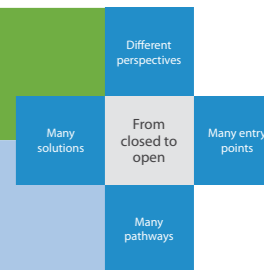




# GOAL – Getting the students doing the thinking in Science

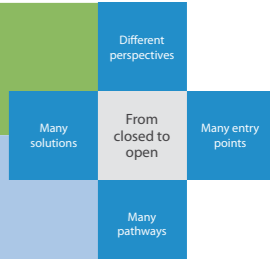
## Transforming tasks strategy: From closed to open


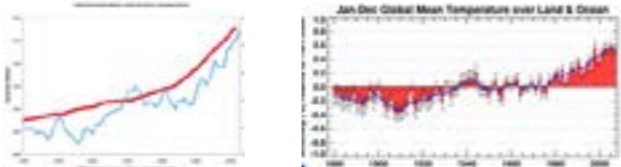
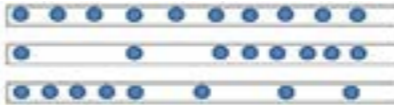




Technique	Before	After	Reflection: Why and how?																																		
<p><b>Different perspectives</b> Our thinking can change beyond one point of view.</p>	<p>Research 3 different earthquakes. Include the following:</p> <ul style="list-style-type: none"> <li>• cause</li> <li>• magnitude</li> <li>• impact of the earthquake (include photos of damage).</li> </ul> <p>What do you think? Should people be prevented from living in earthquake prone areas? Justify your response.</p>	<p>A seismologist’s view is that the tectonic activity that causes earthquakes is essential to sustaining life on Earth. Find out the positive and negative consequences of the tectonic movement on the surface of the Earth. Present a report that lists both the positive and negative effects.</p> <p>What do you think? Do you think the damage of earthquakes outweighs the benefits Many people choose to live in earthquake prone areas. Why might that be? Should people be prevented from living in earthquake prone areas? Justify your response.</p>	<p>WHY would you... have students explore different points of view about earthquakes?</p> <p>To develop skills in considering different points of view and analyse how they can impact on our understanding of the world.</p> <p>HOW does this develop powerful/expert learners? Students appreciate views and opinions are influenced by information and experiences, and develop flexibility in considering alternate ideas.</p>																																		
<p><b>Many entry points</b> Thinking does not have to be linear. Have students work backwards by providing the outcome first.</p>	<p>Different planets take different amounts of time to revolve around the sun. Find out how long each takes. In the table below, match the planet with how many days it takes for it to revolve around the sun.</p> <table border="1"> <thead> <tr> <th>Planet</th> <th>Time for planet to orbit the Sun</th> </tr> </thead> <tbody> <tr> <td>Mercury</td> <td>365.26 Earth days</td> </tr> <tr> <td>Venus</td> <td>29.456 Earth years</td> </tr> <tr> <td>Earth</td> <td>84.07 Earth years</td> </tr> <tr> <td>Mars</td> <td>87.96 Earth days</td> </tr> <tr> <td>Jupiter</td> <td>224.68 Earth days</td> </tr> <tr> <td>Saturn</td> <td>686.98 Earth days</td> </tr> <tr> <td>Uranus</td> <td>11.862 Earth years</td> </tr> <tr> <td>Neptune</td> <td>164.81 Earth years</td> </tr> </tbody> </table>	Planet	Time for planet to orbit the Sun	Mercury	365.26 Earth days	Venus	29.456 Earth years	Earth	84.07 Earth years	Mars	87.96 Earth days	Jupiter	224.68 Earth days	Saturn	686.98 Earth days	Uranus	11.862 Earth years	Neptune	164.81 Earth years	<p>What are the headings for the columns in this table?</p> <table border="1"> <tbody> <tr> <td>Mercury</td> <td>87.96 Earth days</td> </tr> <tr> <td>Venus</td> <td>224.68 Earth days</td> </tr> <tr> <td>Earth</td> <td>365.26 days</td> </tr> <tr> <td>Mars</td> <td>686.98 Earth days</td> </tr> <tr> <td>Jupiter</td> <td>11.862 Earth years</td> </tr> <tr> <td>Saturn</td> <td>29.456 Earth years</td> </tr> <tr> <td>Uranus</td> <td>84.07 Earth years</td> </tr> <tr> <td>Neptune</td> <td>164.81 Earth years</td> </tr> </tbody> </table> <p>Use a diagram to help explain what each heading means.