



## student activity



Mathematics B Education Program

Name: \_\_\_\_\_

Teacher: \_\_\_\_\_

School: \_\_\_\_\_

The tight turns and steep inclines of the Super Tubes HydroCoaster ensure that the world's very latest innovation in waterslide technology is also one of the most exciting. In this activity you will examine the Mathematics behind the shape of the track to learn how this ride achieves its exhilarating drops and terrifying turns.

### Syllabus Links

**Periodic functions and applications** - use sine and cosine rules to solve triangles in two- and three-dimensional contexts and determine lengths/distances and the magnitude of angles in life-related situations such as the height of a tower given the direction and angles of inclination from two fixed locations of known distance apart

**Introduction to functions** - examine the general shapes of polynomial functions of the type  $y = x^n$ ,  $n = 2, 3, 4$

**Introduction to functions** - use a graphing calculator to investigate possible functions for data.

**Maintaining mathematical procedures** - interpretation and drawing of scale drawings and plans

### Equipment

Student activity sheets, pens/pencils, rulers, graphics calculators, clinometers



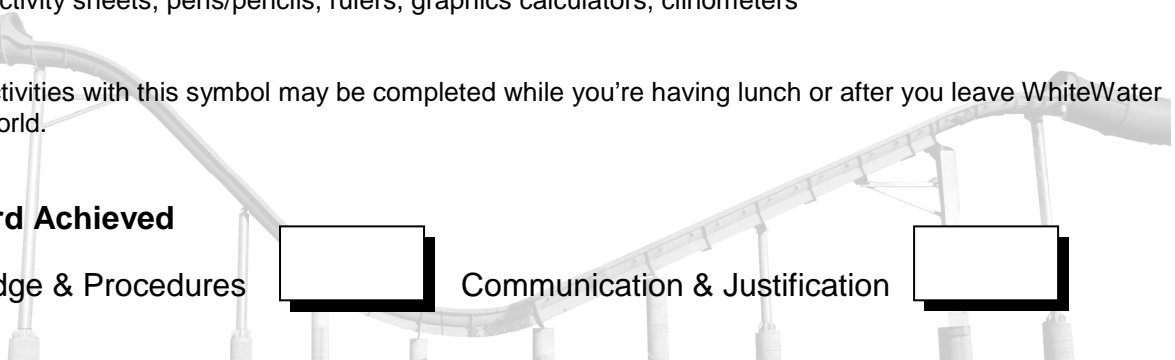
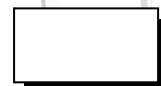
Activities with this symbol may be completed while you're having lunch or after you leave WhiteWater World.

