Individual Skill Element Descriptors – all elements

Scientific method	Description
Observing	Scientific exploration has its roots in the ability to observe the natural world. Observations are sensory experiences about the natural world and can include any of the senses.
Questioning	Observations give rise to questions. Scientific inquiry questions include and name at least two variables: the independent variable(s) and the dependent variable(s). Scientific inquiries explore if or which independent variable has an effect upon the dependent variable.
Hypothesising and predicting	A hypothesis is an idea about how something works that can be tested by carrying out experiments. A prediction states what is thought will happen in an experiment if the idea is correct.
Designing experiments	Designing an experiment involves not only the selection of suitable independent, dependent, and control variables, but planning the delivery of the experiment under appropriate conditions given the limitations of the resources.
Conducting experiments and tests	Experiments and inquiries test if a prediction is accurate and if the hypothesis is supported. To do this, it is important for the experiment to involve a fair test. Fair tests only change one variable at a time while keeping all other conditions the same. Experiments should also be repeated to check the validity of results.
Collecting and organising data	Evidence, or data, is required to test any prediction. Data can be gathered by observing the natural world, performing an experiment in a laboratory, or by developing a model.
Analysing and interpreting data	The analysis of inquiry results involves scientists examining their data and observations. Data can be quantitative or qualitative and aims to highlight any patterns or trends within the observations. It is important to see if the data supports the prediction and to check if the hypothesis was correct. Once data has been collected, displaying it in a chart or a graph helps to reveal any patterns and to see any relationships between the variables involved in the inquiry.
Inferring, concluding and deciding	A conclusion is a summary statement based on experimental data (measurements and observations) and describes what has been found out by the inquiry. This should include a summary of the results, whether or not the hypothesis was supported, the significance of the study, and future work that could be done. Conclusions are clearly structured and explained using the correct terminology and scientific knowledge or ideas.
Evaluating	This aspect of an inquiry involves the assessment of the results and methods to assess the reliability of the evidence collected to reach the conclusion. Where appropriate Comment should be made regarding any improvements that could be made to increase reliability, it should be suggested that further tests are carried out.

Individual skill element levelled criteria – Observation

Levels 1 – 3 cover grades 6, 7 & 8

Levels 4 – 6 cover grades 9 & 10

Levels 7 – 9 cover grades 11 & 12 – please see grades 11 and 12

Level	Observation
6	• Describes and explains processes or phenomena logically, and in the necessary detail, making use of abstract ideas and models from different areas of science. • Chooses and justifies data collection methods that minimise error and results in data with a high degree of accuracy and precision.
5	• Makes explicit connections between abstract ideas and models in describing and explaining processes and phenomena. • Explains how to take account of sources of error in order to collect reliable data.
4	• Uses abstract ideas, models or multiple variables and factors when describing processes or phenomena. • Carefully collects data choosing appropriate ranges, numbers and values for measurements and observations.
3	• Uses scientific ideas or models, including those involving more than one step, when describing processes or phenomena. • Repeats sets of observations or measurement where appropriate selecting suitable ranges and intervals.
2	• Uses science ideas when describing simple processes or phenomena. • Makes sets of observations or measurements, including decimal values, identifying the ranges and intervals used.
1	• Identifies similarities and differences or changes related to simple ideas, processes or phenomena. • Makes some relevant and accurate observations or whole number measurements in relation to the question under investigation.

Observation Assessment ladder - I can/they can statements

Level	I can/they can statements
6	• Describe and explain processes logically and in sufficient scientific detail. • Use abstract ideas/models from different areas of science to support the observations made. • Collect data with a high degree of accuracy and precision. • Choose and justifies data collection methods that will minimise error.
5	• Make connections between abstract ideas and models when describing and explaining processes and phenomena. • Independently collect data that is reliable and accurate. • Explain how to take into account sources of error in order to collect reliable data.
4	• Use abstract ideas/models to describe the processes involved in the inquiry. • Identify multiple variables/factors involved in the inquiry. • Carefully and accurately collect and organise measurements/observations. • Choose appropriate ranges and values for the measurements/observations. • Explain where sources of error may occur in the inquiry.
3	• Use scientific ideas/models to help support/describe observations. • Use two steps in reasoning when describing observations. • Repeat sets of observations or measurements. • Select suitable ranges and intervals for the measurements and observations. • Use ideas such as mean, mode and median values to explain the measurements recorded.
2	• Use scientific ideas to help support/describe observations. • Make/take more than one set of observations or measurements and explain why this was necessary. • Record observations using decimal values where appropriate. • Describe the ranges and intervals used for observations/measurements. • Use own tables and charts to record observations accurately.
1	• Make careful observations/measurements using a prepared table. • Record whole number measurements accurately. • Identify/describe they key features/variables to be observed. • Record/make notes to highlight any relevant similarities, differences noticed or changes made in the inquiry.