</p>	Mercury	87.96 Earth days	Venus	224.68 Earth days	Earth	365.26 days	Mars	686.98 Earth days	Jupiter	11.862 Earth years	Saturn	29.456 Earth years	Uranus	84.07 Earth years	Neptune	164.81 Earth years	<p>WHY would you... have students work backwards from the answer?</p> <p>To develop skills in creative thinking by considering possibilities.</p> <p>HOW does this develop powerful/expert learners? Students develop their ability to think logically and to apply what they know to new situations.</p>
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<p><b>Many pathways</b> There are many possible ways to complete a task.</p>	<p>Sort the following objects into processed materials and natural materials.</p> <table border="1"> <tbody> <tr> <td>pebble</td> <td>feather</td> <td>nylon fishing line</td> </tr> <tr> <td>twig</td> <td>pine cone</td> <td>wooden table</td> </tr> <tr> <td>coke</td> <td>plastic pen</td> <td>woollen jumper</td> </tr> <tr> <td>wire</td> <td>milk</td> <td>cotton wool</td> </tr> </tbody> </table>	pebble	feather	nylon fishing line	twig	pine cone	wooden table	coke	plastic pen	woollen jumper	wire	milk	cotton wool	<p>In what different ways can you sort these objects?</p> <table border="1"> <tbody> <tr> <td>pebble</td> <td>feather</td> <td>nylon fishing line</td> </tr> <tr> <td>twig</td> <td>pine cone</td> <td>wooden table</td> </tr> <tr> <td>coke</td> <td>plastic pen</td> <td>woollen jumper</td> </tr> <tr> <td>wire</td> <td>milk</td> <td>cotton wool</td> </tr> </tbody> </table> <p>Explain your different groups.</p>	pebble	feather	nylon fishing line	twig	pine cone	wooden table	coke	plastic pen	woollen jumper	wire	milk	cotton wool	<p>WHY would you... have students sort materials in multiple ways?</p> <p>To develop skills in creativity through classifying objects in many possible ways.</p> <p>HOW does this develop powerful/expert learners? Students learn to be flexible thinkers in solving problems.</p>										
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<p><b>Many solutions</b> Open ended solution, but thinking stretched by constraints.</p>	<p>Can you make an egg float? What you’ll need: • One egg • Water • A tall drinking glass • Salt Instructions:</p> <ol style="list-style-type: none"> <li>1. Pour water into the glass until it is about half full</li> <li>2. Carefully pour in plain water until the glass is nearly full</li> <li>3. Gently lower the egg into the water and watch what happens. Objects float better in salt water.</li> <li>4. Now add in 6 teaspoons of salt to the glass of water and stir it in until it dissolves.</li> <li>5. Gently lower the egg into the water and watch what happens. Did the egg float? Why?</li> </ol>	<p>Can you make an egg float? In how many ways could you make an egg float? Can you explain why each works? Can you make an egg float by changing the liquid? How would you change it? Why might that work?</p>	<p>WHY would you... have students explore ways to solve a problem including changing the liquid?</p> <p>To develop skills in generating and evaluating a range of possible solutions for a problem and challenge thinking through adding a constraint.</p> <p>HOW does this develop powerful/expert learners? Students learn to be imaginative and logical as they explore ways to answer a question.</p>																																		

