Professional Development Service for Teachers | An tSeirbhís um Fhorbairt Ghairmiúil do Mhúinteoirí

LEAVING CERTIFICATE

AGRICULTURAL SCIENCE

Phase 2 - National Workshop 2

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Key messages

- Working collaboratively with professional colleagues, engaging with the documentation to help plan and support the design and completion of the IIS.
- To support teachers in developing the literacy skills of Senior Cycle Agricultural Science students.
- Using the scientific method to write scientific reports.

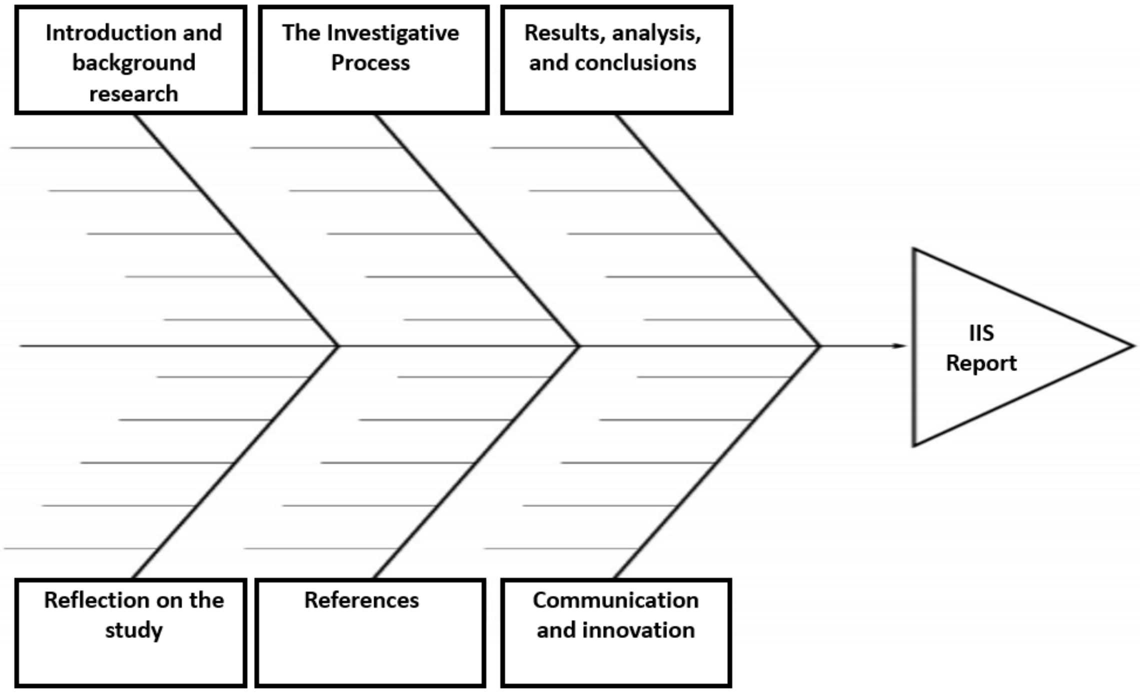
Our CPD Journey

3 Documents supporting the IIS

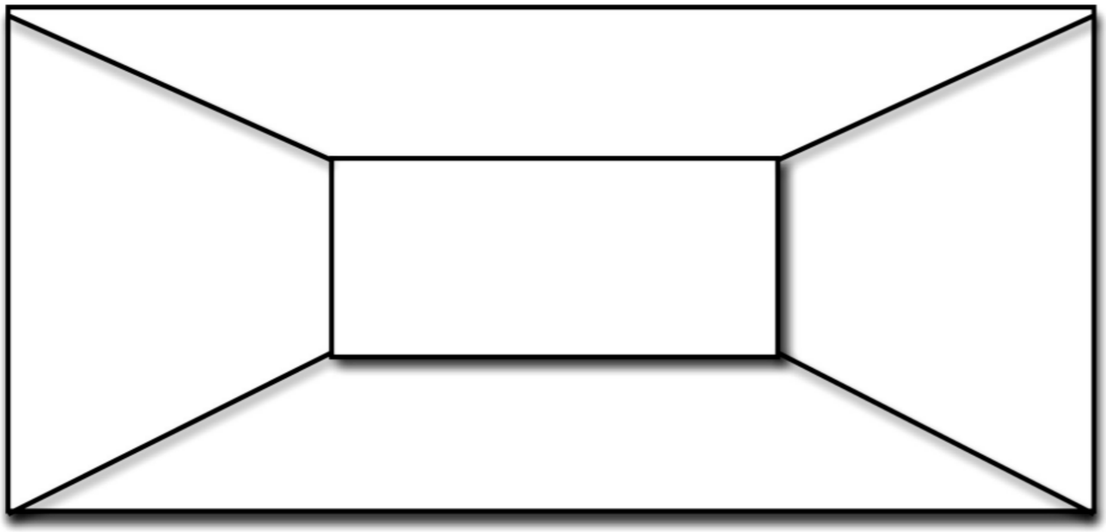
Specification 2018	IIS Guidelines December 2019	SEC IIS Brief December 2019
https://www.curriculumonline.ie/getmedia/9ad3071d-b58d-4988-9afc-f4e229ceb864/NCCA-Specification-for-Leaving-Cert-Agricultural-Science.pdf	https://www.curriculumonline.ie/getmedia/c509fc4d-848e-49b8-8c35-d7fc47683c85/AgScience-GL-Final-Dec-19.pdf	https://www.examinations.ie/misc-doc/EN-EX-25906961.pdf

