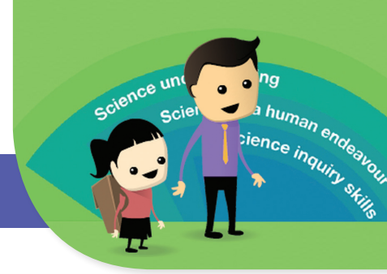

The BitL tool – science years F–10

F–2	3–4	5–6	7–8	9–10
What do you notice? Making observations about yourself and your local environment using your senses.	**What do you notice?** Make observations in order to group similar things together and then name the group (classify). What observations change over time?	**What do you notice?** **What are the observable similarities?** **What do you notice changes over time and/or geographically?** Use equipment to aid observations in order to group and classify similar things. Link form to function and notice observations that change over time and geographically.	**What do you observe?** **What are the observable differences?** **What changes over time and/or geographically?** Use of equipment to aid observations in order to group and classify. Link form to function both microscopic and macroscopic and notice observations that change over time and geographically. Make observations from secondary sources when necessary.	**What do you observe?** **What changes over time and/or geographically?** **What do you observe at a range of scales?** **Will the data you select be reliable?** Critically review what will be observed. Use equipment to aid observations in order to group and classify. Link form to function at a range of scales from both microscopic through to macroscopic and notice observations that change over time and/or geographically. Make observations from secondary sources when necessary.
Pedagogical questions: • What do you see/hear/smell/taste/feel? • What does it do? • What is happening? • What is interesting?	**Pedagogical questions:** • What do you see/hear/smell/taste/feel? • What features/properties are the same? • What features/properties are different? • Which features/properties change over time? • What is interesting?	**Pedagogical questions:** • What do you see/hear/smell/taste/feel? • What features and/or properties are the same? • What features and/or properties are different? • How do these features and/or properties change over time? • How do these features and/or properties change in different places? • What equipment might help to make observations? (camera) • What equipment can extend your senses? (hand lens, microscope, thermometer, scales, ruler, stopwatch) • What is interesting and/or unexpected?	**Pedagogical questions:** • What do you see/hear/smell/taste/feel? • What features and/or properties are the same? • What features and/or properties are different? • How do these features and/or properties change over time and/or geographically? • What changes when you shift your perspective? • What equipment might help to make observations? (camera) • What equipment can extend your senses? (hand lens, microscope, thermometer, scales, ruler, stopwatch) • What do you notice about this data/information? • What is interesting/unexpected?	**Pedagogical questions:** • What do you see/hear/smell/taste/feel? • What features or properties will you observe and/or measure? • How many… will you observe and/or measure? What is a good sample size? How often will you make your observations? • What features/properties change over time and/or geographically? • What are the observable differences? • What do you observe at a range of scales? What more do you notice when you shift your perspective? • What equipment might help to make observations? (camera) • What equipment can extend your senses? (hand lens, microscope, thermometer, scales, ruler, stopwatch) • What do you notice about this data/information? • What secondary sources will you use to help your observations? • What is interesting/unexpected/unexplained?
Example: Foundation ***Earth and Space Sciences*** ***Daily and seasonal changes in our environment, including the weather, affect everyday life.*** What do you see in the sky? How does it feel outside today? What is interesting about the sky?	**Example: Year 3** ***Biological Sciences*** ***Living things can be grouped on the basis of observable features.*** What features do living things have? What features do non-living things have? Which features of living things change as they grow?	**Example: Year 5** ***Chemical Sciences*** ***Solids, liquids and gases have different observable properties and behave in different ways.*** What are the properties of these materials? (include solids, liquids and gases) How do you see the different states of water behave? What equipment might help you to make observations of the properties of these materials? How are these properties changing?	**Example: Year 7** ***Physical Sciences*** ***Change to an object's motion is caused by unbalanced forces acting on the object.*** What happens when you stop quickly on your bike or your skateboard hits a rock? What happens when a balloon is blown up and then released? What happens when the marble rolls down the ruler? What equipment might help you to make observations? What do you notice about vehicle stopping distance data? (secondary data)	**Example: Year 9** ***Chemical Sciences*** ***All matter is made of atoms which are composed of protons, neutrons and electrons; natural radioactivity arises from the decay of nuclei in atoms.*** What are the observable similarities and differences between different models of the atom? What do you notice about the particles in an atom? What equipment might help you to make observations of the properties of an atom? What properties of elements can you observe?