### Standard Achieved

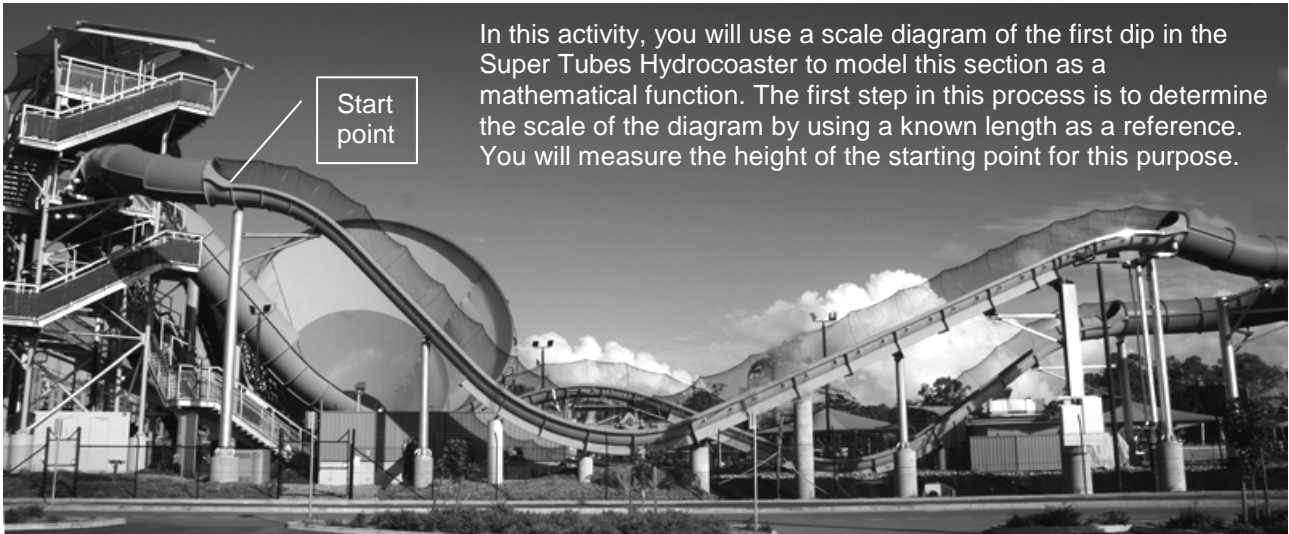
Knowledge & Procedures



Communication & Justification



**Height of Starting Point**



In this activity, you will use a scale diagram of the first dip in the Super Tubes Hydrocoaster to model this section as a mathematical function. The first step in this process is to determine the scale of the diagram by using a known length as a reference. You will measure the height of the starting point for this purpose.

