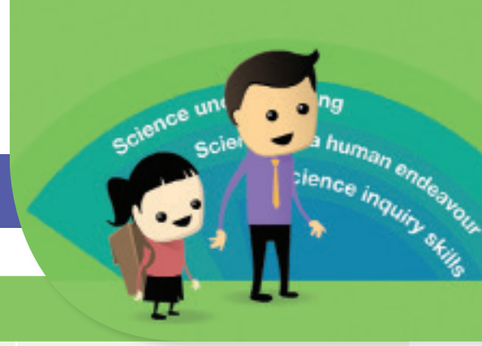
The BitL tool – science years 9–10



Science: Years 9–10

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 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?

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 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?

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 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?

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 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?

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?

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:

- 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?

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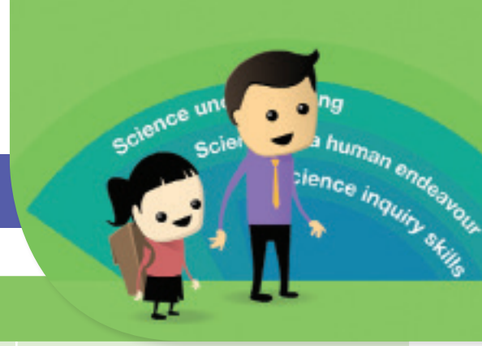

Science: Years 9–10

What do you observe? *Continued*	What patterns and relationships can you see? *Continued*	What do you predict will happen? *Continued*	What investigation could you design? *Continued*	How can you review and communicate? *Continued*	So What? What next? *Continued*
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?	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?	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?	How could you design a test to challenge the plum pudding (Thomson's) model of the atom or (Rutherford's) solar system model?	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?	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?