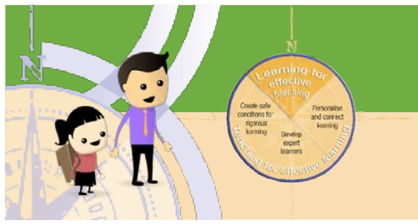
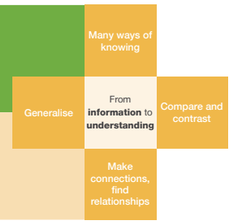


GOAL – Getting the students doing the thinking in Science

Transforming tasks strategy: From procedure to problem solving



Technique	Before	After	Reflection: Why and how?
Students identify the 'problem to solve' Present a provocation and ask students to determine the problem to solve.	**What do you think?** Most fruit plants are grown from seeds. Once the fruit is eaten or decayed the seed is released and grows into a new plant. Find out about the life cycle of a watermelon and draw a labelled diagram showing the key stages.	**What do you think?** Seedless watermelons are very popular today. Consider the plus/minus/and interesting consequences of having seedless fruit. What questions does this raise? What do you need to know? How can you find out?	**Why would you… have students speculate on the positives and negatives of seedless watermelon?** So students to actively participate in their learning by asking questions about the things they notice. **How does this develop powerful/expert learners?** Students exercise curiosity and develop their capacity to think logically and creatively.
Provide insufficient information at first Give a perplexing problem and slowly provide information as needed.	**Describe the features of a cactus.** Use online and print materials to research how the physical characteristics of cactus help it to survive desert conditions. • Present your research as a poster. • Annotate pictures and drawings to point out at least 3 features of a cactus • Explain how these features assist its survival in harsh desert conditions.  https://www.flickr.com/photos/chitrasudar/2623544913/	**What do you notice?** Look at the cactus in the pot and the photo of the cactus's surface structure. Describe the cactus in as much detail as possible using the plant and the photo. **What does it make you wonder?** (For example: Why are they fat? Why do they have sharp spikes?) **What does that make you think?** What issues do plants and animals living in habitats such as deserts face? How might its physical features help it? (For example:The big spikes are to stop the cactus being eaten). **What does it make you wonder?** (For example: What might eat a cactus? What might be deterred by the spikes? What wouldn't? Could spikes help it with any other issue?)  https://www.flickr.com/photos/chitrasudar/2623544913/ 	**Why would you… have students try to deduce the uses and functions of the physical characteristics of a cactus?** So students use reasoning to construct their own questions and theories. **How does this develop powerful/expert learners?** Students become tenacious and resourceful as they imaginatively dig deeply into possibilities, and identify the information required to solve a problem or to gain an insight
Don't give all the steps - at first Provide prompts and support to scaffold the learning as needed.	**Making a parachute** What you will need: • A plastic shopping bag • Scissors • String • A small action figure to act as the weight. **What to do:** 1. Cut out a large square from your plastic bag. 2. Trim the edges so it looks like an octagon (an eight sided shape). 3. Cut a small hole near the edge of each side. 4. Attach 8 pieces of string of the same length to each of the holes. 5. Tie the pieces of string to the object you are using as a weight. 6. Find a high spot to drop your parachute and test how well it worked. Try to make your parachute fall as slowly as possible. How well did your parachute work?	Design a parachute that uses air resistance effectively What you will need: • A plastic shopping bag • Scissors • String • Small weights What shape of parachute do you think will work best? What size do you think the canopy needs to be? What weight will work best? What ideas do you have? Which one will you try first? How will you test it? Try to make your parachute fall as slowly as possible. **DISCUSS** Which variable had the greatest impact on slowing the fall of the parachute? How do you know?	**Why would you… have students design their own investigation and determine which variable affects the air resistance the most?** So students think critically and creatively about designing and analysing the results of an investigation. **How does this develop powerful/expert learners?** Students become more resourceful and independent when they 'know what to try, when they don't know what to do'.
Include some irrelevant information Give additional information that is not required to do the task..	**Bird diversity in the schoolyard** The data collected in September, of our class observations of birds, is given below. Create an infographic to clearly represent this data, showing both the number of birds, and the diversity of bird types. **Class observations:** • We saw 40 New Holland Honey Eaters in week 1 of September, 30 in week 2, 53 in week 3 and 55 in week 4. • We saw 80 Australian crested pigeons in week 1 of September, 10 in week 2, 11 in week 3 and 0 in week 4. • We saw 5 Willy Wagtails in week 1 of September, 7 in week 2, 10 in week 3 and 10 in week 4.	**Bird diversity in the schoolyard** The data collected in September, of our class observations of birds, is given below. Create an infographic to clearly represent this data, showing both the number of birds, and the diversity of bird types. **Class observations:** • There are 20 native trees in our school yard and 40 non-native trees. • We saw 40 New Holland Honey Eaters in week 1 of September, 30 in week 2, 53 in week 3 and 55 in week 4. • We saw 900 ants in September. • We saw 80 Australian crested pigeons in week 1 of September, 10 in week 2, 11 in week 3 and 0 in week 4. • We saw 5 Willy Wagtails in week 1 of September, 7 in week 2, 10 in week 3 and 10 in week 4. Another 5 were seen in week 1 of October. • We saw 2 mice in week 1 and 0 in week 2, week 3 and 25 in week 4.	**Why would you… give students additional information that has no relevance to data about bird diversity in the school?** Students learn to critique information for its relevance, and not to be distracted by irrelevant information, or to rely on someone else predetermining which information should be used. **How does this develop powerful/expert learners?** Students think logically and apply their knowledge as they discern between relevant and irrelevant information.

