Oide
Tacú leis an bhFoghlaim Ghairmiúil i measc Ceannairí Scoile agus Múinteoirí
Supporting the Professional Learning of School Leaders and Teachers

Scientific Practices in Senior Cycle Science

Supporting Materials

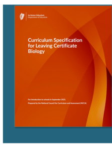
Webinar January 8th 2026

Oide
Tacú leis an bhFoghlaim Ghairmiúil i measc Ceannairí Scoile agus Múinteoirí
Supporting the Professional Learning of School Leaders and Teachers

SCIENTIFIC PRACTICES

- ASKING QUESTIONS
- DEVELOPING AND USING MODELS
- PLANNING AND CARRYING OUT INVESTIGATIONS
- ANALYSING AND INTERPRETING DATA
- USING MATHEMATICS AND COMPUTATIONAL THINKING
- CONSTRUCTING EXPLANATIONS
- ENGAGING IN ARGUMENT FROM EVIDENCE
- OBTAINING, EVALUATING, AND COMMUNICATING INFORMATION

Scientific Practices Webinar Supporting Materials

Practice	 AAC Guidelines Reference	 Biology Specification Reference
1. Asking Questions	During the Initial Response phase students ask questions to support their learning Stage 2, background research, involves students developing a research question in response to the brief	***U.2.1*** Recognise questions that are appropriate for scientific investigation p.15 ***U.2.2*** Pose testable hypotheses developed using scientific theories and explanations p.15 ***Key Competency*** Thinking & Solving Problems Draw conclusions to questions posed by themselves and others p.9–10 ***AAC / Biology in Practice*** Pose a testable hypothesis. Clearly describe the purpose of the investigation p.43–45 ***Contextual Strand Examples*** 1.2 discuss the difficulty of defining viruses p.17 3.7 discuss ethical issues arising from genetic technologies p.40
2. Developing and Using Models	The specification promotes an investigative approach to the development of inquiry and practical skills. As part of ongoing teaching, learning and assessment of the learning outcomes for Leaving Certificate, students have opportunities to develop inquiry and practical skills as they realise various learning outcomes across strands, as appropriate; using secondary sources, developing and using models, reasoning about biological phenomena, gathering primary data and analysing primary and secondary data. Students, therefore, should be developing sufficient knowledge, skills and understanding over the duration of the course to allow them to engage with an AAC.	***U.4*** Generating and using models… the evolving nature of models p.16 ***U.4.2*** Explain biological phenomena using appropriate means such as systems models p.16 ***Teaching & Learning*** Modelling is at the heart of what biologists do p.41 ***Contextual Strand Examples*** 2.2 illustrate enzyme action using the induced-fit model p.23 3.5 model the steps in generating a DNA profile p.40 Genetics outcomes; apply inheritance models to predict outcomes p.18–20 Ecology outcomes; use ecosystem and nutrient-cycle models p.32–37
3. Planning and Carrying Out Investigations	The AAC requires students to conduct scientific research on a particular issue and use appropriate primary data to investigate aspects of that issue. Students generate a hypothesis, plan, and design their experiment. They carry out their experiment and gather primary data. Students will be planning for its completion from the very beginning of the course, developing the skills required to complete the investigation as they engage with the learning set out in the specification. Stage 3 focuses on designing and planning the experiment. Stage 4 involves conducting the experiment.	***U.2.3*** Design, plan and conduct investigations; explain how reliability, accuracy, precision, fairness, error, safety have been considered p.15 ***U.2.5*** Review and reflect on the skills and thinking used in carrying out investigations p.15 ***AAC / Biology in Practice*** plan and design their investigation… gather primary data p.43–45 ***Contextual Strand Examples*** 2.3 investigate factors affecting enzyme activity using primary and secondary data p.24 3.6 investigate patterns using a DNA profile p.40
4. Analysing and Interpreting Data	Students analyse the data and form conclusions Stage 5 focuses on data analysis and conclusions.. Students can use their investigative log to record their data analysis, which they will use to justify conclusions.	***U.2.4*** Critically analyse data to identify patterns and relationships… identify anomalous observations… justify conclusions p.15 ***U.2*** (skills) Evaluate data in terms of accuracy, precision, repeatability and reproducibility p.16 ***AAC / Biology in Practice*** Analyse the data and form conclusions p.43–45 ***Contextual Strand Examples*** 2.3 use primary and secondary data to support conclusions on enzyme activity p.24 3.6 interpret patterns in DNA profiles p.40