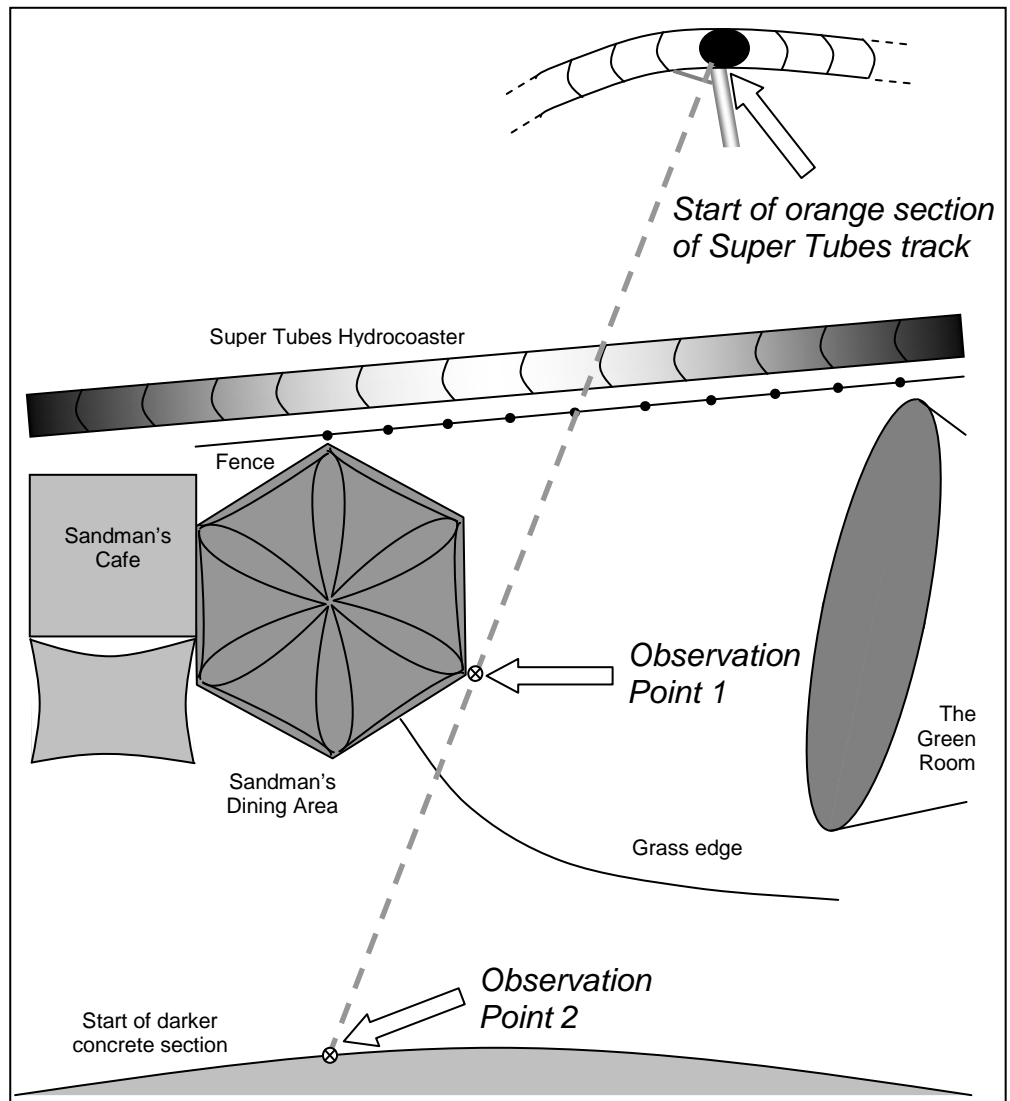
**Question 1**

To determine the height of the starting point above ground level, go to Sandman's Snack Shack & T-Bar and locate the shade sail support pole at the edge of the hexagonal dining area. This is the first observation point in the diagram on the right.

From this point, you should be able to make out the starting point of the Super Tubes Hydrocoaster, where the track changes from orange to red.

Use a clinometer to measure the altitude (angle of elevation) to the top of the track at the start point (as in the diagram above).

Repeat your measurement three times, take an average and record your answer below.



Altitude of Super Tubes start point from Observation Point 1

Trial 1 \_\_\_\_\_° Trial 2 \_\_\_\_\_° Trial 3 \_\_\_\_\_° Average \_\_\_\_\_°

**Question 2**

From your observation point, walk away from the Super Tubes Hydrocoaster until you reach the point where the concrete changes to a darker colour. Find the second observation point in the diagram on the previous page by walking along the line in the concrete until the Super Tubes start point is aligned directly above your first observation point (that is, above the Sandman’s shade sail support pole).

Repeat your clinometer measurement from this point three times and record your answer below.

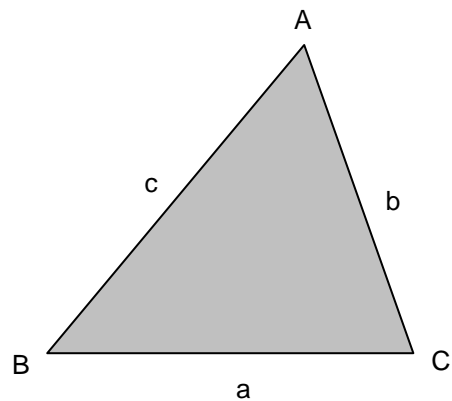
Altitude of Super Tubes start point  
from Observation Point 2

Trial 1	_____ °
Trial 2	_____ °
Trial 3	_____ °
Average	_____ °

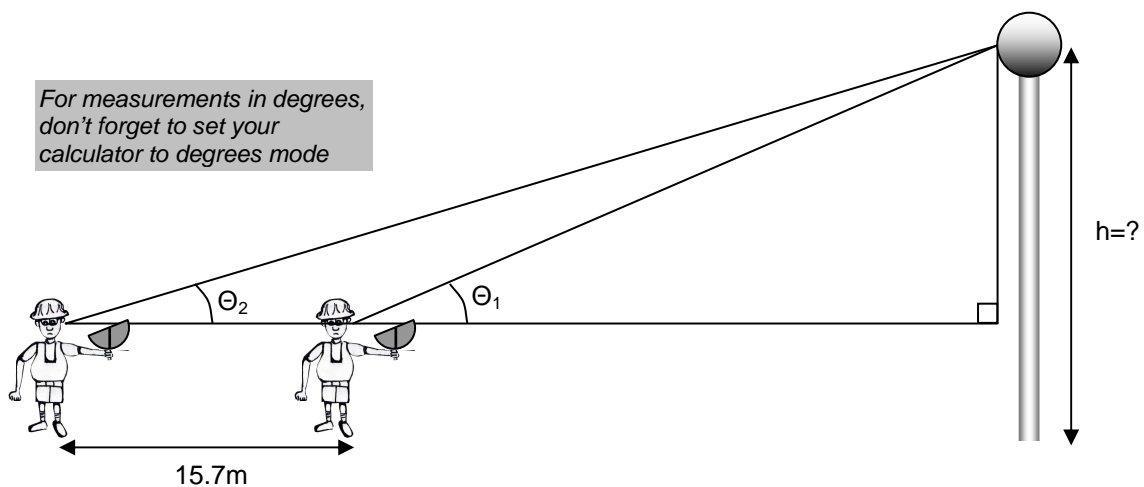
It is possible to calculate the height of the Super Tubes start point from the two angles that you have just measured and the distance between the observation points. You will need to use the sine rule.