SEC Information note:

Features of Quality for the IIS



Notes for SEC information note



Notes:

Level of Achievement Grid

	High level of Achievement	Moderate level of Achievement	Low level of Achievement
Level of substantive and procedural understanding			
Generate a valid, testable hypothesis			
Make predictions and generalisations that are supported by the available evidence			
Use of arguments to put theory into practice			
Apply knowledge and understanding of science to develop arguments and draw conclusions based on collected evidence			

Features of Quality Rubric

	→ Progress →		
	X	Y	Z
Title, Aim, Links to cross cutting themes and Research	Title Introduction	Title Introduction Agricultural context	Title & aim Introduction - Agricultural context Link to cross cutting theme Sources of research include references)
Hypothesis and Prediction	No testable hypothesis Fail to make prediction	Generated a hypothesis not linked to experiment	Testable hypothesis Prediction linked to the experiment
Experimental design	No discussion of variables Outlined a simple plan. Equipment list A safety note Labelled diagram	Variables - independent, dependent, controls Equipment used Basic Method Health and safety Diagrams / photographs	Variables - independent, dependent, controls Equipment used Detailed Method Health and safety Fully labelled diagrams / pictures
Recorded Data (tables & graph)	Basic results table with no repeats or units. Untitled graph with no units on axis	Results table with units and repeats. Appropriate graph	Table with units with repeat results and mean calculated Appropriate graph (Scale Axis Label Title - SALT)
Analysis	Does not explain trends and patterns effectively Can't see relationship between variables Limited or no use of statistical analysis	Has put "graph into words" Limited explanations of trends and patterns. Some discussion of causation. Basic statistical analysis	Trends and patterns explained Use of primary data Causation % correlation Use of agricultural & scientific knowledge to explain trends Use of statistical analysis
Conclusion	Does not accept/ reject hypothesis Fails to draw conclusions linked to data collected	Accepts / rejects hypothesis Form conclusions based on evidence gathered	Accepts / rejects hypothesis Logical conclusions linked to data Discussed limitations & bias
Evaluation	Made a basic comment about the procedure and results obtained. Suggested a simple improvement to their method	Made relevant comments about procedure and results obtained. Suggested a number of improvements Discusses simple extensions	Made detailed comments about procedure and results obtained. Suggested a number of improvements to reduce errors (Systemic/ statistical errors) Comments on reliability of the data taking into account any anomalous results. Discusses possible extensions
Discussion (relevance to agriculture)	Arguments not linked to their findings Fails to see the agricultural significance of the SPA	Demonstrates knowledge and understanding with poorly constructed arguments	Clearly discussed opinions. Concise arguments in relation to results obtained and secondary findings. Significance for agricultural enterprise (link to secondary data)

Example X

3.3.2(i): Measuring the dry matter content of a named crop.

Title: To measure the Dry Matter content of Grass.

Safety: Choose a safe location to collect grass samples.

Wear heat resistant gloves when handling hot material from the oven.

Ensure the oven is free from combustible materials.

Prediction: I think grass is made up of 50% water and 50% Dry stuff.