Individual skill element levelled criteria – Questioning

Level	Questioning
6	• Questions reflect the development of scientific theories emerging from new evidence and ideas.
5	• Recognises that their questions are based upon ideas and theories that have been accepted by the scientific community.
4	• Recognises that a question is underpinned by scientific ideas and answers are based upon evidence. • Their question reflects the approach they choose to take (survey or fair test etc) to design an inquiry. • Their questions allow for a range of predictions, and they can explain the reasons for this.
3	• Responds to suggestions and puts forward their own ideas about how to find the answer with confidence. • Makes suggestions and explains their question in relation to science knowledge. • Formulates questions as hypotheses. • They use inquiry results to inform and make future predictions and comparative tests.
2	• Independently uses texts to suggest/develop questions to be investigated. • Asks questions relevant to their inquiry that will be supported by relevant data. • Asks questions about their line of investigation and begins to look for appropriate solutions to answer them.
1	• Responds to suggestions about inquiry design with a question that could be answered and suggests questions that are suitable for data collation. • Asks a question that can be developed into a prediction. • Responds to suggestions and puts forward their own ideas about how to answer a question. • Recognises why it is important to collect data to answer questions.

Questioning Assessment ladder - I can/they can statements

Level	I can/they can statements
6	• Demonstrate how the questions asked are based upon new evidence and ideas. • Develop hypotheses that involve multiple and interacting variables. • Plan more than one different approach to explore the key hypothesis.
5	• Demonstrate how the questions being asked are based upon ideas/theories that are accepted by the scientists. • Develop hypotheses that involve several relevant variables. • Suggest alternative approaches that could be taken to improve the inquiry.
4	• Show how the question is underpinned by scientific ideas. • Identify and explain the key pieces of evidence which are being used to answer the question. • Explain why the approach taken in the inquiry (survey, fair test etc) will allow the question(s) to be answered. • Ask questions that involve more than one prediction.
3	• Put forward ideas about how to find the answer with confidence. • Phrase and develop a question into a hypothesis. • Explain how the question links to science knowledge. • Use results to make new predictions and relevant tests.
2	• Use texts/sources of information to help develop questions that can be investigated. • Suggest questions that are relevant to the method of inquiry. • Say what types of data needs to be collected. • Ask questions and suggest appropriate ways/methods to answer them.
1	• Ask a question that could be answered and is suitable for data to be collected. • Suggest ways of working that will help answer the question. • Ask a question that can be developed into a prediction. • Show why it is important to collect data to answer questions.

Individual skill element levelled criteria - Hypothesising and Predicting

Level	Hypothesise and predict
6	• The hypothesis uses scientific ideas logically, and in the necessary detail, making use of abstract ideas and models. • The prediction involves a ranking/weighting of the independent variables under investigation.
5	• The hypothesis makes explicit connections between more than one abstract idea or model. • Predictions include an assessment of the quantifiable (i.e. proportional) impact of a range of possible independent variables.
4	• The hypothesis is one of several proposed using scientific knowledge and understanding. • Predictions involve quantitative relationships between the independent and dependent variables.
3	• The hypothesis is developed from scientific understanding. • The prediction is based upon scientific understanding. • Predictions clearly identify a range of independent variables and suggest strategies to control and assess the impact of each variable. • Uses test results to make prediction for further comparative testing.
2	• Formulates their question as a hypothesis that can be tested, naming the key variables. • Makes a prediction regarding the relationship between two variables that can be measured and controlled.
1	• Asks a question that can be developed into a prediction in the form of a relationship. • The question identifies the relevant variables to be tested.