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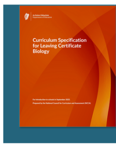
Practice	 AAC Guidelines Reference	 **Biology** Specification Reference
5. Using Mathematics and Computational Thinking	Data analysis may include: • evaluating data in terms of accuracy, precision, repeatability and reproducibility • calculations and/or graphs to facilitate the identification of patterns and relationships • justifications for any iterations of the process • the identification of and explanation for any initial anomalous results or observations	***U.2*** (skills) analyse data… identify patterns… evaluate error and reliability p.15–16 ***Digital Technology*** access and analyse large datasets. Choose appropriate tools for data analysis p.42 ***Contextual Strand Examples*** 2.3 analyse rate of enzyme activity p.24 3.5 use a genome database to search for alleles p.40 Genetics outcomes apply probability and ratio in inheritance problems p.18–20
6. Constructing Explanations	Students develop an evidence-based argument in response to the brief. Students should give an authentic account of how their investigative work unfolds, discuss and explain the outcomes of their investigation and how they might revise aspects of the process.	***U.4.2*** Explain biological phenomena using appropriate means p.16 ***Key Competency*** Thinking & Solving Problems use evidence and data to communicate findings and draw conclusions p.9–10 ***AAC / Biology in Practice*** Develop an evidence-based argument in response to the brief p.43–45 ***Contextual Strand Examples*** 2.1 explain how enzymes function p.23 Ecology outcomes explain ecosystem interactions p.32–37
7. Engaging in Argument from Evidence	Students should provide evidence of their ability to conduct scientific research on a particular issue and to use appropriate primary data to investigate aspects of that issue. Students develop an evidence-based argument in response to the brief.	***U.3.1*** Evaluate media-based arguments concerning science and technology p.16 ***U.3.2*** Evaluate the impact of scientific and technological developments on society p.16 ***Key Competency*** Communicating & Participating in Society p.9–10 ***Contextual Strand Examples*** 3.7 discuss ethical issues arising from genetic technologies p.40 1.2 debate whether viruses meet criteria for life p.17
8. Obtaining, Evaluating, and Communicating Information	Students gather, process and evaluate information from secondary sources. During this stage of the process, students develop a research question on a particular issue in response to the Investigation Brief and informed by their background research into the topic. Good research practice involves reviewing, summarising and evaluating evidence from different viewpoints. This allows an informed and justified opinion to be made in response to the research question. Finalising the AAC Report involves students drawing upon their investigative log, which outlines all the stages of their investigation, to compile their final report.	***U.1.2*** Conduct research and evaluate different sources of information p.14 ***U.2.6*** Organise and communicate… findings using appropriate scientific terminology and representations p.15 ***Key Competency*** Communicating p.9–10 ***AAC / Biology in Practice*** submit a report… communicate findings appropriately and effectively p.43–45 ***Contextual Strand Examples*** Multiple LOs requiring research, presentation and discussion p.17–40

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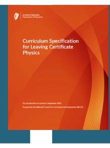
Practice	 AAC Guidelines Reference	 **Physics** Specification Reference
1. Asking Questions	During the Initial Response phase students ask questions to support their learning Stage 2, background research, involves students developing a research question in response to the brief	***U.2.1*** Recognise and pose questions that are appropriate for scientific investigation p.13–14 ***U.2.2*** Pose testable hypotheses developed using scientific theories and explanations p.13–14 ***Cross-cutting Themes*** student pose questions p.11 ***AAC / Physics in Practice*** Pose a testable hypothesis that is underpinned by physics theory p.33–34 ***Contextual Strand Examples*** Mechanics investigate motion and forces using questions and hypotheses p.15–18
2. Developing and Using Models	The specification promotes an investigative approach to the development of inquiry and practical skills. As part of ongoing teaching, learning and assessment of the learning outcomes for Leaving Certificate, students have opportunities to develop inquiry and practical skills as they realise various learning outcomes across strands, as appropriate; using secondary sources, developing and using models, reasoning about biological phenomena, gathering primary data and analysing primary and secondary data. Students, therefore, should be developing sufficient knowledge, skills and understanding over the duration of the course to allow them to engage with an AAC.	***U.4*** Generating and using models / verifying models / evolving nature of models p.15 ***Introductory Statement*** Modelling is at the heart of what physicists do p.30 ***Glossary*** Use words, diagrams, numbers, graphs and equations to describe and solve problems p.38 ***Contextual Strand Examples*** Mechanics — kinematic and force models p.15–18 Waves — model wave motion and sound/light p.19–21 Electricity & Fields — circuit and field models p.22–25 Modern Physics — atomic and quantum models p.26–28
3. Planning and Carrying Out Investigations	The AAC requires students to conduct scientific research on a particular issue and use appropriate primary data to investigate aspects of that issue. Students generate a hypothesis, plan, and design their experiment. They carry out their experiment and gather primary data. Students will be planning for its completion from the very beginning of the course, developing the skills required to complete the investigation as they engage with the learning set out in the specification. Stage 3 focuses on designing and planning the experiment. Stage 4 involves conducting the experiment.	***U.2.3*** Design, plan and conduct investigations; explain how reliability, accuracy, precision, error, fairness, safety have been considered p.13–14 ***U.2.5*** Review and reflect on the skills and thinking used in carrying out investigations p.14 ***AAC / Physics in Practice*** Use a clear investigative design / collect high-quality primary data p.33–34 ***Contextual Strand Examples*** Mechanics / Electricity / Waves experiments labelled investigate p.15–27
4. Analysing and Interpreting Data	Students analyse the data and form conclusions Stage 5 focuses on data analysis and conclusions.. Students can use their investigative log to record their data analysis, which they will use to justify conclusions.	***U.2.4*** Critically analyse data to identify patterns and relationships / Identify anomalous observations / Draw and justify conclusions p.14 ***U.4*** Unit & error analysis includes precision, accuracy, repeatability and reproducibility p.15 ***AAC*** high-quality data presentation and analysis p.33–34 ***Contextual Strand Examples*** Investigations across all strands require analysis of graphs, error & trends p.15–28

