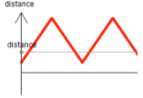
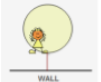
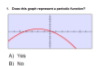


## CLIP 1: Graphing, Identifying, Describing Periodic Functions

Critical Learning:	
◆	<b>representing</b> a function graphically and identifying whether the function is periodic;
◆	<b>communicating</b> a description of the context that produces one complete cycle and identifying changes to the context that affect graphical features of one cycle;
◆	<b>reflecting</b> on familiar curves to recognize that periodic functions are different from linear or quadratic functions

Activity Number/Type	Activity Title	Math content
1.1 Minds On	Collecting and Graphing Data	Students will: <ul style="list-style-type: none"> <li>review graphical representations of linear and quadratic functions</li> <li>investigate the vertical line test on a periodic function</li> <li>define a periodic function</li> </ul>
1.2 Minds On	Periodic Motion: Tides	Students will: <ul style="list-style-type: none"> <li>connect tides to periodic functions</li> </ul>
1.3 Action	Swimming Pool Lengths Sketch (GSP File) 	Students will: <ul style="list-style-type: none"> <li>investigate the periodic functions created by a swimmer moving back and forth in a pool</li> <li>connect changes in the swimmer's conditions to changes in a periodic function (e.g. starting position, speed, etc.)</li> </ul>
1.4 Consolidate	Circular Motion Sketch (GSP File) 	Students will: <ul style="list-style-type: none"> <li>reflect on how the function created by measuring the distance from a wall while walking in a circle creates a periodic function</li> <li>make prediction about which contextual changes will affect the period</li> </ul>
1.5 Consolidate	Quiz: Periodic Functions 	Students will: <ul style="list-style-type: none"> <li>practice identifying a variety of graphs and scenarios as creating periodic or non-periodic functions</li> </ul>
<b>1.6 Show What You Know</b>		
1.6.1 Assessment Demonstration	Swimming Pool or Circular Motion (GSP File)	Students will: <ul style="list-style-type: none"> <li>reflect on their understanding of periodic motion</li> </ul>



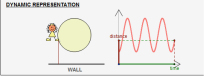
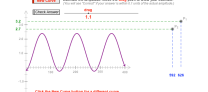
1.6.2 Assessment Game	Relations Cards (printable)	Students will: <ul style="list-style-type: none"><li>• play a matching game that requires them to identify linear, quadratic, periodic and other functions</li></ul>
1.6.3 Written Assessment	Periodic Story	Students will: <ul style="list-style-type: none"><li>• create a story that describes periodic motion</li></ul>
1.6.4 Assessment Think Aloud	Quiz: Periodic Functions	Students will: <ul style="list-style-type: none"><li>• communicate their understanding of periodic motion</li></ul>

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## CLIP 2: Key Properties

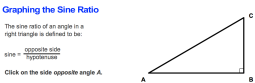
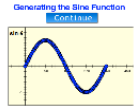
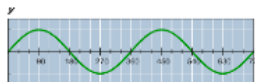
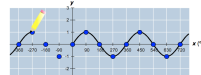

### Critical Learning:

- ◆ **communicating** key properties (i.e. amplitude, period, maximum/minimum values, increasing/decreasing intervals) of periodic functions using precise academic language

Activity Number/Type	Activity Title	Math content
2.1 Minds On	Introduction: Key Properties	Students will: <ul style="list-style-type: none"> <li>• review key properties of linear and quadratic functions</li> <li>• begin to develop an understanding of key properties of periodic function</li> </ul>
2.2 Action	Key Properties of Periodic Functions Sketch 	Students will: <ul style="list-style-type: none"> <li>• investigate key properties of periodic functions using GSP</li> </ul>
2.3 Consolidate	Practice: Key Properties Sketch 	Students will: <ul style="list-style-type: none"> <li>• practise determining key properties of periodic functions using GSP</li> </ul>
<b>2.4 Show What You Know</b>		
2.4.1 Assessment Demonstration	Key Properties of Periodic Function	Students will: <ul style="list-style-type: none"> <li>• communicate their understanding of key properties of periodic functions using the GSP file from activity 2.2</li> </ul>
2.4.2 Assessment Demonstration	Practice: Key Properties Sketch	Students will: <ul style="list-style-type: none"> <li>• explain their learning while determining key properties of periodic functions using the GSP file from activity 2.3</li> </ul>
2.4.3 Assessment Game	Periodic Function Cards (printable)	Students will: <ul style="list-style-type: none"> <li>• play a periodic functions card game using their understanding of key properties</li> </ul>
2.4.4 Written Assessment	Report on key properties	Students will: <ul style="list-style-type: none"> <li>• reflect on the key properties of periodic functions</li> </ul>