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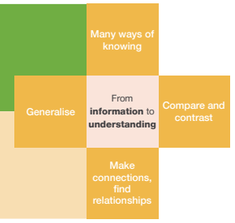

Technique	Before	After	Reflection: Why and how?
Students identify the 'problem to solve' Present a provocation and ask students to determine the problem to solve.	**Intrusive igneous rocks**, such as granite, form from the cooling of magma deep inside the earth. If the rock cools slowly, due to higher temperatures, crystals will have the time to develop. **Extrusive igneous rocks,** such as basalt, cool rapidly on the Earth's surface, usually as a result of a volcanic eruption. Their crystals are small. If the lava fails to form any crystals, obsidian is formed. When the lava releases a large number of volatile components as free gas, light-weight rocks, like pumice, are formed. As the magma cools, the gas creates cavities of different sizes. **Name these igneous rock samples.**	Look at these igneous rock samples: • Pumice • Granite • Obsidian • Basalt What are you wondering?	**Why would you…have students think of questions when looking at a range of intrusive and extrusive igneous rock samples?** So students actively participate in their learning by asking questions about the things they notice. **How does this develop powerful/expert learners?** Students exercise curiosity and develop their capacity to think logically and creatively.
Provide insufficient information at first Give a perplexing problem and slowly provide information as needed.	Most of an atom is actually empty space. For example, a hydrogen atom is 99.9999999999996% empty space! The mass of a mole of substance is called its molar mass. The molar mass of an element is found on the periodic table, and it is the element's atomic weight in grams/mole (g/mol). 1 mole = 6.02214179×1023 (This is Avogardro's constant). It is like saying: 1 dozen = 12 eggs. **Using a periodic table, give the molar mass of the following:** 1. H 2. Se 3. Ne	**'If you removed the empty space from the atoms of all people, the whole human race could fit into the volume of a regular sized sugar cube.'**  If this statement was true... how could it be possible? Work in a small group to brainstorm any possibilities and to decide what information you need to know. You may ask your teacher for answers to specific questions, but you will need to explain how the information would be useful for you.	**Why would you… have students speculate on how something seemingly improbable could be possible?** So students use reasoning to question and construct their own theories. **How does this develop powerful/expert learners?** Students become tenacious and resourceful as they imaginatively dig deeply into possibilities, and identify the information required to solve a problem or to gain an insight.
Don't give all the steps - at first Provide prompts and support to scaffold the learning as needed.	Complete the following, to show a balanced equation for the combustion of methane. **?** CH_4 + **?** O_2 ⇢ **?** CO_2 + **?** H_2O Remember: Combustion reactions produce carbon dioxide and water. Oxygen is required to burn methane. 1. Identify each element found in the equation .....C ..... CH_4 ..... O_2 ..... CO_2 ..... H_2 ..... H_2O 2. Is the net charge on each side of the equation balanced? 3. Do you have to change the coefficients (the numbers in front of the compound or molecule; not the subscripts in the formulas), so that the number of atoms of the element is the same on each side of the equation? 4. Check your work to make certain the charge on both sides of the equation is also balanced.	You will be writing a balanced equation for the combustion of methane. Before you begin, collaboratively devise the steps needed. What strategies might help you to do this task? What information would be useful or important to know? Write a balanced equation for the combustion of methane. **Check:** 1. Is the net charge on each side of the equation balanced? 2. Do you have to change the coefficients (the numbers in front of the compound or molecule; not the subscripts in the formulas) so that the number of atoms of the element is the same on each side of the equation? 3. Check your work to make certain the charge on both sides of the equation is also balanced. Remember: Combustion reactions produce carbon dioxide and water.	**Why would you…have students identify the process and information required to devise a balanced equation for methane combustion?** So students identify the information required and strategically organise the steps they need to take. **How does this develop powerful/expert learners?** Students become more resourceful and independent when they 'know what to try, when they don't know what to do'.
Include some irrelevant information Give additional information that is not required to do the task..	**Draw a pedigree chart for the following scenario:** • A woman's son has cystic fibrosis, a disease caused by recessive genes. • Neither of her parents has the disease. What chance is there that her mother is a carrier (heterozygous) for the trait? • What chance is there that the woman herself is a carrier for the trait?	**Draw a pedigree for cystic fibrosis using information of the Donatella family:** • The father, Vince, and mother, Diane, have three children. • The two oldest children are Anna and Mary and the youngest child is Teddy. The middle child suffers from middle child syndrome. • The oldest daughter, Anna, is married to Barry and has an older son, Will, and younger daughter, Vanessa. Mary is married to Sam has a son, Patrick. • Patrick is the only person in this family group with cystic fibrosis. • Barry's brother is a doctor who has treated patients with cystic fibrosis • Sam is a truck driver who regularly travels interstate. • Teddy is not yet married. • Teddy, Barry and Sam are worried that they may be carriers of the cystic fibrosis gene. • Cystic fibrosis is recessive.	**Why would you…give students additional information that has no relevance to producing a pedigree?** Students learn to critique information for its relevance, and not to be distracted by irrelevant information, or to rely on someone else predetermining which information should be used. **How does this develop powerful/expert learners?** Students think logically and apply their knowledge as they discern between relevant and irrelevant information.