to grow.

Prodiction: I think with more leaves on a stem, it will mean that more roots that will be produced [1].

Independent viriable: The independent variable is the variable that will be changed with each cutting. I will have a different number of leaves on every stem that I will put in the test tubes. There will be cutting with either 0, 2, 4, 6 and 8 leaves [2].

Dependent variable: The dependent variable is the variable that does not change. I will count how many roots grow on every stem and put into my data [3].

Controlled variables: Water – water daily so that it is a fair test and there will be a even amount of water in every test tube.

Temperature – the test tubes were in the science lab, this meant that they had even amount of sunlight, out of the wind. This meant it would be a fair test

To make this a fair test I will put the same amount of water in to the test tubes. I will also cut all the stems evenly so it is fair. I will find the average number of number of roots and assure they are accurate [4].

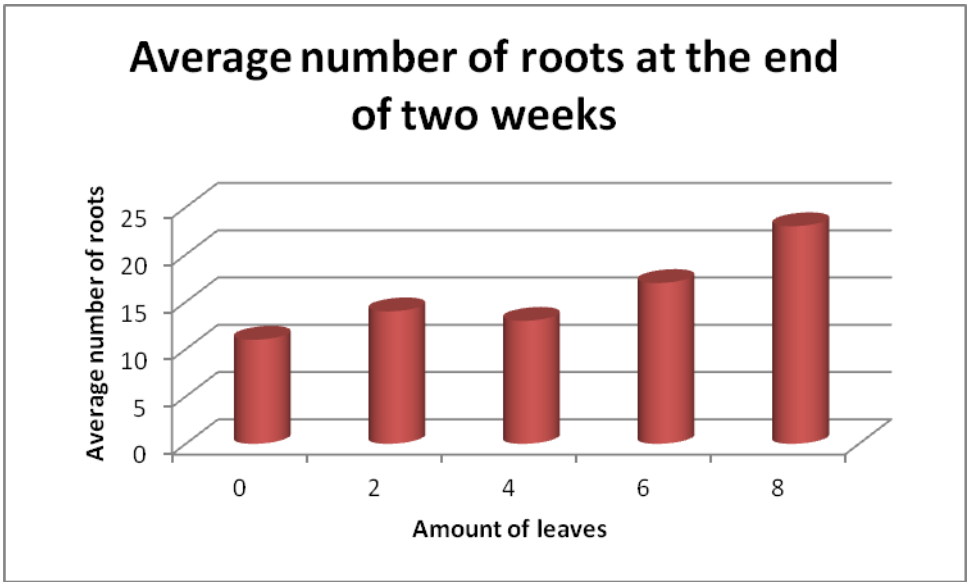
You will need: Ruler, 16 test tubes, 1 test tube stand, 15ml of water per tube, scissors, a health Tahitian Bridal Veil plant, camera, pen, measuring cylinder.

Starting the experiment.

1. Get all the equipment together and ready to do the experiment.
2. Cut the stem on a 45 degree angle away from the node and about at least 6cm long. Re-measure to see if they are at the right length.
3. Separate them into five different groups.
4. In one of the five groups strip all the leaves off it.
5. With one of the five groups, leave two leaves on the stem.
6. With one of the five groups, leave four leaves on the stem.
7. With one of the five groups, leave six leaves on the stem.
8. With one of the five groups, leave eight leaves on the stem.
9. Water your cuttings.
10. At this stage you should be checking and watering the cuttings about everyday. Make sure the test tubes are always topped up to 15mls with water and making sure they are living and are healthy.
11. Record data. Measuring how long the roots on the stems have grown, and what ones are doing the best. To make this a fair test I got two people to help me count the root growth.

Results: I drew up a graph showing the number of roots at the end of the two weeks we had to do our experiment. I clearly shows that the test tubes with eight leaves on it has the most roots that have grown and with zero leaves it has the least number of roots. [5].

Number of leaves on the stem	Average number of roots at the end of two weeks
0	11
2	14
4	13
6	17
8	23



Conclusion: Throughout this practical investigation we were seeing if leaves were really necessary. We found out that leaves are really necessary, because the plant with the most leaves grew the most roots. We experimented with a plant with no leaves, it had the least leaves, averaging 11 roots that grew over the practical investigation. The plant with eight leaves, which was the largest amount of leaves averaging 22.9 roots that grew over the practical investigation. I predicted that more leaves in the stem there would be more roots growing [6].