The BitL tool – science years F–10

F–2	3–4	5–6	7–8	9–10
What do you think? Consider questions and seek answers relating to the observations of yourself and the world around you.	**What patterns and relationships can you see?** Group according to similarities and compare differences. Using prior knowledge describe patterns and relationships you see. Identify exceptions.	**What patterns and relationships can you see?** Consider the different time and geographical scales of dynamic and stable systems. How do the components within a system relate to each other and change over time? Compare ideas from different cultures. Describe exceptions. Pose questions.	**What patterns and relationships can you see?** **How have changes in science knowledge over time changed the way we see the world?** **What are your questions?** Classify according to prior knowledge. Consider different time and geographical scales. Describe matter and energy flows through systems. Consider structure and function relationships and how components within a system relate to each other. Integrate ideas from different disciplines. Describe exceptions. Ask a variety of investigable scientific questions.	**What patterns and relationships can you see?** **What are your questions?** **How did someone come up with this idea?** **What is a challenging question you would ask a significant scientist from history? Why would you ask that question?** **How do models change over time?** Classify according to prior knowledge of theories. Generate questions related to specific instances of the physical law or theory. Consider systems at various scales and the interactions with external factors both in a local and global context. Describe how changing part of a system results in changes in the equilibrium? Compare the different time and geographical scales. Describe and explain exceptions. Use models, laws and theories to explain the relationships, processes and structures of science. How do models, theories and laws change over time?
Pedagogical questions: • What is the same? • What is different? • How does it change? • Is there anything unusual? • What questions do you have? • What else is it like?	**Pedagogical questions:** • What similarities and differences are there? • How could you group them? Are they always the same? • How does it change? • What patterns do you notice? • Is there anything unusual? • What is happening? • What questions do you have? • What is it like?	**Pedagogical questions:** • How could you group or classify them? • How are they the same as each other? What do these things have in common either in the way they look or the way they behave? • How are these different to each other? • What is happening? • How do the patterns and/or relationships change? • What questions could you ask? • What is the time scale over which these changes occur? • Are there any exceptions? • How do the patterns and/or relationships change with time? • How might another culture have different ideas? • What else is like this? How? • What are the problems or challenges?	**Pedagogical questions:** • What patterns and/or relationships are there (in the data)? Are there any exceptions? • How do these patterns or relationships compare over time and/or geographically? • Are they always the same? • Is there anything unusual? • What do you think is happening and why? • How could you generalise? • What is the time scale over which these changes occur? • How might another discipline contribute to this? • What are your questions? • Is your question investigable? • How has science changed the way we see the world over time?	**Pedagogical questions:** • What patterns and/or relationships do you see (in the data)? • Are there any anomalies? • What do you think is happening and why? • How could you generalise? • How does this generalisation change over time and/or globally? • What other questions could you ask? • How have the models of… changed over time? How can I explore theories by gathering evidence and apply physical laws? How might equilibrium be affected by change? • How did the originator come up with this idea? What questions could you ask? • How might technology contribute to our understanding of science?
Example: Foundation ***Earth and Space Sciences*** ***Daily and seasonal changes in our environment, including the weather, affect everyday life.*** What questions do you have about the sky? What is the same/different about the sky in the morning compared to the afternoon? What is happening to the sky during the day? Is there anything unusual about the sky?	**Example: Year 3** ***Biological Sciences*** ***Living things can be grouped on the basis of observable features.*** How are living things the same as and/or different to each other? How could you group them? Are there any exceptions?	**Example: Year 5** ***Chemical Sciences*** ***Solids, liquids and gases have different observable properties and behave in different ways.*** What are the similarities and differences in the properties of ice, water and water vapour? How can you change water from one state to another? Does water always behave like this? Is there anything unusual? What questions do you have about solids, liquids and gases?	**Example: Year 7** ***Physical Sciences*** ***Change to an object's motion is caused by unbalanced forces acting on the object.*** How do the forces change if you stop suddenly on your bike or if a skateboard hits a rock? What makes the balloon move? What causes the marble to move or change movement? How might this be different if the marble was on the moon? Are there any exceptions? Why are the stopping distances different? What questions have you about forces and movement?	**Example: Year 9** ***Chemical Sciences*** ***All matter is made of atoms which are composed of protons, neutrons and electrons; natural radioactivity arises from the decay of nuclei in atoms.*** How have the models of an atom changed over time? Why have they changed? How did the originator of each model come up with the idea? What's a challenging question that you would ask one of those historic scientists? How might today's technology have changed those scientists thinking?