Equipment:

Fresh Grass samples	3 Beakers	Oven
Electronic balance	Stop watch	Tongs
Tissue Paper	Scissors	

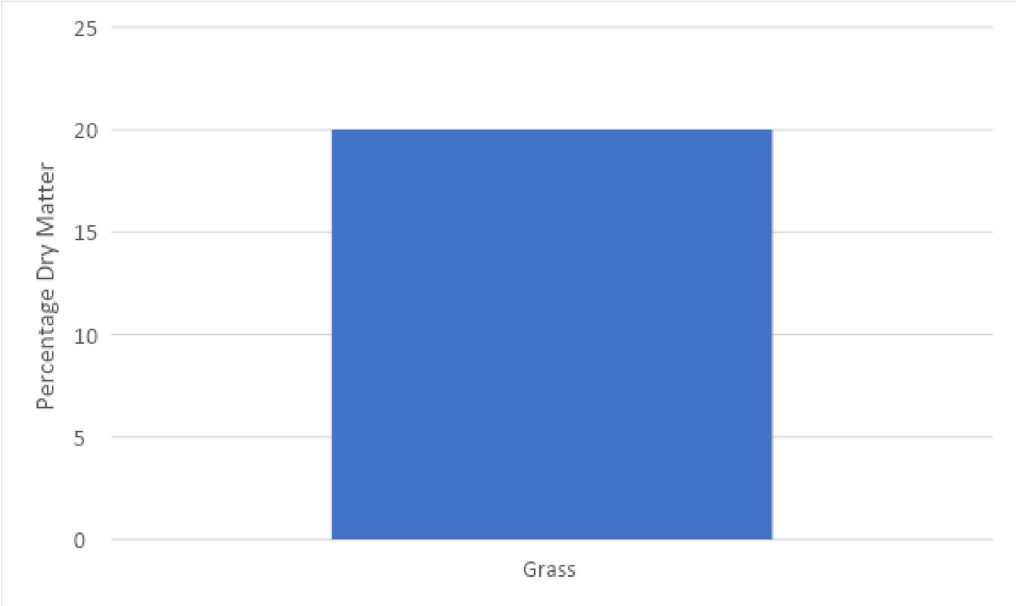
Method:

1. Collect fresh grass samples.
2. Weigh an empty beaker using an electronic balance and record the mass.
3. Add the sample of grass (50g) to the beaker.
4. Reweigh the beaker containing the grass sample and record the mass.
5. Place the beaker of grass in the oven at 100˚C for 15 mins.
6. Calculate the percentage Dry Matter of grass.

Results:

Mass of empty beaker:	280g
Mass of empty beaker + fresh grass sample:	330g
Mass of beaker + dried grass after constant mass was reached:	292g
Mass of dried grass only:	10g
Percentage DM: $\frac{Mass\ of\ dried\ grass}{Mass\ of\ fresh\ grass}\ x\ \frac{100}{1}$	20%

Graph:



Discussion: Dry Matter of grass was 20% Dry Matter.

Example Y

3.3.2(i): Measuring the dry matter content of a named crop.

Title: To measure the Dry Matter content of a named crop – Grass.

Aim: To calculate the percentage Dry Matter content of grass by comparing the mass before and after heat dehydration in an oven.

Research: Grass can be divided into its water and dry matter content. 100 kg of grass will contain approximately 83 kg of water. But it's the dry matter that contains the key nutrients that the animal needs. The dry matter can be divided into cell wall and cell contents. The cell wall of grass is the fibre content. While, the cell contents include sugar, protein, fats, minerals and other compounds.

From my research I can see that grass is roughly 80% water and 20% dry matter.

Hypothesis: Grass will contain 20% dry matter.

Safety: Choose a safe location to collect grass samples.

Wear heat resistant gloves when handling hot material from the oven.

Ensure the oven is free from combustible materials.

Equipment:

Fresh Grass samples	3 Beakers	Oven
Electronic balance	Stop watch	Tongs
Tissue Paper	Scissors	Heat proof gloves
Ruler		