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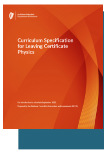
Practice	 **AAC Guidelines Reference**	 **Physics** Specification Reference
5. Using Mathematics and Computational Thinking	Data analysis may include: • evaluating data in terms of accuracy, precision, repeatability and reproducibility • calculations and/or graphs to facilitate the identification of patterns and relationships • justifications for any iterations of the process • the identification of and explanation for any initial anomalous results or observations	***U.2 & U.4*** Use words, diagrams, numbers, graphs and equations. Unit/dimensional analysis. Order-of-magnitude estimates p.13–15 ***Contextual Strand Examples*** Mechanics equations of motion p.15–18 Electricity circuit laws & relationships p.22–25 Waves & quantum formulae p.19–21, 26–28
6. Constructing Explanations	Students develop an evidence-based argument in response to the brief. Students should give an authentic account of how their investigative work unfolds, discuss and explain the outcomes of their investigation and how they might revise aspects of the process.	***U.2.4*** Draw and justify conclusions p.14 ***Key Competency*** Thinking & Solving Problems Use evidence to construct and justify conclusions p.10 ***AAC*** Develop an evidence-based argument in response to the brief p.33–34 ***Contextual Strand Examples*** All strands require physics-based explanation of observed phenomena p.15–28
7. Engaging in Argument from Evidence	Students should provide evidence of their ability to conduct scientific research on a particular issue and to use appropriate primary data to investigate aspects of that issue. Students develop an evidence-based argument in response to the brief.	***U.3.1*** Evaluate media-based arguments concerning science and technology p.14 ***U.3.2*** Evaluate the impact of scientific developments on society p.14–15 ***Key Competency*** Reasoned argument & evaluation p.10 ***AAC*** Develop an evidence-based argument p.33–34 ***Contextual Strand Examples*** Ethical, technological & societal applications across strands p.11–12, 15–28
8. Obtaining, Evaluating, and Communicating Information	Students gather, process and evaluate information from secondary sources. During this stage of the process, students develop a research question on a particular issue in response to the Investigation Brief and informed by their background research into the topic. Good research practice involves reviewing, summarising and evaluating evidence from different viewpoints. This allows an informed and justified opinion to be made in response to the research question. Finalising the AAC Report involves students drawing upon their investigative log, which outlines all the stages of their investigation, to compile their final report.	***U.1.2*** Conduct research and evaluate sources of information p.13 ***U.2.6*** Organise and communicate… findings using relevant scientific terminology p.14 ***Key Competency*** Communicating p.10 ***AAC*** Communicate findings appropriately and effectively p.33–34 ***Contextual Strand Examples*** esearch, presentation & report writing embedded across strands p.15–28