## CLIP 3: The Sine Ratio

Critical Learning:	
◆	<b>representing</b> numerical data, generated by the sine ratio graphically to produce the graph of $y = \sin x$
◆	<b>reflecting</b> on the nature of the curve $y = \sin x$ to conclude that it is a function
◆	<b>communicating</b> key properties of $f(x) = \sin x$ using precise academic vocabulary
◆	<b>selecting</b> key properties of the graph of $f(x) = \sin x$ to produce a paper/pencil sketch

Activity Number/Type	Activity Title	Math content
3.1 Minds On	<p>The Sine Ratio</p> 	<p>Students will:</p> <ul style="list-style-type: none"> <li>connect prior knowledge of the sine ratio in right triangles to the graph of the sine ratio between <math>0^\circ</math> and <math>90^\circ</math></li> </ul>
3.2 Action	<p>Generating the Sine Function</p> 	<p>Students will:</p> <ul style="list-style-type: none"> <li>compare angles given between two arms/rays to angles in standard position</li> <li>define the following terms as they related to angles on a coordinate grid: initial arm, terminal arm, vertex, initial ray, terminal ray, centre, angle, theta.</li> <li>investigate the relationship between the coordinate points, the radius of a point on the terminal ray, and the sides of the right triangle created from that point</li> <li>investigate the sine ratio of an angle in standard position</li> <li>generate a sine function using points from the unit circle</li> </ul>
3.3 Action	<p>Key Properties of the Sine Function</p> 	<p>Students will:</p> <ul style="list-style-type: none"> <li>investigate the key properties of the sine function e.g. cycle, period, maximum value, minimum value, zeroes</li> <li>investigate the meaning of increasing and decreasing, domain and range, amplitude and phase shift</li> <li>match key property words with graphical representations of the sine function</li> </ul>
3.4 Action	<p>Sketching the Sine Function</p> 	<p>Students will:</p> <ul style="list-style-type: none"> <li>investigate shortcuts for graphing a sine function using key properties (e.g. maximum, minimum and zeros)</li> </ul>
3.5 Consolidate	<p>Sine Skills Games and Practice</p> 	<p>Students will:</p> <ul style="list-style-type: none"> <li>practice creating sine graphs using key points playing either the Sinesweeper Game, or the Sine Dancing Game</li> </ul>
3.6 Consolidate	<p>Quiz: The Sine Function</p>	<p>Students will:</p> <ul style="list-style-type: none"> <li>answer 10 questions that demonstrate their understanding of the sine function</li> </ul>
3.7 Show What You Know		



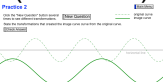



3.7.1 Assessment Demonstration	Create a physical model	Students will: <ul style="list-style-type: none"><li>• create a physical model of a unit circle to use while discussing the key features of the sine function</li></ul>
3.7.2 Assessment Demonstration	Web Search Results Page	Students will: <ul style="list-style-type: none"><li>• use the internet to find and summarize web pages that show connections between the sine ratio and the sine function</li></ul>
3.7.3 Assessment Think Aloud	Key Properties of Sine Function	Students will: <ul style="list-style-type: none"><li>• communicate their understanding of key properties of the sine function using activity 3.3</li></ul>
3.7.4 Assessment Game	Sine Skills Games and Practice	Students will: <ul style="list-style-type: none"><li>• practice graphing the sine function using activity 3.5</li></ul>
3.7.5 Assessment Game	Memory Match game	Students will: <ul style="list-style-type: none"><li>• match key properties terminology with pictures, values and/or definitions</li></ul>
3.7.6 Assessment Game	Key Properties of the Sine Function cards (printable)	Students will: <ul style="list-style-type: none"><li>• match key properties terminology with pictures, values and/or definitions</li></ul>


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## CLIP 4: Transformations of Periodic Functions