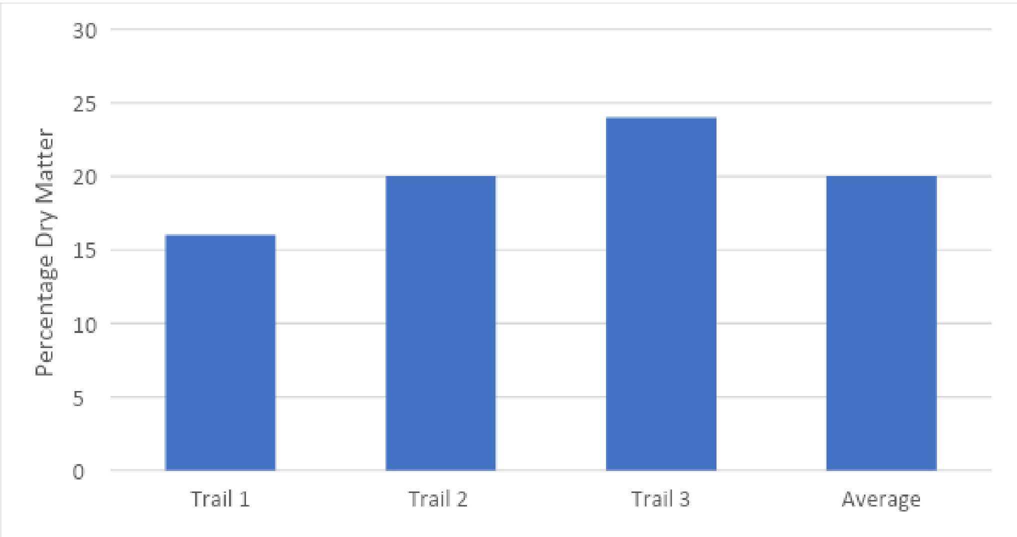
Method:

1. Collect fresh grass samples.
2. Dry off any excess water from the grass using tissue paper.
3. Cut the grass samples into short lengths of 30 cm.
4. Weigh an empty beaker using an electronic balance and record the mass.
5. Add the sample of grass (50g) to the beaker.
6. Reweigh the beaker containing the grass sample and record the mass.
7. Place the beaker of grass in the oven at 100˚C.
8. Remove the beaker from the oven using tongs, every 10 mins and reweigh, until a constant mass is reached.
9. Calculate the percentage Dry Matter of grass.
10. Repeat this for three samples of grass to get the average.

Results:

	Trial 1:	Trial 2:	Trial 3:	Average:
Mass of empty beaker:	280g	280g	280g	280g
Mass of empty beaker + fresh grass sample:	330g	330g	330g	330g
Mass of beaker + dried grass after constant mass was reached:	288g	290g	292g	292g
Mass of dried grass only:	8g	10g	12g	10g
Percentage DM: $\frac{Mass\ of\ dried\ grass}{Mass\ of\ fresh\ grass}\ x\ \frac{100}{1}$	16%	20%	24%	20%

Graph:



Analysis: From analysing my results I can see that the dry matter varies in different samples of grass. My findings are in line with my research, grass contains about 20% DM.

Conclusion: The data I have collected backs up my hypothesis. The Dry Matter content of grass was measured on average to be 20% Dry Matter.

Evaluation: My results seem good as they are all around the mean.
If I was to do this experiment again I would also use a digitally controlled oven to get a more accurate temperature.

Discussion: From my results the average Dry Matter of grass was 20% Dry Matter. This evidence proves my hypothesis to be correct.

From my research Dry Matter is composed of Protein, Sugar, Cellulose and Fibre.

There was only one independent variable so it is fair to say the investigation was a fair test.

This investigation could be extended to compare the Dry Matter content of grass, silage and hay.

Example Z

3.3.2(i): Measuring the dry matter content of a named crop.

Title: To measure the Dry Matter content of Grass.

Aim: To calculate the percentage Dry Matter content of grass by comparing the mass before and after heat dehydration in an oven.

Research: From my research Dry Matter is composed of Protein, Sugar, Cellulose and Fibre. Sugars and Protein are the parts of the Dry Matter that are easy for livestock to digest and are used to supply the animal's body with energy and protein. These Dry Matter components are very important to a dairy farmer, who needs cattle to have energy to produce milk that has a high protein content, which is required for cheese and yogurt production. Protein is also used by the animal's body to produce muscle, so farmers involved in meat production would want grass with a high level of these Dry Matter components. Cellulose and Fibre are more difficult to digest but still play an important role in the livestock's diet as they act as rough to prevent bloat. Sugars are made during photosynthesis, while grass makes protein from the nitrogen it absorbs through its roots. Slurry is a good source of nitrogen for grass. Sugar is converted to cellulose and fibre when the grass enters the reproductive stage of growth. They are used to build structures in the grass, like cellulose is used in plant cell walls.

Hypothesis: Grass will contain about 20% Dry Matter; as most living things are composed of about 80% water.