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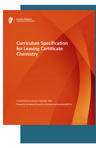
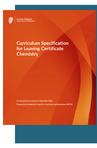
Practice	 AAC Guidelines Reference	 **Chemistry** Specification Reference
1. Asking Questions	During the Initial Response phase students ask questions to support their learning Stage 2, background research, involves students developing a research question in response to the brief	***U.2.1*** Recognise questions that are appropriate for scientific investigation p.15 ***U.2.2*** Pose testable hypotheses… evaluate and compare strategies for investigating hypotheses p.15 ***Key Competency*** Thinking & Solving Problems ask questions, gather and explore data, observe and investigate the chemical world p.10–11 ***AAC*** Research Investigation pursue answers to questions raised through their research investigations p.4–5 ***4.3.8*** research and investigate an area of chemistry through a cross-cutting theme p.35
2. Developing and Using Models	The specification promotes an investigative approach to the development of inquiry and practical skills. As part of ongoing teaching, learning and assessment of the learning outcomes for Leaving Certificate, students have opportunities to develop inquiry and practical skills as they realise various learning outcomes across strands, as appropriate; using secondary sources, developing and using models, reasoning about biological phenomena, gathering primary data and analysing primary and secondary data. Students, therefore, should be developing sufficient knowledge, skills and understanding over the duration of the course to allow them to engage with an AAC.	***U.4*** Visualisation / generating and using models / the evolving nature of models p.15–16 ***U.1*** Understand the power of model and the limitations of models p.15 ***Teaching & Learning*** Visualise and generate their own internal models of chemical processes p.11 ***1.2*** Evaluate historical models of atomic structure p.18 ***2.1*** Use models of bonding including sigma and pi bonds p.21–22 ***2.2*** Use VSEPR theory to model shapes of molecules and ions p.21–22 ***2.3*** Use the ideal gas equation $PV=nRT$ as a model of gas behaviour p.23 ***3.1*** Use energy profile diagrams to represent enthalpy changes p.25–26 ***3.3*** Use KC as a mathematical model of equilibrium systems p.27
3. Planning and Carrying Out Investigations	The AAC requires students to conduct scientific research on a particular issue and use appropriate primary data to investigate aspects of that issue. Students generate a hypothesis, plan, and design their experiment. They carry out their experiment and gather primary data. Students will be planning for its completion from the very beginning of the course, developing the skills required to complete the investigation as they engage with the learning set out in the specification. Stage 3 focuses on designing and planning the experiment. Stage 4 involves conducting the experiment.	***U.2.3*** Design, plan and conduct investigations; explain how reliability, validity, accuracy, precision, error, fairness, safety have been considered p.15 ***U.2*** (skills) use SI units, consider systematic and random errors p.15 ***AAC rationale*** learn practical and experimental design skills and appropriate risk assessment p.4–5 ***1.1.5*** Verify the law of conservation of mass (EI) p.17 ***2.1.5*** Identify common cations and anions in salts (EI) p.22 ***3.1.3*** Determine heat of reaction ΔH (EI) p.24–25 ***3.2.3*** Investigate factors affecting rate of reaction (EI) p.26 ***4.1*** Carry out volumetric analysis including standardisation and determination of concentration (EI) p.31–32
4. Analysing and Interpreting Data	Students analyse the data and form conclusions Stage 5 focuses on data analysis and conclusions.. Students can use their investigative log to record their data analysis, which they will use to justify conclusions.	***U.2.4*** Produce and select data, critically analyse data to identify patterns and relationships, identify anomalous observations, justify conclusions p.16 ***U.2*** Evaluate data in terms of precision and accuracy… repeatability and reproducibility p.15–16 ***Key Competency*** Communicating gather, organise and interpret primary data p.10–11 ***3.2.3*** Interpret rate data and graphs p.26 ***3.3.5*** Analyse data to predict the effect of changes on equilibrium systems p.27 ***4.1.3*** Interpret titration results and data to determine concentration p.31

Scientific Practices Webinar Supporting Materials

Practice	 AAC Guidelines Reference	 **Chemistry** Specification Reference
5. Using Mathematics and Computational Thinking	Data analysis may include: • evaluating data in terms of accuracy, precision, repeatability and reproducibility • calculations and/or graphs to facilitate the identification of patterns and relationships • justifications for any iterations of the process • the identification of and explanation for any initial anomalous results or observations	***U.2*** Manipulate mathematical representations of data, use SI units, evaluate error p.15–16 ***U.4*** Use symbolic and mathematical representations to describe chemical systems p.15–16 ***1.4*** Use mole calculations, concentration, percentage yield and gas volume relationships p.18–19 ***2.3*** Use the ideal gas equation PV=nRT in calculations p.23 ***3.3*** Construct and use KC expressions and carry out equilibrium calculations p.27 ***3.4*** Use pH, Kw, Ka and Kb relationships to solve problems p.28–29 ***4.1 / 4.2*** Carry out volumetric and stoichiometric calculations in analytical and organic chemistry p.31–33
6. Constructing Explanations	Students develop an evidence-based argument in response to the brief. Students should give an authentic account of how their investigative work unfolds, discuss and explain the outcomes of their investigation and how they might revise aspects of the process.	***U.4.2*** Relate observable phenomena to chemical processes, explain chemical phenomena using appropriate means p.16 ***Key Competency*** Thinking & Solving Problems use evidence to explain and solve problems p.10–11 ***2.1*** Explain bonding types using orbital and electron-pair models p.20–22 ***2.2*** Explain shapes of molecules and ions using VSEPR theory p.21–22 ***3.1–3.5*** Explain thermochemistry, kinetics, equilibrium, acids and bases and redox reactions p.24–29 ***4.2*** Explain organic reaction types and structure–function relationships p.32–33
7. Engaging in Argument from Evidence	Students should provide evidence of their ability to conduct scientific research on a particular issue and to use appropriate primary data to investigate aspects of that issue. Students develop an evidence-based argument in response to the brief.	***U.3*** Evaluate media-based arguments concerning science and technology, justify opinions p.16 ***Key Competency*** Participating in Society use reasoning and evidence in scientific discussion p.10–11 ***3.4*** Evaluate claims relating to acids, bases and environmental chemistry p.28 ***4.3*** Evaluate chemical issues relating to health, environment and society p.34–35 ***Research Investigations (RI)*** e.g. 2.4.2 / 3.5.9 / 4.3.8 research and evaluate information related to chemistry in society p.23, 29, 35
8. Obtaining, Evaluating, and Communicating Information	Students gather, process and evaluate information from secondary sources. During this stage of the process, students develop a research question on a particular issue in response to the Investigation Brief and informed by their background research into the topic. Good research practice involves reviewing, summarising and evaluating evidence from different viewpoints. This allows an informed and justified opinion to be made in response to the research question. Finalising the AAC Report involves students drawing upon their investigative log, which outlines all the stages of their investigation, to compile their final report.	***U.1.2*** Conduct research and evaluate different sources of information p.15 ***U.2.6*** Organise and communicate findings using relevant scientific terminology and representations p.16 ***Key Competency*** Communicating communicate qualitative and quantitative information - written, oral, visual and digital p.10–11 ***AAC rationale D***evelop and communicate scientific arguments and findings p.4–5 ***Research Investigations:*** 2.4, 3.5, 4.3, 4.3.8 research, evaluate and communicate information on chemistry topics p.23, 29, 34–35