# GOAL – Getting the students doing the thinking in Science

## Transforming tasks strategy: From closed to open



Technique	Before	After	Reflection: Why and how?
<p><b>Different perspectives</b> Our thinking can change beyond one point of view.</p>	<p>This chart shows the correlation between Atmospheric Carbon Concentration (in Parts Per Million) and Average Surface Temperature. Do you agree with Al Gore's famous words, "Yes, they fit." Why / Why not?</p>  <p>Matt Lemmon, Carbon Concentration and Average Surface Temperature Chart</p>	<p>In Al Gore's famous words, "Yes, they fit." This chart shows the correlation between Atmospheric Carbon Concentration (in Parts Per Million) and Average Surface Temperature.</p>  <p>Now observe the graph on Global Mean Temperature over Land and Ocean from 1880 until 2000. How might climate sceptics use this graph to argue against climate change being caused by humans? How might a scientist(s) explain this? How would they approach the anomalies in the data?</p> <p>Matt Lemmon, Carbon Concentration and Average Surface Temperature Chart</p>	<p>WHY would you... have students explore different points of view on climate change data that contains anomalies? To develop skills in identifying and analysing anomalies like a scientist in order to communicate and collaborate with other people's values, perspectives and ideas.</p> <p>To develop a healthy scepticism of current explanations about phenomena and embrace the dynamic and tentative nature of scientific knowledge.</p> <p>HOW does this develop powerful/expert learners? Students learn to be self-aware, collaborative and inquisitive.</p>
<p><b>Many entry points</b> Thinking does not have to be linear. Have students work backwards by providing the outcome first.</p>	<p>Ticker timers are used to represent speed. Practise pulling the tape through at a constant speed. The pattern should show an even distribution of dots. Turn off the timer once you have achieved a constant speed for ten 0.1s intervals. (50 dots)</p> <p>Use the tape to draw:</p> <ol style="list-style-type: none"> <li>(1) a time distance graph</li> <li>(2) a speed-time graph.</li> </ol>	<p>Ticker timers are used to represent speed. What do you think the following ticker tape patterns indicate?</p>  <p>See if you can pull the tape through the ticker tape machine at rates that approximately duplicate the 3 patterns. What did you notice? Devise a way to accurately measure speed using a ticker tape.</p>	<p>WHY would you... have students work backwards from the answer? To develop skills in creative thinking by considering possibilities in constructing an explanation at a starting point relevant to them.</p> <p>HOW does this develop powerful/expert learners? Students develop their ability to think logically and to apply what they know to new situations.</p>
<p><b>Many pathways</b> There are many possible ways to complete a task.</p>	<p>Use the half equation method to balance the following redox reaction.</p> $\text{Ag}_{(s)} + \text{Zn}_{(aq)}^{2+} \rightleftharpoons \text{Ag}_2\text{O}_{(aq)} + \text{Zn}_{(s)}$ <ol style="list-style-type: none"> <li>1. Balance elements in the equation other than O and H.</li> <li>2. Balance the oxygen atoms by adding water (H<sub>2</sub>O) molecules.</li> <li>3. Balance the hydrogen atoms by adding H<sup>+</sup> ions.</li> <li>4. Add up the charges on each side. Make them equal by adding enough electrons (e<sup>-</sup>) to the more positive side and multiply them by appropriate integers so both sides are equal in charge.</li> <li>5. The half-equations are added together, cancelling out the electrons to form one balanced equation and cancel common terms also.</li> <li>6. Check the equation is balanced.</li> </ol>	<p>Can you balance this redox reaction? How many ways can you find to balance this equation?</p> <p>Check your equation is balanced each time.</p> $\text{Ag}_{(s)} + \text{Zn}_{(aq)}^{2+} \rightleftharpoons \text{Ag}_2\text{O}_{(aq)} + \text{Zn}_{(s)}$ <p>Which way is the most efficient?</p>	<p>WHY would you... have students sort materials in multiple ways? To develop skills in creativity through solving a problem in many possible ways.</p> <p>HOW does this develop powerful/expert learners? Students learn to be flexible thinkers in solving problems.</p> <p>(There are multiple ways to balance a redox reaction.)</p>
<p><b>Many solutions</b> Open ended solution, but thinking stretched by constraints.</p>	<p>Plate Tectonic Boundaries Task</p>  <ol style="list-style-type: none"> <li>1. Colour the ocean and water light blue.</li> <li>2. Colour the land green or brown.</li> <li>3. Name the plates, the continents and oceans.</li> <li>4. What type of plate movement is happening at the edge of the Pacific and North American Plate?</li> <li>5. What countries are on the Euro-Australian Plate?</li> <li>6. What continental plate is Spain on?</li> <li>7. What continental plate is Russia on?</li> </ol>	<p>Plate Tectonic Boundaries Task</p>  <ol style="list-style-type: none"> <li>1. What type of plate movement is happening at the edge of the Pacific and North American Plate?</li> <li>2. Which countries might this affect? How might they be affected?</li> <li>3. Where is a convergent boundary? What would you expect to find there?</li> <li>4. Which countries might be affected? How?</li> </ol>	<p>WHY would you... have students use inquiry to solve a problem? To develop skills in generating and evaluating a range of possible solutions for a problem through adding a constraint.</p> <p>HOW does this develop powerful/expert learners? Students learn to be imaginative and logical as they explore ways to answer a question.</p>