The BitL tool – science years F–10

F–2	3–4	5–6	7–8	9–10
What do you think if? Make predictions about familiar objects and events.	**What do you think if?** Using prior knowledge and specific examples predict how patterns and relationships change within a system.	**What do you predict?** Predict the findings of an investigation or devise and justify predictions based on learning.	**What do you predict will happen?** Make predictions based on scientific knowledge.	**What do you predict will happen?** **What drives this change over time?** Formulate an investigable question. Formulate a scientifically testable hypothesis. What drives this change over time?
Pedagogical questions: • What if? • What might happen if? • What if I changed this? • What might happen if… was different? • Somebody told me that if I did (this) then (that) would happen. What do you think about that idea? • Scientists currently think… so how does this relate to what you think?	**Pedagogical questions:** • Is there another way to group them? • What would happen if you added/removed…? • If we changed… then how might that affect…? • Scientists currently think…, how does this relate to your idea?	**Pedagogical questions:** • Explain what might happen if…? • Explain how changing… might affect… • What do you think will happen next? • What do you think would happen if? • Scientists currently think…, how does this relate to your idea?	**Pedagogical questions:** • If we changed…, how might that affect…? What science idea might help you explain this? • What science will help you predict what might happen if…? • What do you already know or what have you observed that led to your prediction? • How does flow of energy and matter help you to think about this? • What other predictions might be plausible? • Scientists currently think…, how does this relate to your idea…?	**Pedagogical questions:** • What might happen if…? • What would happen if you added or removed…? • If we changed…, then how might that affect…? • What do you think will happen next? • What is your hypothesis? • What reasons do you have for making that prediction? • What do you already know or what have you observed that led to your prediction? • What other predictions might be plausible? • Scientists currently think… so how does this relate to your idea…? • What changes can we predict with accuracy? • How might someone else explain or interpret this same phenomena?
Example: Foundation ***Earth and Space Sciences*** ***Daily and seasonal changes in our environment, including the weather, affect everyday life.*** What would your skin feel like if the sun is hidden by clouds? What might happen to how your skin feels if the clouds move? How might that change what you do? Some people say the sun makes us hot. What do you think? When is it different?	**Example: Year 3** ***Biological Sciences*** ***Living things can be grouped on the basis of observable features.*** Can you think of another way we could group living things? What would happen to your grouping if you had to include/remove this criteria…? (eg if you removed all living things). How could you change the rules to include…?	**Example: Year 5** ***Chemical Sciences*** ***Solids, liquids and gases have different observable properties and behave in different ways.*** What might happen if water is heated on a stove? What causes this? Explain how an ice cube put in water would behave differently to one left in a dish? Why do you think this? Scientists currently think that temperature causes a change of state. How does this relate to what you know about water?	**Example: Year 7** ***Physical Sciences*** ***Change to an object's motion is caused by unbalanced forces acting on the object.*** What might happen to passengers with and without seatbelts if a car stopped suddenly? What science ideas can help you explain this? How could you change the way the balloon moves? Predict what might happen? Why? What else might affect stopping distances? Why?	**Example: Year 9** ***Chemical Sciences*** ***All matter is made of atoms which are composed of protons, neutrons and electrons; natural radioactivity arises from the decay of nuclei in atoms.*** What might happen if the number of particles in an atom were changed? When might this happen? What might happen if the elements are heated? What is your hypothesis? What reasons do you have for making that prediction? What do you already know or what have you observed that led to your prediction? What other predictions might be plausible?