Prediction: I predict that the DM of grass will come in between 15 – 20%

Variables:

Independent variable:	**Dependant Variable:**	**Control variables/constants:**
The grass sample	*The final mass of the grass after being exposed to the heat.*	*Same beaker (500 ml)* *Temperature of oven (100˚C)* *Weighing intervals (10 mins)* *Weighing method (electronic balance)* *Length of grass (30 cm)*

Safety: Choose a safe location to collect grass samples.
Wear heat resistant gloves when handling hot material from the oven.
Ensure the oven is free from combustible materials.
Keep walkways and emergency exits clear
Wear safety glasses and appropriate PPE

Equipment:

Fresh Grass samples	3 Beakers	Oven
Electronic balance	Stop watch	Tongs
Tissue Paper	Scissors	Heat proof gloves
Ruler		

Method:

1. Fresh grass samples were collected.
2. Any excess water from the grass was dried off using tissue paper.
3. Grass samples were cut into short lengths of 30 cm.
4. An empty 500 ml beaker was weighed using an electronic balance and the mass was recorded.
5. A sample of grass was added to the beaker.
6. The beaker containing the grass sample was weighted and the mass recorded.
7. The beaker of grass was placed in the oven at 100˚C.
8. The beaker was removed from the oven using a tongs, every 10 mins and reweighted, until a constant mass was reached. These masses were recorded.
9. The initial mass and final mass of the grass after being exposed to heat was used to calculate the percentage Dry Matter of grass.
10. This method was repeated for three samples of grass to allow for use of data based on an average.

Results:

Table 1: Change in mass of beaker & grass sample while being exposed to heat.

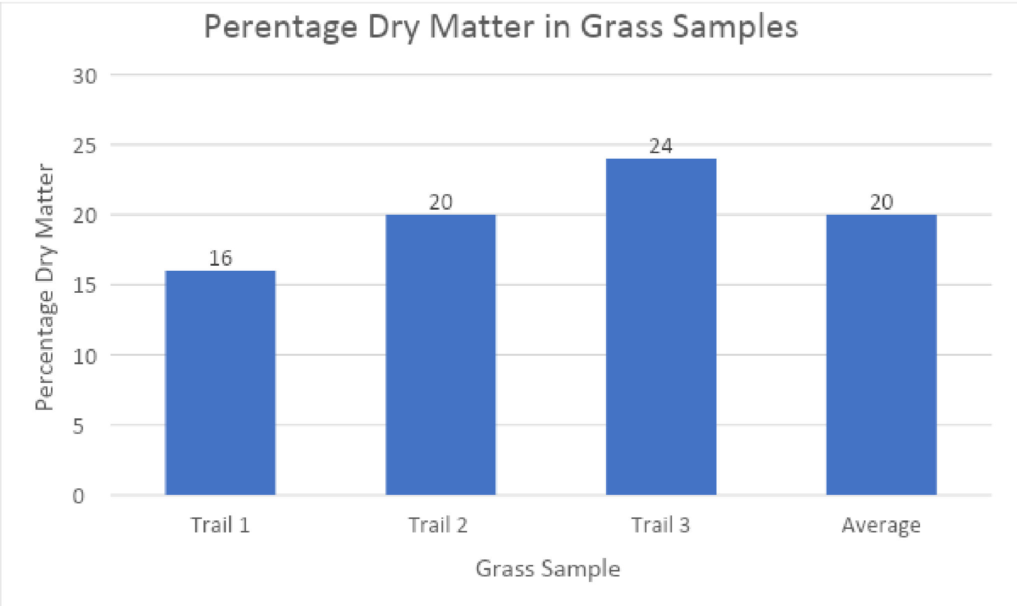
	Time:	**10 mins:**	**20 mins:**	**30 mins:**	**40 mins:**	**50 mins:**	**Constant:**
Mass (g):	Trial 1:	300g	290g	288g	288g	288g	288g
	Trial 2:	300g	294g	290g	290g	290g	290g
	Trial 3:	302g	296	292g	292g	292g	292g

Table 2: Masses of samples required to calculate percentage Dry Matter.

	Trial 1:	**Trial 2:**	**Trial 3:**	**Average:**
Mass of empty beaker:	280g	280g	280g	280g
Mass of empty beaker + fresh grass sample:	330g	330g	330g	330g
Mass of beaker + dried grass after constant mass was reached:	288g	290g	292g	$\frac{288+290+292}{3}$ = 292g

Mass of dried grass only:	288-280 = 8g	290-280 = 10g	294-280 = 12g	$\frac{8+10+12}{3}$ = 10g
Percentage DM: $\frac{Mass\ of\ dried\ grass}{Mass\ of\ fresh\ grass} x \frac{100}{1}$	$\frac{8g}{50g} x \frac{100}{1}$ 16%	$\frac{10g}{50g} x \frac{100}{1}$ 20%	$\frac{12g}{50g} x \frac{100}{1}$ 24%	$\frac{16+20+24}{3}$ = 20%

Graph:



Analysis: From analysing my results I can see that the dry matter varies in different samples of grass from 16 – 24%. This is in line with my findings from my background research which told me that about 83% of grass is water and 17% is dry material.