Hypothesis/Prediction Assessment ladder – I can/they can statements

Level	I can/they can statements
6	• Explain in logical detail how scientific ideas and models have been used to develop a hypothesis. • Show that the different possible impacts of the variables identified have been considered and ordered based upon their importance within this inquiry.
5	• Describe the explicit connections between the abstract ideas/models that underpin the hypothesis. • Discuss the possible effect of each of the independent variables being investigated.
4	• Investigate more than one hypothesis, each of which is based upon scientific knowledge and understanding. • Phrase the prediction to highlight the quantitative relationship between the independent and dependent variables that is being investigated.
3	• Explain how the prediction/hypothesis is based scientific understanding. • Identify the independent and dependent variables in the prediction. • Describe the strategies that will be used to control the variables. • Keep a track of the impact of the variables involved in the inquiry. • Use test results to make predictions for new tests that could be carried out.
2	• Phrase the question as a hypothesis. • Identify the key variables to be measured and controlled. • Write a question as a prediction that shows which relationship is being investigated.
1	• Ask a question that can be developed into a prediction. • Ask a question that shows the relationship that will be investigated. • Ask a question, including the relevant variables to be tested.

Individual skill element levelled criteria - Experimental design and conducting

Level	Experimental design and conduct
6	• Chooses and justifies data collection methods that will minimise error and produce precise and reliable data. • Adapts their approach to practical work to control risk by consulting appropriate resources and expert advice.
5	• Identifies key variables in complex contexts, explaining why some cannot readily be controlled and so plans appropriate approaches to an investigation to take account of this. • Explains how to take account of sources of error in order to collect reliable data.
4	• Applies scientific knowledge and understanding to the planning of an inquiry, identifying and accurately describing the significant variables. • Justifies their choice(s) of data collection method and the proposed number of observations/measurements to be taken. • Collects data choosing appropriate ranges, numbers and values for the measurements and observations. • Uses equipment with an appropriate degree of precision.
3	• Recognises significant variables in the inquiry and selects the most appropriate to investigate. • Independently carries out a fair test, identifying all of the key variables. • Explains why particular pieces of equipment or information sources are appropriate for the question under investigation. • Repeats sets of observations or measurements where appropriate selecting suitable ranges and intervals.
2	• Decides upon an appropriate approach (survey or fair test etc) to answer a question. • Plans and carry out a fair test specifically mentioning how they are controlling the variables. • Selects equipment that is appropriate for the task. • Records data to a suitable degree of accuracy. • Makes sets of observations or measurements, identifying the ranges and intervals used
1	• Can name and select many pieces of equipment identifying the role of each. • Uses a range of equipment to make careful observations and measurements. • Takes some accurate measurements using standard units. • Accurately identifies the key variables involved in the inquiry. • Can carry out a fair test with limited help and explain why it's fair.

Experimental Design and Conducting Assessment Ladder – I can/they can statements

Level	I can/they can statements
6	• Explain how the data collection methods chosen will minimise error and produce precise and reliable data. • Show how approach appropriate resources and expert advice has been used to limit the risks involved in the inquiry.
5	• Identify and describe the key variables in complex contexts. • Explain why some variables cannot readily be controlled and show how the inquiry takes this into account. • Explain how to take account of sources of error so that the data can be reliable and trustworthy.
4	• Apply scientific knowledge and understanding to the planning of an inquiry and identify and describe the significant variables involved. • Explain the choice(s) of data collection method and the number of observations/measurements to be taken. • Collect data choosing appropriate ranges and values for the inquiry. • Use equipment with an appropriate degree of precision.
3	• Explain which variables are the most relevant in the inquiry. • Carry out a fair test and coherently identify all the key variables involved in the inquiry. • Explain why the equipment/information sources being used are appropriate for the question(s) under investigation. • Repeat sets of observations or measurements if this helps to answer the question.
2	• Explain why the method chosen will answer the question. • Plan and carry out a fair test, showing which variables need to be controlled. • Select equipment that is appropriate for the inquiry. • Record data accuracy. • Show how to collect a range of data and the intervals used to collect reliable data.
1	• Show how to correctly use, and select, many pieces of relevant equipment. • Use a range of equipment to make careful observations/measurements. • Take some accurate measurements using standard units. • Identify the key variables involved in the inquiry. • Carry out a fair test with help.