Relevant findings: After a Google search, I could not find any other investigations on shoot and root, but I did find that there is a relationship called the root:shoot ratio. This is used to measure the overall health of your plants. My findings linked to the www.myfarm.co.nz article because my cuttings grew roots and it was influenced by the carbonhydrates supplied by the leaves. The cuttings that had the most leaves produced the most roots because they had more leaves to photosynthesize therefore had more carbonhydrates to encourage root growth [7].

	Grade Boundary: High Not Achieved

6.	For Achieved, the student needs to carry out an extended practical agricultural or horticultural investigation.
	
	This involves:
	
	• a statement of the purpose – this may be an aim, testable question, prediction, or hypothesis based on a scientific idea
	• a method that describes:
	  • for a fair test: the independent variable and its range, the measurement of the dependent variable, and the control of some other variables
	  • for pattern seeking: the data that will be collected, the range of data/samples, and consideration of other factors.
	• the recording and processing of data
	• a valid conclusion based on the processed data
	• identifying and including relevant findings from another source.
	
	The student provides a method that describes a fair test (1), provides a statement of purpose (2), provides the independent variable (3), describes the measurement of the dependent variable (4), describes the control of some variables (5), records and processes data (6), and writes a valid conclusion based on the interpretation of the processed data (7).
	
	To reach Achieved, the student should identify and include relevant findings from another source.

Student 6. **Plan**

Aim: Does the number of leaves on a stem cutting affect the number of roots in stem cuttings? [2].

Equipment needed: 5 glass jars, scissors, ruler, a healthy Tahitian Bridal Veil plant.

Instructions. [1]

1. Take 25 cuttings of about 30cm long from the tip of a healthy growing stem. Always cut beneath the node on a 45° angle away from the node [5].
2. Group the cuttings into piles of 5.
3. Take the first pile of 5 and remove all the leaves on each of the five cuttings.
4. Take the next pile of five and leave only two leaf on each of the 5 cuttings.
5. Take the next pile of five and leave only four leaf on each of the 5 cuttings.
6. Take the next pile of five and leave only six leaf on each of the 5 cuttings.
7. Take the last pile of five and leave only eight leaf on each of the 5 cuttings [3].
8. Fill all of the jars with 300mls of water [5].
9. Put each pile of 5 cuttings into different jars. Each jar should have 5 cuttings place into it.
10. Leave those jars where they will recive sunlight and darkness [5].
11. Take photos every 2 days and record any results or anything that is happening to the cuttings.
12. Leave the cuttings for 2 weeks.
13. After two weeks, measure the root lengths and count the number of roots [4]. Record all information.

Report: [6]

Number of leaves	Number of roots grown over two weeks	Average
0	2, 5, 3, 4, 2	3.2 → 3
2	5, 5, 4, 3, 2,	3.8 → 4
4	6, 4, 4, 8, 5,	5.4 → 5
6	5, 6, 7, 4, 8,	6
8	8, 6, 9, 3, 7,	6.6 → 7

In this assessment 91289 I carried out a practical investigation to see whether the effect of leaves on the production of roots in stem cuttings. For this assessment I used Tahitian Bridal Veil plant to produce a report.

My purpose for this investigation was: Does the number of leaves on stem cuttings effect the number of roots in stem cuttings [2].

When gathering my results from the investigation there was a pattern shown, after calculating the averages of the results. As the number of leaves increased on each cutting the number of roots increased [7]. For the first group of cuttings which had 0 leaves, the average number of roots was 3. As the number of leaves increased, for example the next group of cuttings had 2 leaves, the average number of roots was 4. Then it increased from 5, 6, 7 number of roots. So therefore the pattern shown in the processed data was, as the number of leaves increased of each cutting the number of roots increased. So answering my purpose I can say; "Yes the number of leaves does effect the number of roots". This was shown in the pattern collected from my results. So therefore the more leaves on the cuttings the root growth increases [7].