Scientific Practices Webinar Supporting Materials

Strands	Nature of Science
Understanding About Science	1. Students should be able to appreciate how scientists work and how scientific ideas are modified over time
Investigating in Science	2. Students should be able to recognise questions that are appropriate for scientific investigation, pose testable hypotheses, and evaluate and compare strategies for investigating hypotheses 3. Students should be able to design, plan and conduct investigations; explain how reliability, accuracy, precision, fairness, safety, ethics, and selection of suitable equipment have been considered 4. Students should be able to produce and select data (qualitatively/quantitatively), critically analyse data to identify patterns and relationships, identify anomalous observations, draw and justify conclusions 5. Students should be able to review and reflect on the skills and thinking used in carrying out investigations, and apply their learning and skills to solving problems in unfamiliar contexts
Communicating in Science	6. Students should be able to conduct research relevant to a scientific issue, evaluate different sources of information including secondary data, understanding that a source may lack detail or show bias 7. Students should be able to organise and communicate their research and investigative findings in a variety of ways fit for purpose and audience, using relevant scientific terminology and representations 8. Students should be able to evaluate media-based arguments concerning science and technology
Science in Society	9. Students should be able to research and present information on the contribution that scientists make to scientific discovery and invention, and its impact on society 10. Students should be able to appreciate the role of science in society; and its personal, social and global importance; and how society influences scientific research

Unifying Strand Learning Outcomes

Students learn about	Students should be able to
U1 Scientific knowledge • the nature of scientific knowledge • science as a global enterprise that relies on clear communication, international conventions, peer review and reproducibility	1. appreciate how scientists work and how scientific ideas are modified over time
• recognising bias	2. conduct research relevant to a scientific issue, evaluate different sources of information including secondary data, understanding that a source may lack detail or show bias
U2 Investigating in Science • questioning and predicting	1. recognise questions that are appropriate for scientific investigation 2. pose testable hypotheses developed using scientific theories and explanations, and evaluate and compare strategies for investigating hypotheses

• objectivity
  • identifying potential sources of random and systematic error
  • evaluating data in terms of repeatability and reproducibility
	3. design, plan and conduct investigations; explain how reliability, accuracy, precision, error, fairness, safety, integrity, and the selection of suitable equipment have been considered
	4. produce and select data (qualitatively/quantitatively), critically analyse data to identify patterns and relationships, identify anomalous observations, draw and justify conclusions
	5. review and reflect on the skills and thinking used in carrying out investigations, and apply their learning and skills to solving problems in unfamiliar contexts

• communicating results to a range of audiences	6. organise and communicate their research and investigative findings in a variety of ways fit for purpose and audience, using relevant scientific terminology and representations
U3 Science in society • evaluating evidence for relevance, accuracy, bias	1. evaluate media-based arguments concerning science and technology
• relating science and scientists to society by considering economic, social, sustainability and ethical factors	2. research and present information on the contribution that scientists make to scientific discovery and invention, and evaluate its impact on society

Chemistry U4

U4. Abstraction to representation • visualisation as a key aspect of understanding core concepts • generating and using models • the evolving nature of models	1. relate observable phenomena to the chemical processes at the atomic, sub-atomic or molecular level 2. appreciate that models: • are simplified representations of complex systems or phenomena with underlying assumptions • can be modified as more data becomes available from the system/phenomenon • can predict the behaviour of a system/phenomenon

Biology U4

U4 Biological reasoning • generating and using models • the evolving nature of models	1. appreciate that models • are simplified representations of complex systems or phenomena with underlying assumptions • can be modified as more data becomes available from the system/phenomenon • can predict the behaviour of a system/phenomenon

• means by which to explain biological phenomena:
  • systems
  • interdependence, unity and diversity of life
  • form fits function
  • transfer of information, matter, and energy, etc.
	2. explain biological phenomena using appropriate means

Physics U4 & U5

U4. Modelling in Physics • generating and using models • the evolving nature of models	1. appreciate that models • are simplified representations of complex systems or phenomena with underlying assumptions • can be modified as more data becomes available from the system/phenomenon • can predict the behaviour of a system/phenomenon
• verifying models	2. make connections between mathematical representations of a system and data about the system obtained from that system with integrity through reliable, accurate, and precise observation and safe and fair experiment
U5. Unit analysis • dimensional/unit analysis • making order of magnitude estimates	1. evaluate and articulate whether an answer is reasonable by analysing the dimensions / units and the order of magnitude