Individual skill element levelled criteria - Organising, analysing and interpreting data

Level	Organising, analysing and interpreting data
6	• Processes data, including using multi-step calculations and compound measures to identify complex relationships between variables. • Critically interprets, evaluates and synthesises conflicting evidence.
5	• Explains how data can be interpreted in different ways and how unexpected outcomes could be significant. • Presents and identifies quantitative relationships between variables, using them to inform conclusions and make further predictions.
4	• The method of data recording and analysis is proportionate to the complexity of the inquiry. • Analyses data using scatter graphs and lines of best fit where appropriate. • Selects and manipulates data and information to develop suitable conclusions.
3	• Interprets data in a variety of formats, recognising obvious inconsistencies. • Uses graphs to highlight different types of relationship such as direct or inverse proportion. • Provides straightforward explanations for differences in repeated observations and measurements.
2	• Records and analyses data using appropriate methods for the task. • Plots a line graph to show their data, using a relevant scale. • Presents findings in ways that are appropriate and uses line graphs to interpret data in a way that is appropriate to the task. • Identifies and describes straightforward patterns in results and relates these to science knowledge.
1	• Records and analyses data in a variety of ways/methods with confidence including diagrams, tables and graphs. • Identifies and describes patterns in results.

Organising, Analysing and Interpreting Data Assessment Ladder – I can/they can statements

Level	I can/they can statements
6	• Process data to identify complex relationships between variables. • Use multi-step calculations and compound measures to support conclusions. • Critically interpret, evaluate and synthesise conflicting evidence.
5	• Show how data could be interpreted in different ways and decide upon the most appropriate. • Explain how unexpected outcomes could change the conclusion and findings. • Present and describe quantitative relationships between variables. • Use relationships to inform conclusions and make further predictions.
4	• Use data recording and analysis that is in line with the complexity of the inquiry. • Analyse data using scatter graphs and lines of best fit where appropriate. • Select and use data and information to develop and support the conclusions.
3	• Interpret data in a variety of formats, recognising obvious inconsistencies. • Use graphs to describe and show different types of relationship i.e. direct and inverse proportion. • Explain any differences in repeated observations and measurements.
2	• Record and analyse data using methods that help to answer the question. • Present findings in ways that help to answer the question. • Use line graphs to interpret data in a way that helps to answer the question. • Plot a line graph to show data using a suitable scale. • Identify and describe patterns in results and relate these to science knowledge.
1	• Confidently record data in a range of different ways. • Use tables and line graphs to analyse the results. • Identify and describe patterns in results.

Individual skill element levelled criteria – Inferring, concluding, deciding and evaluating

Level	Infer, conclude, decide and evaluate
6	• Explains results logically and in detail using abstract ideas and models from different areas of science. • Processes data using multi-step calculations and compound measures, to identify complex relationships between variables. • Critically evaluates information and evidence from various sources, explaining limitations, misrepresentation or lack of balance. • Critically interprets, evaluates and synthesises conflicting evidence. • Suggests and justifies improvements to experimental procedures using detailed scientific knowledge and understanding and suggest coherent strategies to take particular investigations further. • Presents robust and well-structured explanations, arguments or counter arguments in a variety of ways. • Proposes scientific explanations for unexpected observations and measurements, making allowances for anomalies.
5	• Identifies quantitative relationships between variables, using them to inform conclusions and to make further predictions. • Explains how data can be interpreted in different ways and how unexpected outcomes could be significant. • Makes explicit connections between abstract ideas and/or models in explaining results. • Effectively represents abstract ideas using appropriate symbols, flow diagrams and different kinds of graphs in presenting explanations and arguments. • Assesses the strength of their evidence, deciding whether it's sufficient to support their conclusion. • Explains ways of modifying their working methods to improve reliability.
4	• Draws appropriate conclusions that are consistent with the evidence they have collected and explains them using scientific knowledge and understanding, using abstract ideas or models, including multiple variables. • Chooses forms to communicate qualitative or quantitative data that are appropriate to the data and the purpose of the communication. • Distinguishes between data from primary and secondary sources and presents them in the most appropriate form. • Suggests reasons using scientific knowledge and understanding for any limitations or inconsistencies in their evidence. • Makes valid and accurate comments upon the validity of their data.