Critical Learning:	
◆	<b>reflecting</b> on prior knowledge about transformation of shapes and extending it
◆	<b>connecting</b> through exploration with technology, a visual change to the name of a single transformation including specific non-numeric details (for vertical and horizontal translations, vertical and horizontal dilatations to a line, and a reflection in a horizontal line) on a variety of shapes and curves

Activity Number/Type	Activity Title	Math content
4.1 Minds On	Transformations 	Students will: <ul style="list-style-type: none"> <li>investigate the meaning of the term 'transformation' in real life situations</li> </ul>
4.2 Action	Types of Transformations Sketch 	Students will: <ul style="list-style-type: none"> <li>investigate transformations of objects, the parabola and the sine curve using GSP.</li> </ul>
4.3 Consolidate	Naming Transformations Sketch (GSP File) 	Students will: <ul style="list-style-type: none"> <li>visualize what happens to a transformed sine function when individual transformations are 'undone'</li> <li>practice naming transformations of the base sine function</li> </ul>
4.4 Show What You Know		
4.4.1 Assessment Demonstration	Elastic band	Students will: <ul style="list-style-type: none"> <li>demonstrate different types of transformations using an elastic band</li> </ul>
4.4.2 Assessment Game	Naming Transformations (printable) 	Students will: <ul style="list-style-type: none"> <li>identify transformations by matching a graph card with a transformation card</li> </ul>




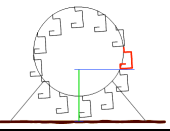

<p>4.4.3 Assessment Game</p>	<p>Transforming Sine Curves Sketch</p> 	<p>Students will:</p> <ul style="list-style-type: none"><li>• create a game to demonstrate their understanding of transformations using a transformations GSP sketch</li></ul>
<p>4.4.4 Assessment Think Aloud</p>	<p>Naming Transformations Sketch</p>	<p>Students will:</p> <ul style="list-style-type: none"><li>• communicate their understanding of transformations using the GSP sketch from activity 4.3</li></ul>
<p>4.4.5 Assessment Game</p>	<p>Memory Match game</p>	<p>Students will:</p> <ul style="list-style-type: none"><li>• match transformed graphs, descriptions of transformations and equations of transformed sine functions</li></ul>

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## CLIP 5: Transformations of Periodic Functions in Context

### Critical Learning:


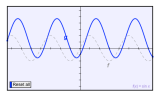
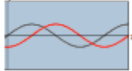
- ◆ **connecting** through exploration with technology, changes in real-world periodic relationships with resulting transformations in their graphical models
- ◆ **reasoning** about changes in real-world contexts and resulting changes in mathematical representations
- ◆ **communicating** using precise mathematical vocabulary

Activity Number/Type	Activity Title	Math content
5.1 Minds On	Reasoning about Changes 	Students will: <ul style="list-style-type: none"> <li>• explore how the graphical representation of a periodic function created by walking around a circle is changed by the size and position of the circle as well as the walker's starting point, speed, and direction change</li> </ul>
5.2 Action	Transformations in Context 	Students will: <ul style="list-style-type: none"> <li>• explore how changes made to a Ferris wheel's motion (position, speed etc) transform the graphical representation of the function representing the height of one seat on the Ferris wheel</li> </ul>
5.3 Consolidate	Changes in Contexts 	Students will: <ul style="list-style-type: none"> <li>• investigate the periodic nature of some real world contexts.</li> <li>• investigate how changes to real world contexts transform the graphical representation of that context (eg. skipping rope, noise cancelling headphones, engine piston, pendulum and escalator)</li> </ul>
5.4 Show What You Know		
5.4.1 Assessment Written	Create a periodic story	Students will: <ul style="list-style-type: none"> <li>• communicate their understanding of real world periodic motion and transformations caused by changes in context</li> </ul>
5.4.2 Assessment Think aloud	Transformations in Context	Students will: <ul style="list-style-type: none"> <li>• communicate their understanding of transformations using activity 5.2</li> </ul>
5.4.3 Assessment Oral/Written	SineBeauty and SpecialEffects	Students will: <ul style="list-style-type: none"> <li>• create a special effect using a GSP animation file of sine functions</li> <li>• explore how changing transformations effects the path of a ball</li> </ul>