The BitL tool – science years F–10

F–2	3–4	5–6	7–8	9–10
How can you explore? Investigate your questions and explore the things and places around us.	**How can you explore?** Identify questions that can be investigated scientifically. Plan and conduct an investigation considering safety and fairness.	**How can you test it?** Use a fair test to investigate cause and effect between variables. This may be through modelling, simulations and/or investigations. Consider safety.	**What investigations could you design?** **How can you use collaboration?** **Where do you find connections across the disciplines?** **Which variables will you control?** Plan and carry out a safe and fair test using accurate measurements and controlling variables.	**What investigations could you design?** **How will you change, measure and control variables?** **How can you measure accurately?** **What could you explore to test this theory?** Design an investigation. Select appropriate equipment and process to gather reliable data. Assess risks involved and consider ethics. How might collaboration and interdisciplinary perspectives be beneficial for scientists seeking an answer to a question?
Pedagogical questions: • How are you going to find out (investigate)? • What ideas do you have? • What could you try? • Which is your best idea? • How could you test your idea? • What might a scientist do to find out about that?	**Pedagogical questions:** • What are you going to investigate? • How will you investigate? • What ideas do you have? • What could you try? • Which is your best idea? • How could you test your idea? • How can you keep yourself and others safe when doing the investigation? • How could you make your test fairer?	**Pedagogical questions:** • How might you test your predictions? • What (variable) will you change? • What (variable) will you measure and/or count and/or draw? • What (variable) will you keep the same to make a fair test? • What might a scientist do to find out about that? • What safety things do you have to think about?	**Pedagogical questions:** • How might you test your predictions? • Which variable (independent) will you manipulate? Why? • Which variable (dependent) will you measure? Why? • Which variables will you keep constant? Why? • What might a scientist do to find out about that? • What equipment do you need and/or have? • What equipment will you choose that will improve the accuracy in the data you collect? • What safety aspects do you have to think about? • How can you organise your data?	**Pedagogical questions:** • How might you test your predictions? • What could you try? Do you think you could.....? • What kinds of tests can you design to help you answer your questions? • What should you consider in planning? • How will you measure and record the data? • How will you ensure the data is reliable, representative? • How will you consider fairness? • Which variable (independent) will you manipulate? Why? • Which variable (dependent) will you measure? Why? • Which variables will you keep constant? Why? • How might collaboration be of use to scientists? • Where do you find connections across the disciplines? • Do you have the equipment needed to test your idea? • Which safety and ethical issues should you consider in your investigation? • What equipment will you choose that will improve the accuracy in the data you collect? • How would your hypothesis have differed from that of the scientist? • How will you record your results?
Example: Foundation ***Earth and Space Sciences*** ***Daily and seasonal changes in our environment, including the weather, affect everyday life.*** How are you going to find out what it feels like when the sun is hidden by the clouds? What are your ideas? Which is your best idea? How could you test your idea?	**Example: Year 3** ***Biological Sciences*** ***Living things can be grouped on the basis of observable features.*** Can you find out if there are any exceptions to the sorting rules? Which living things do your rules not work for? How could you include them? What ideas do you have? What could you try? Which is your best idea? How could you test your idea? Which other grouping systems could you investigate? What will you record? What safety aspects do you need to remember?	**Example: Year 5** ***Chemical Sciences*** ***Solids, liquids and gases have different observable properties and behave in different ways.*** What happens to the state when we dissolve other materials in water? How might you investigate this? What will you change/measure/keep the same? What are the safety risks? Are there digital or other technologies which may aid your investigation?	**Example: Year 7** ***Physical Sciences*** ***Change to an object's motion is caused by unbalanced forces acting on the object.*** What will you investigate about forces and movement? How will you investigate? What will you change/measure/control? What equipment will give you the most accurate and fair test? How could the fairness be improved? What are the safety issues? Are there digital or other technologies which may aid your investigation?	**Example: Year 9** ***Chemical Sciences*** ***All matter is made of atoms which are composed of protons, neutrons and electrons; natural radioactivity arises from the decay of nuclei in atoms.*** How could you design a test to challenge the plum pudding (Thomson's) model of the atom or (Rutherford's) solar system model?

The BitL tool – science years F–10

F–2

How can you share?

Share observations with others by oral and written language, role play, drawings as representations of ideas and valuing counting to gather information.

Compare observations with predictions.

Pedagogical questions:

- How could you share what you saw/heard/tasted/felt/smelt?
- How could you draw that?
- How can you show what you counted?
- Did others think the same as you? How?
- How did they think differently?
- Was this the same as your prediction? How was it different?

Example: Foundation

Earth and Space Sciences

Daily and seasonal changes in our environment, including the weather, affect everyday life.