Conclusion: I can conclude that my data backs up my hypothesis. The Dry Matter content of grass was measured on average to be 20% Dry Matter.
There were a few limitations to my experiment, these include the actual size of the grass blades. Whilst I took care to cut them all to a length of 30cm, their masses would have varied. This would affect the amount of DM

Evaluation: I am happy with my results as they are consistent with my research into grass. I think my results are accurate as they are quite closely grouped.
If I was to do this experiment again I would control the mass of the grass sample not just cut the grass all to 30cm. I would also use a digitally controlled oven to get more control over the actual temperature.

To extend this experiment I would like to investigate the DM in different grass types, for example compare the DM of rye grasses, timothy and cocksfoot and compare it to my sample.

Discussion: Based on the primary data collected from this investigation, it can be said that on average grass contains 20% dry matter. This evidence proves my hypothesis to be correct.

There were a number of precautions put in place to minimise uncertainty in the data collected. Statistical uncertainty was minimised as I used as large a sample size as possible and averaged the data collected.

Systematic uncertainty was minimised as the electronic balance was calibrated before conducting the experiment. Systematic uncertainty could have occurred when opening the door of the oven, as heat was being lost each time the door was opened and the temperature was not constant at 100˚C. This could be a source of error in my data.

The data collected by this investigation was quantitative as it deals with number values. Comparing the primary data collected from this investigation to theoretical data collected by others, it is fair to say that the data from this investigation is accurate, as both identify grass to grass to have an average Dry Matter of 20%. Comparing the primary data collected from the three trials, they are within +/- 4% of each other so it is fair to say the data is precise. There was only one independent variable so it is fair to say the investigation was a fair test.

Formative Comments for Coursework

	Z	Y	X
Title, Aim, Links to cross cutting themes and Research			
Hypothesis and Prediction			
Experimental design			
Recorded Data (tables & graph)			
Analysis			
Conclusion			
Evaluation			
Discussion (relevance to agriculture)			

What does it mean to be scientifically literate?
Keywords:

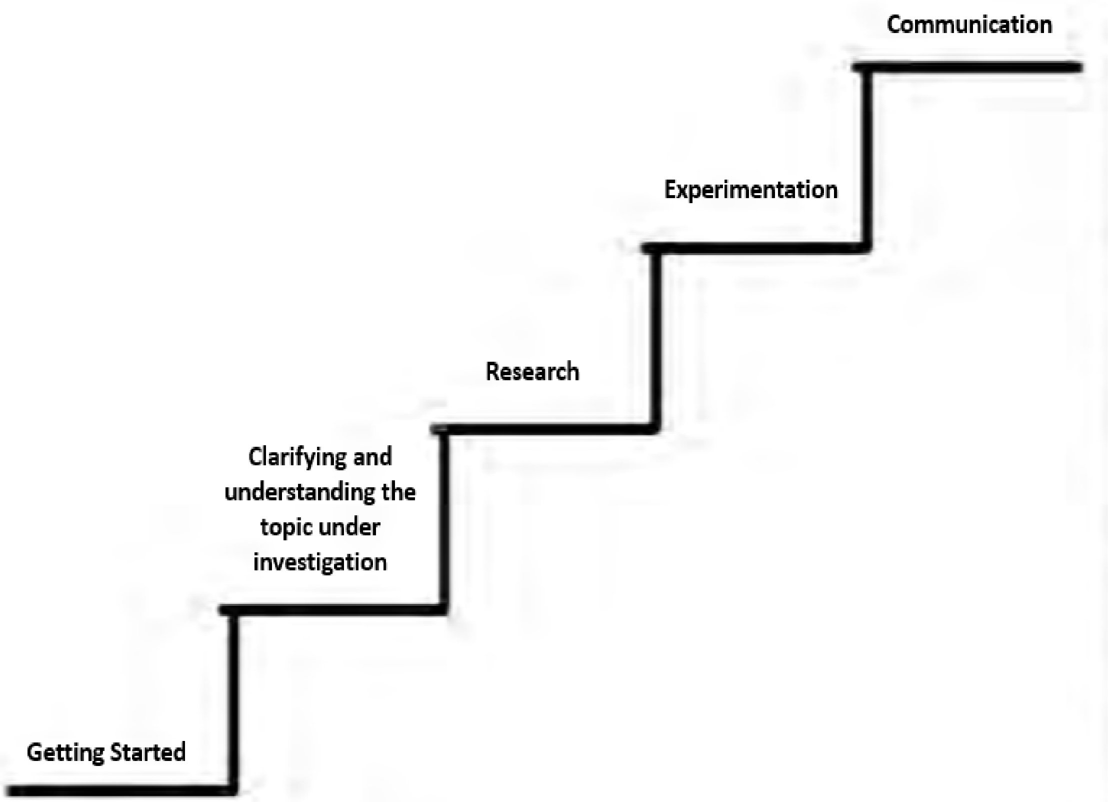
Think - Pair - Share

Question	My thoughts/Ideas	My Partners thoughts/ Ideas	Combined Ideas
Oral Language			
Writing			
Reading			

Using Digital Technology to Enhance Literacy and Differentiation

Teagasc Article	Teagasc Article - Rewordify
Soil Carbon Sequestration Carbon sequestration describes the process of transferring carbon from the atmosphere to the terrestrial biosphere (soil or vegetation). Soils contain vast quantities of plant, animal and microbial residues in varying stages of decomposition and store more carbon globally than the atmospheric and living vegetation pools combined. Temperate grasslands have shown strong potential to store carbon belowground in roots and soil. However, there is still large uncertainty surrounding baseline soil C values and verifying the strength and permanence of carbon sequestered in different soil fractions. Research in Teagasc Johnstown Castle is focussed on assessing the *quantity* and *quality* of soil organic carbon (SOC) in agricultural soils as well as management, soil and climatic effects on C sequestration. Soil samples taken across a range of soil types as part of the Irish Soil Information System and SQUARE projects will be analysed. In addition, flux data from long-term eddy covariance towers will provide detailed information on carbon exchange at an ecosystem level and the drivers of carbon uptake and release.	**Soil Carbon (separation from others)** Carbon (separation from others) describes the process of moving (from one place to another) carbon from the atmosphere to the (on land) (locations on the Earth that support life) (soil or green plants). Soils contain huge amounts of plant, animal and microbial residues in different stages of rotting and store more carbon around the world than the (related to the air outside) and living green plants pools combined. (huge areas of grass) have shown strong possible ability to store carbon belowground in roots and soil. However, there is still large doubt surrounding (a measure of what occurs naturally/sports boundary line) soil C values and (checking for truth/proving true) the strength and (state of existing forever) of carbon separated/isolated in different soil fractions. Research in Teagasc Johnstown Castle is focussed on testing/evaluating the amount and quality of soil organic carbon (SOC) in farming-based soils as well as management, soil and (related to the Earth's weather) effects on C (separation from others). Soil samples taken across a range of soil types as part of the Irish Soil Information System and SQUARE projects will be analysed. Also, flux data from long-term little swirling water current covariance towers will provide described/explained information on carbon exchange at a community level and the drivers of carbon uptake and release.

