student activity

WHITEWATER WORLD
BY DREAMWORLD

Science Education Program

Name: _____

Teacher: _____

School: _____

Psyche yourself up for a white-knuckle experience! The first of its kind in the country, The Rip will subject you to some of the most extreme forces and accelerations that you will experience at WhiteWater World, throwing you from a 16m tower into a high-speed whirlpool and out the plughole into a momentary freefall. In this activity, you'll discover exactly what you've been subjected to in this ride as you calculate the forces and accelerations that you experience. It will leave you grateful for the cushioning effect of your cloverleaf tube!

Syllabus Outcomes

Years 6 and 7

Energy and Change D4.4 Students explore properties of some common force and energy phenomena by playing with toys.

Energy and Change D4.5 Students devise and use tools to compare the effectiveness of materials designed to protect the human body from impact forces.

Years 8 and 9

Energy and Change D5.5 Students outline the energy changes that occur in simple physical and chemical changes and link their observations to scientific understandings about the conservation of energy.

Year 10

Energy and Change DB6.1 Students participate in investigations to quantify the relationship between force and motion.

Equipment

Student activity sheets, pens/pencils, calculators

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

Standard Achieved

E&C D4.4, E&C D4.5	E&C D5.5	E&C DB6.1

Impact Forces

Question 1 (Level 4 Outcome)

After you shoot through the plughole at the end of The Rip you'll appreciate your inflatable raft more than ever. Explain how it protects you from impact forces in this ride.

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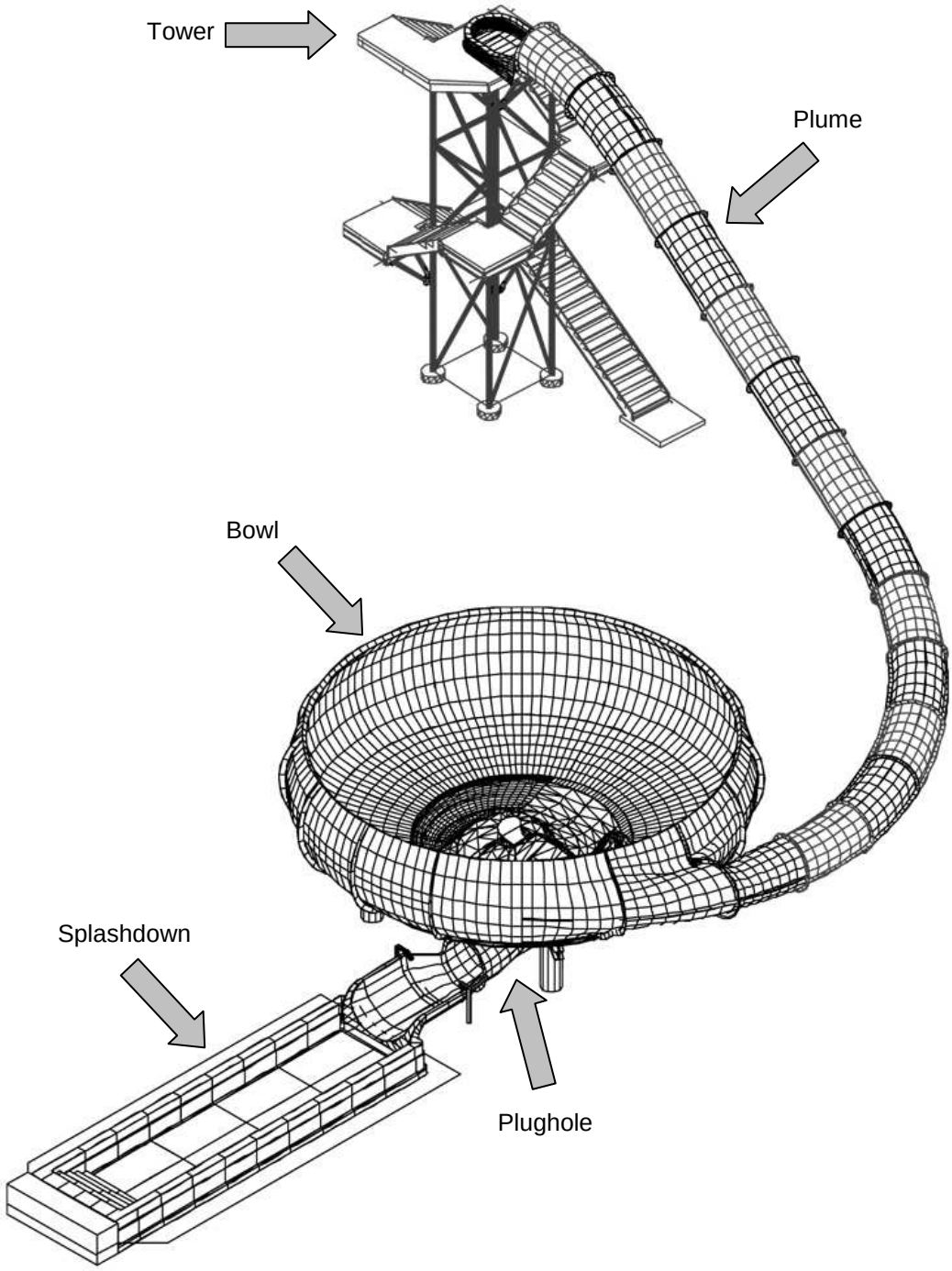