How could you record (count/draw) your observations of the sky and how your skin feels?

Who saw something different in the sky?

What did they see?

Who feels differently?

Was the way your skin felt, the same/different to what you predicted? How?

3–4

How can you review and communicate?

Record data and represent ideas in diagrams, simple tables and graphs, physical representations and simple reports in order to identify trends.

Compare your results with your predictions, suggesting reasoning.

Pedagogical questions:

- How might you represent your data and ideas?
- How will you communicate your thinking?
- How might grouping and sorting help you?
- How might you show other students the groupings you have decided on?
- What tools (list, table, graph, drawing) might you use to identify patterns and share this information?
- How could you improve your investigation?
- How did your thinking change?

Example: Year 3

Biological Sciences

Living things can be grouped on the basis of observable features.

How might you use a list, diagram or table to record and share the living and non-living groups that you have decided on?

What else could you use?

What are the advantages and disadvantages of each method?

How did you change your rules?

5–6

How can you review and communicate?

Use evidence to explain observations.

Compare data with predictions.

Suggest improvements in the methodology to answer your question or solve a problem.

Understand the importance of measuring accurately.

Use multimodal texts to communicate.

Pedagogical questions:

- How can you represent your data and thinking in a way that you can share it with others?
- What tools (list, table, graph, drawing) might you use to identify trends and share this information?
- How can you use the evidence gathered to support the science ideas?
  How can you compare the data you obtained with your predictions?
- How can you use science ideas to explain your data?
- How fair was your test/investigation?
  How could you improve it?
  What would you do differently?
- How accurate was your measurement?
- Do you need to improve it? Why (not)?

Example: Year 5

Chemical Sciences

Solids, liquids and gases have different observable properties and behave in different ways.

How could you use lists, tables or graphs to record and communicate your data and thinking about ice, water and water vapour?

What are the advantages and disadvantages of each method?

How could science ideas about change of state help you explain the data?

How does the data support (or not) science ideas?

How fair was your investigation?
How could you improve it?

7–8

How can you review and communicate?

Can you use a model to help describe simplify, clarify or provide an explanation of the working structure or relationship within an object, system or idea?

Reflect on quality of data and suggest improvements to the methodology.

Communicate using appropriate scientific language and text types.

Refer to evidence to support conclusions.

Use models to develop explanations of relationships.

Include accuracy and fairness when evaluating claims.

Pedagogical questions:

- How can you represent the data and your explanations in a way that enables sharing with others?
- What tools (list, table, graph, drawing) might you use to share this information and/or help you identify trends?
- How does a science generalisation explain your data?
- How can you use the evidence gathered to explain a science generalisation?
- How fair was your test/investigation? How could it be improved? How could you improve the quality of the data collected?
- How might someone else explain or interpret this same phenomenon?
- How could you improve your investigation?

Example: Year 7

Physical Sciences

Change to an object's motion is caused by unbalanced forces acting on the object.

How can you represent the data and your explanations about forces and movement in a way that you can communicate the patterns and trends with others?

How do Newton's laws of motion explain your data?

How can you use the evidence gathered to explain Newton's laws of motion?

How fair was your test/investigation?
How could it be improved?

Who might be interested in this? Why?

9–10

How can you review and communicate?

How does the science community develop a shared understanding?

How does the science community refine a shared understanding?

How can a model influence the way we think about science and help develop scientific theories?

Analyse patterns and trends in data.

Communicate ideas, arguments and critical evaluation of evidence, claims, methods and theories.

Use scientific terminology, conventions and representations for a particular purpose.

Use evidence to justify arguments and decisions.

Consider the sources of uncertainty in the results (error) and ways to improve the quality of the data.

Use models to develop explanations of relationships.

Pedagogical questions:

- How can you best represent the data?
- How can you identify and communicate trends in the data?
- How might you show other students the groupings you have decided on?
- How might you represent these groups?
- How does the data/evidence you have gathered compare with the current science understanding (theories)?
- How could you communicate ideas using appropriate language, conventions and representations for particular purposes?
- How can you evaluate the fairness of your test/investigation?
- How could you improve your test/investigation?
- What could you do differently?
- Were your results consistent with your hypothesis?
- What could you change next time to get more accurate results?
- How could you explain?
- How might someone else explain or interpret this same phenomenon?
- Has your prediction changed? How? How does it compare with your original hypothesis?
- Why might a scientist want to repeat and build on someone else's investigation?
- How does the science community contest and refine ideas claims etc?
- What can you infer from the data? What generalisations can you make? What evidence led to your explanation? How can you justify your conclusion?