3	• Interprets data in a variety of formats, recognising obvious inconsistencies. • Provides straightforward explanations for differences in repeated observations or measurements. • Draws valid conclusions the utilise more than one piece of supporting evidence, including numerical data and graphs. • Uses abstract ideas or models, including two step reasoning, to describe results. • Uses appropriate scientific and mathematical conventions and terminology to communicate abstract ideas. • Suggests how collaborative approaches to scientific inquiry may improve the evidence collected. • Evaluates the effectiveness of their working methods making practical suggestions for improving them.
2	• Report and present findings in ways that are appropriate and use test results to inform and ask new questions, making future predictions and suggesting comparative tests. • Identifies patterns in data presented in a range of forms such as graphs. • Able to identify which evidence is being used to support or refute their ideas. • Can relate their conclusions to the patterns in their data and scientific knowledge. • Communicate findings with appropriate scientific language and relationships and a degree of trust in their results. • Takes into consideration safety precautions based upon the risks involved and relevant to the task and shows an understanding of the appropriate warning symbols.
1	• Report on findings and conclusions in appropriate ways. • Explain what has been found out in experiments linking cause and effect. • Use science evidence to support their findings. • Use test results to make predicts to carry out further comparative tests. • Suggest a variety of sensible improvements to their work and shows knowledge of specific safety considerations to be taken.

Inferring, Concluding, Deciding and Evaluating Assessment Ladder – I can//they can statements

Level	I can/they can
6	• Explain results logically and in detail using abstract ideas and models from different areas of science. • Process data, including using multi-step calculations and compound measures, to identify complex relationships between variables. • Critically evaluate information and evidence from various sources explaining limitations or misrepresentations. • Critically interpret, evaluate and synthesise any conflicting evidence. • Suggest and justify improvements to experimental procedures using detailed scientific knowledge and understanding. • Suggest coherent strategies to take particular investigations further. • Present robust and well-structured explanations, arguments or counter arguments. • Propose scientific explanations for unexpected observations and measurements to make allowance for any anomalies.
5	• Identify quantitative relationships between variables and use them to inform conclusions and make further predictions. • Explain how data can be interpreted in different ways. • Explain how unexpected outcomes could be significant. • Make explicit connections between abstract ideas and/or models when explaining results. • Use abstract ideas (appropriate symbols, flow diagrams, different types of graphs) in explanations and arguments. • Assess the strength of the evidence collected to help decide if it supports the conclusion. • Explain ways of improving the inquiry methods to improve reliability.
4	• Draw conclusions that are consistent with the evidence collected and explain these using scientific knowledge and understanding. • Use abstract ideas/models, including multiple variables, to explain results. • Choose suitable ways to show qualitative or quantitative data. • Highlight, in appropriate ways, the use of data from primary and secondary sources. • Comment upon how valid the data is, suggesting improvements where relevant. • Suggest reasons (using scientific knowledge) for any limitations/ inconsistencies in their evidence.

3	• Interpret data in a variety of ways and recognise obvious inconsistencies. • Provide straightforward explanations for differences in repeated observations or measurements. • Draw valid conclusions that involve more than one piece of supporting evidence (including data and graphs). • Use abstract ideas or models, including two step reasoning, to describe and explain results. • Use appropriate scientific and mathematical conventions and terminology to communicate abstract ideas. • Suggest how collaborative approaches to scientific inquiry may improve the evidence collected. • Evaluate the effectiveness of the methods used in the inquiry, making practical suggestions for improvement.
2	• Use test results to inform and make future predictions and suggest further lines of inquiry. • Identify patterns in data and present these in a range of ways, drawing valid conclusions from the data. • Use evidence to support or refute the inquiry's findings. • Can relate conclusions to relationships and patterns in the data. • Can communicate findings using scientific language and describe the important relationships and findings. • Explain why the results are trustworthy. • Suggest further questions to be explored based upon the data obtained. • Take into consideration safety precautions based upon the risks involved in the inquiry, showing why warning symbols are helpful.
1	• Present and share findings in appropriate ways using a variety of methods. • Explain patterns in results and relate these to science knowledge. • Explain what has been found out in the inquiry, making connections between the variables involved. • Use science evidence to support the findings. • Use test results to make predictions for new tests. • Suggest a variety of sensible improvements to the inquiry and show knowledge of safety considerations to minimise risks.