

# BMX Stunt Bike Riding Investigation

## Lesson Plan

### Aims

1. Develop a mathematical model for the flight path of a BMX stunt-bike rider.
2. Use the mathematical model to estimate the maximum height of a rider.
3. Use the mathematical model to find the rider's height given his horizontal distance from the start of the jump and to find the rider's horizontal distance from the take-off point given his height.

Number of Lessons: 1

### Introduction

1. BMX extreme sports cover dirt jumping, vert, street and flatland events. The BMX riders perform tricks as they ride on or over different surfaces and obstacles. In the dirt, street and vert events, riders are scored out of 100 for height, degree of difficulty of tricks, smoothness and balance, number of tricks and how well the course is used. Dirt jumping is where BMX riders jump a series of dirt jumps. While in the air, riders perform one or more tricks. Video analysis tools can be used to investigate rider flight paths, ramp shapes and ramp positions for the dirt jump event.

2. Show the **BMX Events Movie 2005**.

3. We are going to focus on the BMX dirt event and see how mathematics can help us to examine the rider's path through the air.

4. Show the Steve McCann dirt jump part of the movie again and then ask the following questions to assist students in thinking about how mathematics can be used to examine the flight path and more:

- Think about what you saw in the movie and ask yourself, if you were a BMX rider what information about the dirt jumps and rider's flight path would help you in your training.
- What does the rider aim to do over each jump? **Answer:** perform one or more tricks.
- What must the rider do to be able to perform one or more tricks? **Answer:** stay in the air.
- What determines the rider's maximum height? **Answer:** rider's take-off speed and angle of up ramp.
- How far apart should the up and down ramps be? **Answer:** depends on rider's take-off speed and angle of up ramp.
- At what angle should the up ramp be placed to allow the rider to reach the maximum height? **Answer:**  $45^{\circ}$ .
- How can we find the maximum height reached by the rider? **Answer:** the BMX assignment will ask them to develop a way of doing this.
- What conditions/forces impact on the time a rider is in the air? **Answer:** force of gravity and air resistance.
- If it takes 2.5 seconds to complete a double backflip, then how long will a rider need to be in the air? **Answer:** yes we can decide the airtime needed.
- If a rider needs to reach a maximum height of 8 metres, then what should the slope of the up ramp be and with what speed should the rider leave the jump? **Answer:** yes we can decide the slope and speed.

5. Now demonstrate how **VidShell**, a video analysis tool, can be used to help answer some of these questions

### **Demonstration of Vidshell Software**

6. Demonstrate how to use **VidShell** to find a quadratic equation to model the flight path of a BMX rider. When doing the demonstration try to avoid saying how to find the maximum height of the rider because this is the first question in their assignment.

7. Follow the instructions on the **BMX Movie and VidShell Instructions and Graphics Calculator Commands for Finding the Least Squares Regression Line** sheets. Use the video clip **Ben Dirt Jump 22** for the demonstration. Although only three points are needed to find a least squares regression line for a parabola, mark ten points on the rider's flight path.

8. Use the quadratic equation to find the height of the rider when he is 2 metres horizontally from the take-off point.

9. Use the quadratic equation to find the horizontal distance from the take-off point when the rider is 1.5 metres above the top of the up ramp.

10. Ask the class if there are any limitations on the mathematical model.

### **Estimating Maximum Height of BMX Rider**

11. The aim is to find the maximum height of a rider as he flies through the air. Use the **Ahmed Dirt Jump 25 video for the assignment.**

12. What method can be used to find the maximum height of a rider using VidShell and a graphics calculator?

Allow students to work in groups of two or three, for about 5 minutes, on this question and then get class feedback on possible methods.

13. Now for each method (see note below) **use VidShell to**

- **collect the coordinates needed for the least squares regression line, and**
- **measure the distance from the rider's maximum height to the ground.**

Give this data to the students so they can complete the assignment using their method to find the riders maximum height.

**Note: depending on time you may wish to select one method and then use VidShell to collect the coordinates needed to complete the assignment.**