What is Good Research? - Five Phases



NCCA Plan document

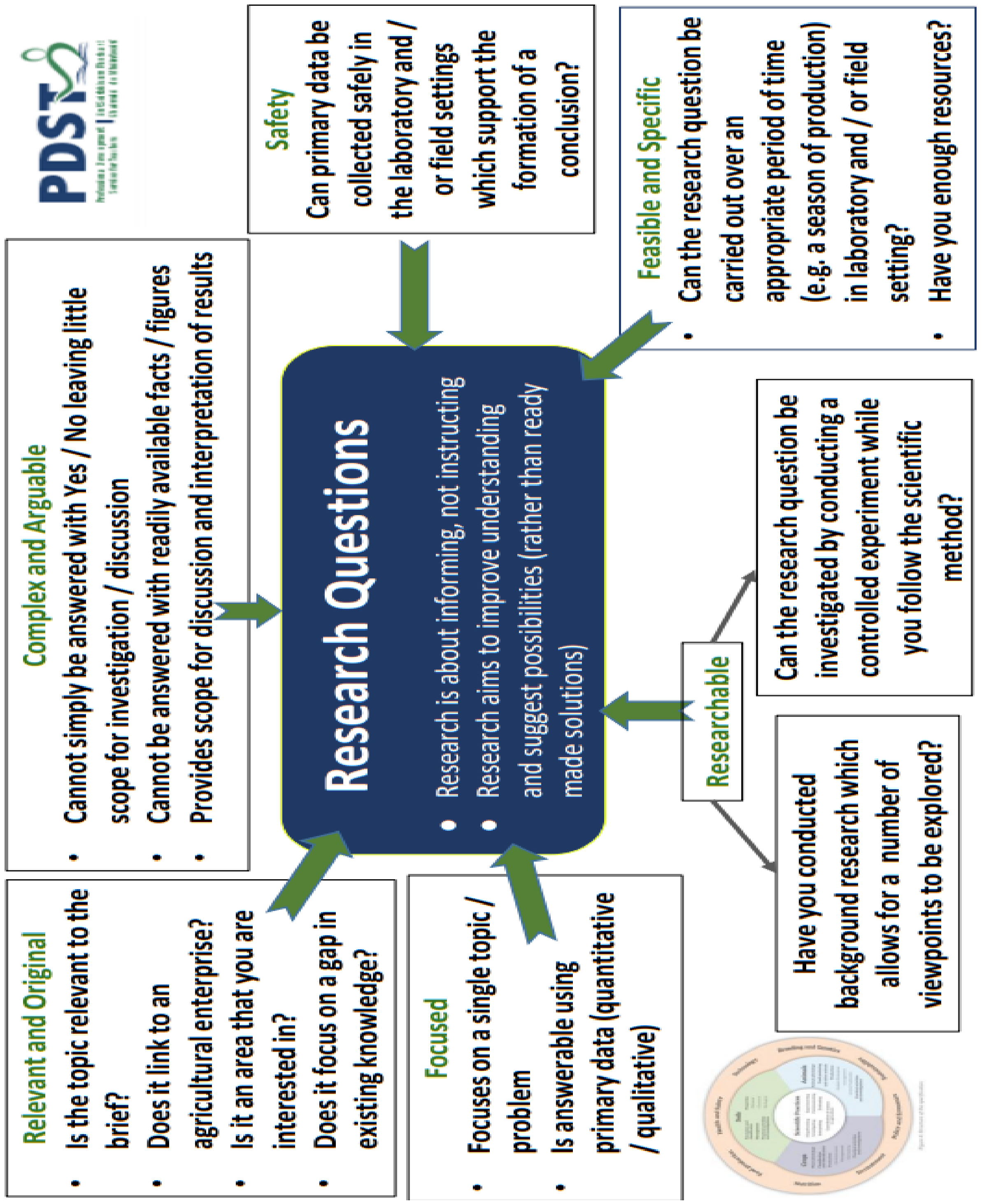
Appendix 1: Suggested student plan for the study

Student name:	Date:
	Class:
The topic I wish to investigate:	
How it connects to the brief:	
My plan for conducting the study	
Areas of the study	Timeline
Research	
Experimentation	
Communication	
Approved by:	Date:
Feedback:	

Appendix 3: Suggested experimental plan

Student name:	Date:
	Class:
Experiment:	
How it connects to the brief:	
Equipment and materials request:	
Safety:	
Proposed method:	
Approved by:	Date:
Feedback:	

Developing a Research Question



Question Stems for Students

Remembering	Understanding
• Who, what, where, why, when, which….? • Describe or define…? • Can you find….? • Can you list…? • Can you recall…? • Can you select…? • Label…?	• Describe in your own words… • Summarise ……. • Classify…. • Interpret…… in your own words • Compare and contrast…… • The main idea is…… • Can you explain what is happening…..? • Can you explain what is meant…..? • Which is the best answer….?
Analysing	**Applying**
• What conclusions can you draw from…..? • What evidence can you find….? • What is the relationship between…? • Classify or categorise the evidence…? • Can you make a distinction between ….? • Examine closely and explain how did…? • What is the function of…? • What ideas justify…?	• What examples can you find…? • What facts show that…? • How would you organise … to show…? • What would happen if…? • How could you use what we have learned today…? • How would you solve…. using what you have learned? • How would you show your understanding of….? • What approach would you use to….?
Evaluating	**Creating**
• Do you agree that…? • What would you advise…? • What do you think is the most important…? • Why do you think .. is/is not important….? • Prioritise…. • How would you rate…? • What would you recommend…? • How could you determine…? • What is your opinion of….? • How could you prove / disprove that….? • Can you assess the value / importance of..? • Would it be better if….?	• Can you propose an alternative…? • How could you adopt / modify…? • How could you test…? • What would happen if…? • Can you predict the outcome if….? • Can you think of an original way…? • What solutions would you suggest…? • What changes would you make to solve….? • How would you improve…? • What could be done to minimise / maximise ….? • Suppose you could… What would you do?