Testable Vs Non-Testable Questions

Feature	Testable Question	Non-Testable Question
Measurable Variables	Involves variables that can be measured	Involves opinions, beliefs or concepts that are not easily measured
Experimental Inquiry	Can be answered through experiments and observations	Cannot be answered through experiments or observations
Answers	Tend to have objective answers that can be verified through evidence	Tend to have subjective answers that vary from person to person

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Instructions: For each of the 20 questions below, decide whether the question is Testable or Non-Testable. Then, briefly explain why you chose that category, using the criteria: measurable variables, experimental inquiry, or type of answer (objective vs subjective)

Question	Testable / Not-Testable	Why? Justification
Does the amount of fertiliser affect the height of bean plants?		
What is the most beautiful flower?		
How does temperature affect the rate of yeast fermentation?		
Why do some people prefer cats over dogs?		
Does increasing exercise time reduce resting heart rate?		
Is it better to study in the morning or at night?		
What effect does caffeine have on reaction time?		
Which planet is the most interesting?		
How does light intensity affect photosynthesis in pondweed?		
Do students learn better in silence or with background music?		
Is chocolate the best dessert?		
How does the type of soil affect water drainage rate?		
Should animals be kept in zoos?		
Does the pH level of water affect seed germination?		
What is the most important subject in school?		
How does sugar affect the growth of mould on bread?		
Do plants grow faster with classical or rock music?		
Why is kindness important in society?		
How does the angle of a ramp affect the speed of a toy car?		
What is the best way to solve climate change?		

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Possible / Suggested responses

Question	Testable / Not Testable	Why? (Justification)
Does the amount of fertiliser affect the height of bean plants?	Testable	*Fertiliser amount can be changed and plant height can be measured and compared.*
What is the most beautiful flower?	Not testable	*Beautiful is subjective and depends on personal opinion, not measurable data.*
How does temperature affect the rate of yeast fermentation?	Testable	*Temperature can be controlled and fermentation rate measured (e.g. CO_2 produced).*
Why do some people prefer cats over dogs?	Not testable	*Preferences are personal opinions and cannot be measured scientifically.*
Does increasing exercise time reduce resting heart rate?	Testable	*Exercise time can be changed and resting heart rate measured before and after.*
Is it better to study in the morning or at night?	Not testable	*Better is vague and depends on individual experience and opinion.*
What effect does caffeine have on reaction time?	Testable	*Caffeine intake can be controlled and reaction time measured.*
Which planet is the most interesting?	Not testable	*Interesting is subjective and not measurable.*
How does light intensity affect photosynthesis in pondweed?	Testable	*Light intensity can be varied and photosynthesis rate measured (e.g. oxygen bubbles).*
Do students learn better in silence or with background music?	Not testable	*Learn better is subjective and difficult to measure reliably.*
Is chocolate the best dessert?	Not testable	*Best is based on personal opinion, not scientific measurement.*
How does the type of soil affect water drainage rate?	Testable	*Soil type can be changed and drainage time measured.*
Should animals be kept in zoos?	Not testable	*This is an ethical question, not a scientific investigation.*
Does the pH level of water affect seed germination?	Testable	*pH can be controlled and germination rate measured.*
What is the most important subject in school?	Not testable	*Importance depends on opinion and values, not measurable variables.*
How does sugar affect the growth of mould on bread?	Testable	*Sugar levels can be varied and mould growth measured over time.*
Do plants grow faster with classical or rock music?	Testable	*Type of music can be changed and plant growth measured.*
Why is kindness important in society?	Not testable	*This is a philosophical/social question, not experimentally measurable.*
How does the angle of a ramp affect the speed of a toy car?	Testable	*Ramp angle can be changed and speed measured.*
What is the best way to solve climate change?	Not testable	*Best is subjective and involves opinion, ethics, and policy decisions.*

EVALUATING SOURCES

C — Credibility

Who is the author?
What evidence is offered of his/her knowledge ?

A — Accuracy

Can facts & statistics be verified?
Does there appear to be errors on the source ?

R — Reliability

Does the source present bias?

R — Revelance

Does the information directly support or help to answer my question?

D — Date

Does this investigation question need current information or when was the source created ?

S — Source

Is the information based on primary or secondary sources ?
Did the author document their sources ?

S — Scope and Purpose

Does this source address my question comprehensively?

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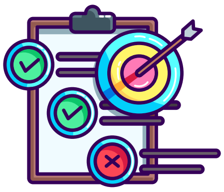
Searching V's Researching Lesson Resource



Learning Intention:

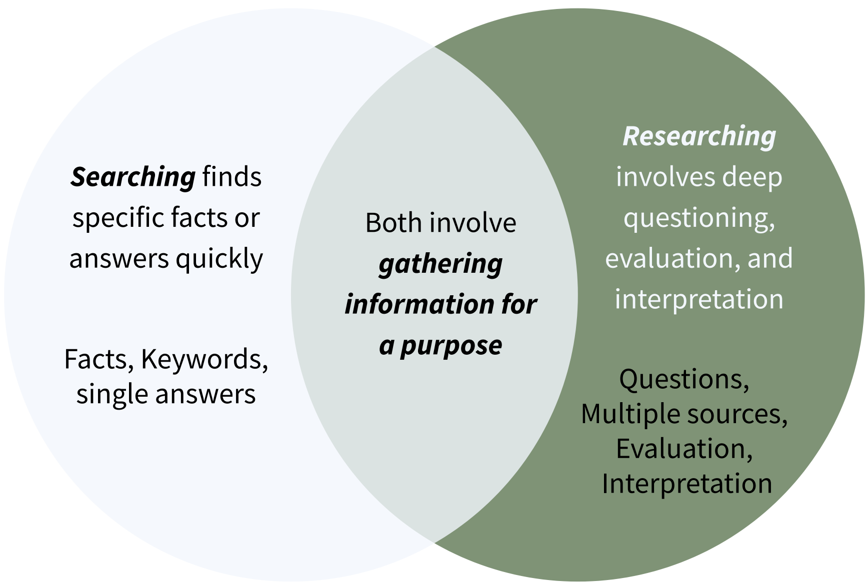
- Students can distinguish between searching and researching.
- Students appreciate that research involves questioning, evaluation and interpretation.

Starter Game – Search Race

Teacher Question 1: How tall is the Eiffel Tower?
Students search (phones, tablets, or quick recall).
Teacher Question 2: Why was the Eiffel Tower controversial when it was built?
Plenery: Students realise they need more than one source, multiple perspectives, deeper answers.
Discussion Prompt: Which question was easier answer? Which needed more thinking? Which one was research?

Follow up Activity - Fact or Research?

Show a Venn diagram comparing Searching vs Researching
Suggest the analogy: Searching is like finding ingredients, researching is like cooking a meal.



Give pairs/groups task cards (examples below).
Students sort into Search task or Research task .

Find the boiling point of water

Investigate how climate change affects rainfall in Ireland

Who won the 2022 world cup

How does sport influence mental health in teenagers?

What is the capital of Australia?

How does diet influence growth in adolescents

Who is the current 100m sprint world record holder?

How effective are vaccines in controlling infectious diseases?

Scientific Practices Webinar Supporting Materials

Give pairs/groups task cards (examples below).
Students sort into Search task or Research task .

What is the symbol for sodium in the periodic table?

What year was penicillin discovered?

Find the population of Brazil.

What is the formula for calculating speed?

Which planet is closest to the sun?

What is the chemical formula for methane?

Who invented the telephone?

How many bones are in the adult human body?

Note: Oxygen symbol on Sodium task card is intentional

Scientific Practices Webinar Supporting Materials

Give pairs/groups task cards (examples below).
Students sort into Search task or Research task .

Investigate the impact of fast fashion on the environment.

Research the advantages and disadvantages of renewable energy.

Investigate the effects of vaping on human health.

How has smartphone use affected sleep patterns in young people?

Investigate how plastic pollution affects marine ecosystems.

Research how scientists use AI in medicine today.

How has the discovery of DNA changed modern medicine?

Note Blanks for students to create own

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ANSWER

Search Tasks (fact finding only)
Find the boiling point of water.
Check who won the 2022 World Cup.
What is the capital of Australia?
What is the symbol for sodium in the periodic table?
What year was penicillin discovered?
Find the population of Brazil.
What is the formula for calculating speed?
Which planet is closest to the sun?
What is the chemical formula for methane?
Who invented the telephone?
How many bones are in the adult human body?

Research Tasks (require analysis, comparison, evaluation)
Investigate how climate change affects rainfall in Ireland.
Research how sport influences mental health in teenagers.
How does diet influence growth in adolescents?
Investigate the impact of fast fashion on the environment.
How effective are vaccines in controlling infectious diseases?
Research the advantages and disadvantages of renewable energy.
Investigate the effects of vaping on human health.
How has smartphone use affected sleep patterns in young people?
Investigate how plastic pollution affects marine ecosystems.
Research how scientists use AI in medicine today.
How has the discovery of DNA changed modern medicine?

Plenary

Reflection slip:

One way searching is different from researching is...

Scientific Practices Webinar Supporting Materials

Below please find supports mentioned during the webinar.
Some of these resources may support specific aspects of Scientific Practices, with an emphasis on communicating and constructing scientific information and findings.

SCAMPER

Modify

(MAGNIFY/MINIFY)

- Could I modify the time taken for my experiment? Could I modify an experimental set up to make it safer?
- What could I make bigger or smaller to improve the efficiency of my design?

Adapt

(CHANGE)

- Could I adapt a piece of apparatus to serve my need?
- Could I adapt a method to work for my experiment?
- Could a solution to one issue be adapted to help solve a different issue?

Purpose

(PUT TO ANOTHER USE)

- Could the products or by products of my experiment be put to a use in the real world?
- Could my apparatus, method or device be used for something else? Could I use my apparatus in other investigations?

Combine

(BRING TOGETHER)

- Could I combine methods or pieces of apparatus to test my hypothesis?
- If I repeat the test many times and combined the results to get an average, would it improve my investigation?