Example: Year 9

Chemical Sciences

All matter is made of atoms which are composed of protons, neutrons and electrons; natural radioactivity arises from the decay of nuclei in atoms.

What new questions might you ask to find out more about the model?

What technology could you use to communicate the models to others?

What are the advantages and disadvantages of the different technologies?

For which purpose and audience would the various representations be useful?

The BitL tool – science years F–10

F–2	3–4	5–6	7–8	9–10
So what? People use science in their daily lives.	**So what? What next?** Describe how science knowledge could help people to understand the effect of their actions.	**So what? What next?** Identify how scientific understandings, discoveries and inventions are used to solve problems that directly affect people's lives. Explain how science knowledge and understanding can inform personal and community decisions.	**So what? What next?** **We can but should we?** **How might we respond? What action might be needed?** **Where might you see applications of this new knowledge and/or understanding?** Respond to issues and social problems from a scientifically informed position. Pose evidence based arguments and perform peer critical reviews. Discuss possibilities for the future. Discuss ethical issues and social significance of a scientific idea or event.	**So what? What next?** **What technological changes have occurred as a consequence?** **What if a particular technology had not been available?** **How has technology changed the way we think about this scientific idea?** Respond to issues and social problems from a scientifically informed position. Propose evidence based arguments and perform peer critical reviews. Discuss possibilities for the future eg. New careers that emerge. Discuss ethical issues and social significance of a scientific idea or event. What technological changes have occurred as a consequence of this research? How has technology changed the way we think about this scientific idea?
Pedagogical questions: • Where might you use this? • Who might be interested in this? Why?	**Pedagogical questions:** • Who might be interested in this? Why? • What else could you investigate?	**Pedagogical questions:** • Who might be interested in this? Why? • Which of your decisions might this understanding influence? How? • What science might help us understand this? • What else could you investigate?	**Pedagogical questions:** • Who might need to know this? Why? • Which of your decisions might this understanding influence? How? • What other science might help us understand this and/or make this decision? • What else could you/would you need to investigate? • How do we know this? Which sources give you the most confidence that the information is accurate?	**Pedagogical questions:** • Which of your decisions might this understanding influence? How? • What other science might help us understand this/make this decision? • What else could you/would you need to investigate? • What new developments might this lead to? Or new careers? • What do we still need to know? • Who decides what is valued to investigate? • Who might need to know this and why? • Who decides how the science is used? • Who might benefit? What is the 'cost'? • What would our lives be like if we didn't know this?
Example: Foundation ***Earth and Space Sciences*** ***Daily and seasonal changes in our environment, including the weather, affect everyday life.*** When do we need to know about the weather? Why? How do you look after your pet when it's hot? Raining?	**Example: Year 3** ***Biological Sciences*** ***Living things can be grouped on the basis of observable features.*** Who might be interested in/need to know about grouping living things? Why? How might you use this in your life? What else could you investigate?	**Example: Year 5** ***Chemical Sciences*** ***Solids, liquids and gases have different observable properties and behave in different ways.*** Who might be interested in water changing state? Why? How might this inform decisions about climate change/ keeping your drink bottle cold/ keeping food safe? What else about the different states of matter could you investigate?	**Example: Year 7** ***Physical Sciences*** ***Change to an object's motion is caused by unbalanced forces acting on the object.*** Who might be interested in forces and change in motion? Why? How might this inform decisions around road safety? What else could you investigate about forces and motion? Who owned the information about car stopping distances? Why might they have published it? Whose point of view should also be considered?	**Example: Year 9** ***Chemical Sciences*** ***All matter is made of atoms which are composed of protons, neutrons and electrons; natural radioactivity arises from the decay of nuclei in atoms.*** Who might be interested in modelling of atoms? Why? What else could you investigate about the composition of matter? Whose theory on the model of the atom is most widely accepted today? How else might people think about the elements? Whose point of view should also be considered? How has technology changed the way we think about the structure of atoms today? Are there new careers that have been developed as a result of understanding the atomic model?