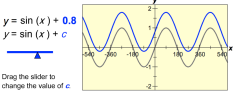
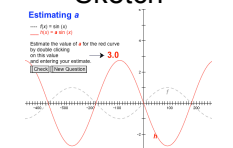

## CLIP 6: Roles of the Parameters $a$ , $c$ and $d$

Critical Learning:	
◆	<b>connecting</b> through exploration with technology, a change in one of the parameters $a$ , $c$ or $d$ in algebraic models of sine functions with transformations of the graph of $f(x) = \sin x$
◆	<b>representing</b> graphical transformations by changes in values of parameters, and representing changes in parameters graphically

Activity Number	Activity Title	Math content
6.1 Minds On	Special Effects 	Students will: <ul style="list-style-type: none"> <li>connect changes in the parameters of a sine function to changes in the path of a ball</li> </ul>
6.2 Action	Exploring the Parameters $a, c$ and $d$ Sketch 	Students will: <ul style="list-style-type: none"> <li>investigate the types of transformations that result from changes in the parameters <math>a</math>, <math>c</math> and <math>d</math> using GSP</li> </ul>
6.3 Consolidate	Quiz: Transformation Connections 	Students will review and practice: <ul style="list-style-type: none"> <li>matching graphs of transformed functions to descriptions of transformations</li> <li>determining the general form of the equation of a transformed sine function</li> </ul>
6.4 Show What You Know		
6.4.1 Assessment Demonstration	Exploring the Parameters $a$ , $c$ , and $d$	Students will: <ul style="list-style-type: none"> <li>explain the effects of changes to the parameters <math>a</math>, <math>c</math> and <math>d</math> on the sine graph using the GSP sketch from activity 6.2</li> </ul>
6.4.2 Assessment Think aloud	Quiz (think aloud)	Students will: <ul style="list-style-type: none"> <li>communicate their understanding while answering questions related to transformations using activity 6.3</li> </ul>
6.4.3 Assessment Organizer	Create a graphic organizer	Students will: <ul style="list-style-type: none"> <li>communicate their understanding of transformations using a graphic organizer</li> </ul>

## CLIP 7: Sketching the Sine Function

Critical Learning:	
◆	<b>representing</b> $f(x) = a \sin x$ , $f(x) = \sin x + c$ , and $f(x) = \sin(x - d)$ as graphical models by sketching their graphs using transformations of the graph of $f(x) = \sin x$
◆	<b>reflecting</b> on the precision of graphical representations of sine functions
◆	<b>communicating</b> the range of the functions

Activity Number	Activity Title	Math content
7.1 Minds On	Connections: Parameters & Transformations 	Students will: <ul style="list-style-type: none"> <li>review concepts related to transformations by entering values for period, maximum value, minimum value and amplitude</li> <li>make connections between the graph and an equation created by dragging sliders</li> </ul>
7.2 Action	Using Transformation Sketch 	Students will: <ul style="list-style-type: none"> <li>estimate the value of a parameter in the equation of a transformed sine function given the graphical representation in a GSP sketch</li> </ul>
7.3 Consolidate	Quiz: Sketching Sine Functions 	Students will: <ul style="list-style-type: none"> <li>describe transformations that must be applied to create a graph given an equation and then sketch one cycle of the curve</li> </ul>
7.4 Show What You Know		
7.4.1 Assessment Demonstration	Using Transformations to Graph Sine Functions	Students will: <ul style="list-style-type: none"> <li>communicate their understanding by determining parameter values given a graphical representation of a transformed sine function using the GSP sketch from activity 7.2</li> </ul>
7.4.2 Assessment Think aloud	Quiz: Sketching Sine Functions	Students will: <ul style="list-style-type: none"> <li>communicate their understanding of transformations while completing the quiz from activity 7.3</li> </ul>



7.4.3 Assessment Demonstration	Graphing Transformations of $f(x) = \sin x$	Students will: <ul style="list-style-type: none"><li>• sketch <math>f(x) = \sin x</math> and several different transformed functions on the same grid</li><li>• discuss the key properties of each graph</li></ul>
7.4.4 Assessment Game	Memory Match game	Students will: <ul style="list-style-type: none"><li>• match transformed graphs, descriptions of transformations and equations of transformed sine functions</li></ul>

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