**The Sine Rule**

In any triangle  $\Delta ABC$ ,  $\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$ .



The distance between the two observation points is 15.7m.



You can use this information to find the height of the Super Tubes start point. Follow the steps on the next page.

**Question 3**

Calculate  $\Theta_3$  and mark it in the diagram below. Hint: Use  $\Theta_1$  and the fact that angles on a straight line are supplementary.

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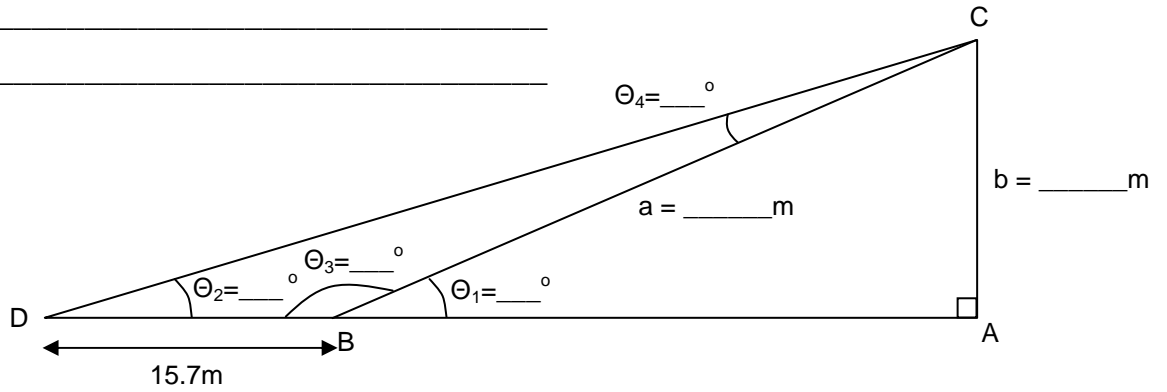
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**Question 4**

Calculate  $\Theta_4$  and mark it in the diagram above. Hint: Use  $\Theta_2$  and  $\Theta_3$  and the fact that angles in a triangle are supplementary.

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**Question 5**

Use  $\triangle DCB$  and the sine rule (see previous page) to calculate length  $a$  and mark it in the diagram above.

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**Question 6**

Use  $\triangle ABC$  to calculate the length of  $b$  and mark it in the diagram above.

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**Question 7**

Use length  $b$  and your own height to eye level to calculate the height,  $h$ , of the Super Tubes start point.

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$h = \underline{\hspace{2cm}} \text{ m}$

**The Equation of the First Dip**

**Question 8**

Measure the height (in mm) of the start point in the diagram to the right.

$h = \underline{\hspace{2cm}}$  mm

**Question 9**

Use the heights measured in Questions 7 and 8 to determine the scale of the diagram to the right.

Scale =  $\underline{\hspace{1cm}}$  :  $\underline{\hspace{1cm}}$

**Question 10**

Use a ruler to measure the x- and y-coordinates of each of the points marked on the diagram to the right (in mm). Use the scale from Question 9 to convert each measurement to its real dimensions (in m). Record your results in the table below.

	x (mm)	y (mm)	x (m)	y (m)
A				
B				
C				
D				
E				
F				
G				
H				
I				
J				
K				
L				
M				
N				
O				
P				
Q				
R				
S				
T				
U				
V				
W				
X				