Energy Calculations

Question 2 (Level 5 Outcome)

The potential energy of the cloverleaf tube at the top of the tower is the product of its mass (m), its height (h) and the acceleration of gravity (g). That is, $PE = mgh$.

If the tube has a mass of 10kg, calculate the total mass of the tube and four 50kg occupants.

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Mass = _____ kg

The height of the launch point above the bowl (h) is 16m and the acceleration of gravity (g) is 9.8m/s^2. Use this information with the mass that you have just calculated to determine the potential energy of the tube. The units for energy are joules, J.

$PE = mgh$ = _____ = _____ J

Question 3 (Level 6 Outcome)

As the tube descends into the bowl its potential energy is converted into kinetic energy. The *Law of Conservation of Energy* states that energy cannot be created nor destroyed, only converted from one form to another. Hence, the kinetic energy when it reaches the bowl is equal to the potential energy at the top of the tower. You can use the potential energy that you have just calculated to determine the kinetic energy and hence the velocity as it enters the bowl.

Kinetic energy is half of the product of mass and the square of velocity. That is, $KE = \frac{1}{2}mv^2$.

Conservation of energy tells us: *KE = PE*

Hence, $PE = \frac{1}{2}mv^2$

Substitute the mass and potential energy calculated in Question 2 into this equation.

_____

Now solve this equation to find the velocity in m/s.

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Velocity = _____ m/s

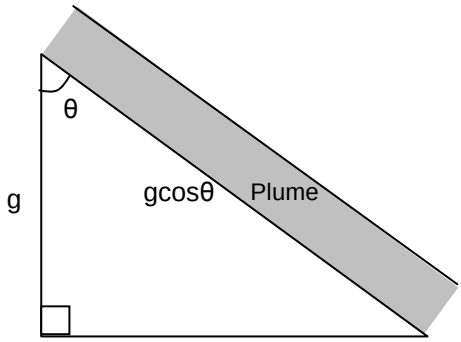
Acceleration and Force

Question 4 (Level 6 Outcome)

The acceleration that you experience in free fall is the acceleration due to gravity, *g*, 9.8m/s^2. When you're falling at an angle *θ*, such as in the plume as you approach the bowl in The Rip, your acceleration is a fraction of *g*, given by $a = g\cos\theta$.

The angle of the plume is $\theta = 40^o$.

Use your calculator to find the acceleration that you experience as you travel down the plume.



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a = _____ m/s^2

Question 5 (Level 6 Outcome)

The force that you experience is the product of your mass and your acceleration, given by $F = ma$. Use the mass that you calculated in Question 2 and the acceleration from Question 4 to calculate the force that is exerted on your tube in the plume. The units for force are newtons, N.

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F = _____ N

Question 6 (Level 6 Outcome)

If you choose to ride with heavier friends, explain what effect this will have on the acceleration and force that you experience in the plume.

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Question 7 (At-home Level 6 Extension Outcome)

Pushing the boat out further Research the most extreme G-forces that the human body can be subjected to, and strategies that allow the body to withstand even larger forces.