Eliminate

(REMOVE)

- Could I remove a variable affecting my results?
- Could I eliminate a piece of apparatus?
- What can be removed or simplified?

INSERT OWN IMAGE HERE

Substitute

(SWAP)

- Could I swap for a different chemical, object, method, variable, material or piece of apparatus
- Could I replace any parts or features in the original to improve or change the design to make it my own?

Rearrange

(REVERSE/CHANGE ORDER)

- Would rearranging the order of steps in my method produce a different outcome?
- What if I reversed the way my device works
- What other arrangement might work better or more efficiently?

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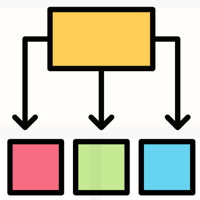
Please note: The questions detailed above are examples and are not intended to be exhaustive

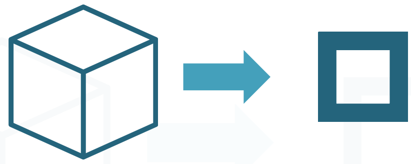
Scientific Practices Webinar Supporting Materials

Computational Thinking can be defined as competence in problem solving & design to create useful solutions, informed by the possibilities that Computing offers.

Millwood, R. et al. (2018) Review of literature on Computational thinking, Paper funded by NCCA, 2018



1: Decomposition
Breaking down a problem into smaller parts

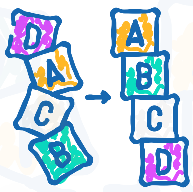


3: Abstraction
Filtering out unnecessary details - Focusing on important or necessary information

Computational Thinking

The 4 components / cornerstones

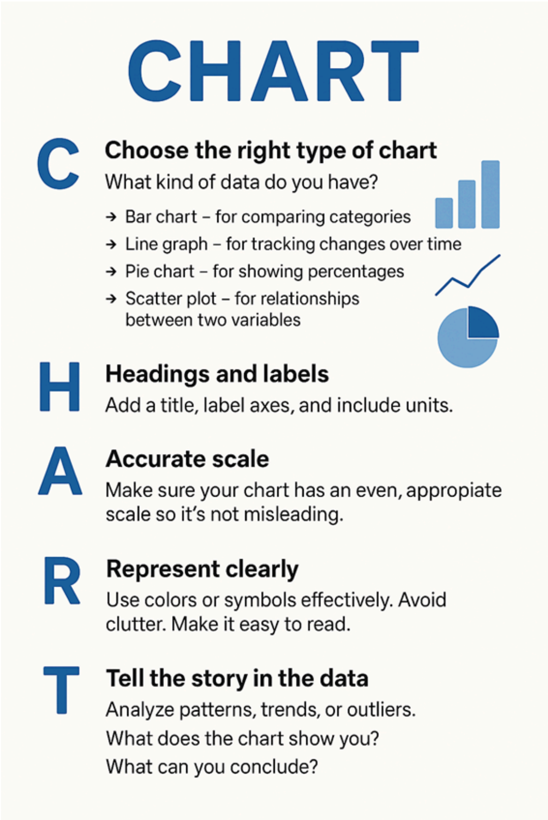
2: Pattern Recognition
Looking for similarities or trends

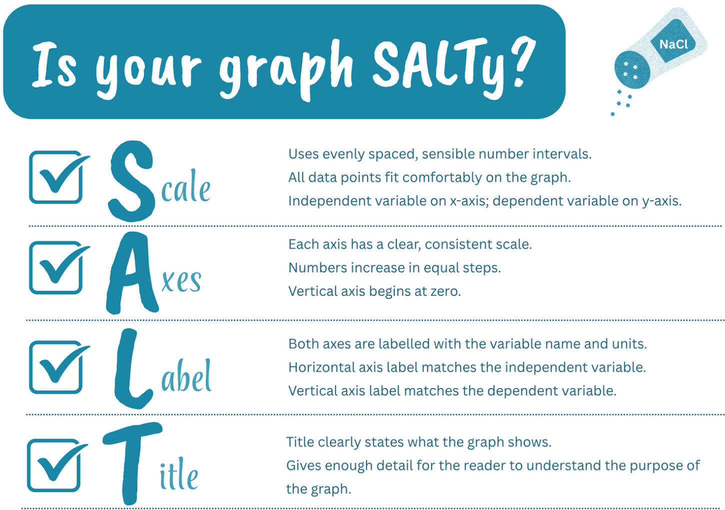


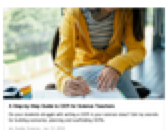
4: Algorithmic Design
Developing step by step solutions

Scientific Practices Webinar Resources

Some of these resources may support specific aspects of Scientific Practices, with an emphasis on communicating and constructing scientific information and findings.







Scientific Practices Webinar Resources

NCCA Focus on Learning Toolkit

Supporting a whole-school approach to professional development and capacity building in developing effective, ongoing assessment practice which supports students' learning.

The workshops are designed to be used in a flexible manner around five topics:

- Learning intentions and success criteria
- Effective questioning
- Formative feedback
- Students reflecting on their learning
- Learning outcomes

NOTES