THORPE PARK

THRILLS WORKSHOP

@HOME

Science of Roller Coasters
Teacher/Parent Info

Thorpe Park Resort
Thrills Workshop @Home

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Page 3 - Record Breaking Rides

A few fun facts about some of our top coasters to get things started/to use as an ice-breaker.

Page 4 - Coaster Construction

Click the red play icon, this will link to a Youtube construction video.

After the video has played, return to the presentation to discuss the construction process. Add anything you know to the lesson.

Page 5 - Forces for Thought

A selection of physics related considerations when it comes to building a roller coaster. Feel free to elaborate on each point if you know further information or get your student to define each of the terms and how they might apply to roller coaster design.

Page 6 - Exhilarating Energy

Potential energy - use the slide to either read straight off or as a memory jog when discussing.

Page 7 - Roller Coaster Roundup

Use these questions as a mid-presentation break to review your knowledge so far and go back over some points if the student is not able to answer correctly.

Answers:

1. How steep is SAW – The Ride's record breaking drop? 100 Degrees

2. Which coaster took the world record from Colossus for most inversions when it opened in 2013? The Smiler at Alton Towers Resort

3. How long does a coaster typically take to open from the initial conceptualisation phase? 4 years

4. Name three physical factors that need to be considered when designing a roller coaster? Any three words listed on page 4

5. What kind of energy does a roller coaster train gain as it ascends the lift-hill? Gravitational Potential Energy

6. What other kinds of energy can Gravitational Potential Energy be transferred as? Heat and sound energy

Page 8 - Exhilarating Energy

Advise students to write down equations and numbers as they go as they will need this information later.

Follow slide for what to discuss, using SAW - The Ride as an example.

Show where to get the information from for Weight and Height.

Page 9 - Exhilarating Energy *Exercise*

It's the student's turn, allow them to work out the equations on the board for Swarm and Stealth. Use the rounded figure of 10 for gravity.

Answers:

THE SWARM

Weight - 10000kg
Height - 39m
Gravity = 10N/kg

10000 x 10 x 39 = 39000000J

Stealth

Weight - 8000kg
Height - 62.5m
Gravity = 10N/kg

8000 x 10 x 62.5 = 5000000J

Page 10 - Vivacious Velocity

Show students the equation for how they work this out and advise to write it down.

Demonstrate using SAW as the example again. Students will need a calculator to answer OR they may use their mobile to calculate the equation.

Explain we are using the rounded figures from the previous slide's answers. Also explain that in reality a small fraction of the energy would be transferred as heat and sound energy but for the purposes of this example we are using GPE and KE as 100% transferable.

Page 11 - Vivacious Velocity *Vocation*

Ask students to use their answers from the questions on Slide 8 to apply the formula for calculating velocity.

Answers:

THE SWARM
Weight - 10000kg
GPM - 3900000

√ (2 x 3900000)/10000 = 27.93m/s

Stealth
Weight – 8000kg
GPM - 5000000

$\sqrt{(2 \times 5000000)/8000}$ = 35.36m/s

Page 12 - Kinetic Energy

Kinetic Energy - Follow the slide through to explain to students.

Talk through SAW as the example. They will need the mass for THE SWARM and Stealth that they have already written down and the correct velocity answers from the previous slide to solve this.

Page 13 - Kinetic Energy *Conundrum*

Answers:

Accept correct answers up to two decimal places.

Stealth
Weight – 8000
Velocity – 35.36m/s

$0.5 \times 8000 \times 35.36^2$ = 5,001,318J

THE SWARM
Weight – 10000
Velocity – 27.93m/s

$0.5 \times 10000 \times 27.93^2$ = 3,900,425J

Page 14 - Braking Force

Now we have looked at speed, it's time to put on the brakes.

All the information needed to do this is on the side of the slide.

Ask if anyone can work out the answer quickly, if not don't worry just explain this equation.

Page 15 - Braking Distance

Braking Distance – same as previous slide style, in terms of information location.

Page 16 - G-force Explained

Talk through the slide, have they experienced any Thorpe Park Resort rides? Can they guess which rides are the most intense?

Answers:

Joint 3rd - Nemesis Inferno, Stealth & THE SWARM - 4.5Gs

2nd - SAW - The Ride - 4.7Gs

1st... drum roll - Detonator: Bombs Away - 5.5Gs, making it the 3rd most intense ride in the world!

Page 17 - A Weighty Issue

Talk through the slide explaining how a traditional coaster works, i.e. climbs a lift hill using a chain or cable and is released and that gravity does the rest.

Follow the slide for the information.

Add in anything else you might know about lift hills and chain lifts.

Page 18 - Centripetal Force

Talk through the slide to explain centripetal acceleration.

Demonstrate the best ride to feel this force on here at Thorpe Park Resort is ‘Zodiac’.

Click the red play icon, this will link to a Youtube construction video. After the video has played, return to the presentation

Page 19 - G-force *Task*

Answer:

Acceleration - 37.5m/s^2
Gravity – 10N/kg

37.5/10 = 3.75Gs

Page 20 - Industry Adaptations

Talk through the slide and add any other information you may have regarding industry adaptations.

A fun fact! Roller coaster elements are often named after aerial manoeuvres, such as:

Barrel roll
Zero-G roll
Immelmann turn

Page 21 - See you soon!

Read through slide to highlight what we have learned.

Ask one question to one student about each point to check they have retained the information.

Feel free to tweet any questions to:
@thorpepark