

CONCEPTUAL PHYSICS**Tech Lab****Part One: Mechanics****Qualitative Video Analysis**

Bicycle Dancer of Edinburgh

Purpose

To analyze a short video of a street trials bicycle performer, identifying the physics involved in the stunts he performs

Apparatus

computer with Internet access

YouTube video v=Z19zFlPah-o (“Inspired Bicycles – Danny MacAskill April 2009”)

headphones and signal splitters (optional)

Discussion

The web video clip, “Inspired Bicycles – Danny MacAskill April 2009,” is a professionally produced film featuring the bike stunts of a talented world-class performer. The stunts are feats of skill, talent, and outstanding demonstrations of physics!

The description of the 5 1/2-minute video is as follows: *Filmed over the period of a few months in and around Edinburgh by Dave Sowerby, this video of Inspired Bicycles team rider Danny MacAskill (more info at www.dannymacaskill.com) features probably the best collection of street/street trials riding ever seen. There’s some huge riding, but also some of the most technically difficult and imaginative lines you will ever see. Without a doubt, this video pushes the envelope of what is perceived as possible on a trials bike. Credit to Band of Horses for their epic song “The Funeral.”*

Procedure

Step 1: Turn on the computer and allow it to complete its start-up cycle. If you are completing this activity in a laboratory or classroom setting, connect signal splitters and headphones to the computer as needed.

Step 2: Launch the computer’s web browser (e.g., Firefox, Safari, Internet Explorer).

Step 3: Locate the YouTube video, “Inspired Bicycles – Danny MacAskill April 2009.” It should be located at <http://www.youtube.com/watch?v=Z19zFlPah-o>. That is, it is video Z19zFlPah-o within YouTube’s vast collection.

Step 4: Watch the video in its entirety. Mute the sound unless you are using headphones or completing this activity in a private setting. It’s preferable to watch the first time with the sound on.

Step 5: When the video has played to its conclusion, set the computer aside and complete the steps that follow.

Step 6: Review the following vocabulary by matching each term to its definition.

Gravitational Potential Energy •	• energy of motion
Chemical Potential Energy •	• interval during which a collision takes place
Kinetic Energy •	• delicate balance
Centripetal •	• energy of position (based on height above ground)
Unstable Equilibrium •	• directed toward the center of a circle or arc
Impact Time •	• energy of position (based on molecular interaction)

Step 7: Match each energy transformation process to the correct description.

- | | | |
|---|---|--|
| Turning chemical potential energy into gravitational potential energy | • | • trading speed for height |
| Turning chemical potential energy into kinetic energy | • | • using muscles and food energy to gain height |
| Turning kinetic energy into gravitational potential energy | • | • trading height for speed |
| Turning gravitational potential energy into kinetic energy | • | • using muscles and food energy to gain speed |

Step 8: Match each term to the corresponding description.

- | | | |
|---|---|---|
| Dynamic Unstable Equilibrium | • | • spinning as in a somersault |
| Centripetal Acceleration | • | • maintaining delicate balance while moving |
| Rotation Around a Vertical Axis | • | • "cushions" a collision by "absorbing" the effects |
| Rotation Around a Horizontal Axis | • | • spinning as a helicopter blade would spin |
| Impact: increase time to decrease force | • | • the change in velocity required for circular motion |

Step 9: Examine the checklist on the following page. Each stunt shown in the video clip involves one or more principles of physics from the checklist. Each stunt has been given a title on the checklist, such as "Death Fence" or "Bike Shop—Copy Stop Hop."

Step 10: Watch the video clip again. Pause and rewind the playback as needed. **Identify the primary principles demonstrated in each stunt.** A single stunt may involve up to five principles. Many involve at least three; some involve only one. Place a checkmark in the appropriate column or columns for each stunt. **When you are done, each of the 26 rows will have at least one checkmark and each of the 9 columns will have at least one checkmark.**

SAFETY NOTE: DANNY MACASKILL IS A PROFESSIONAL RIDER WITH OVER 12 YEARS OF TRAINING. MANY STUNTS PERFORMED IN THE VIDEO CLIP ARE EXTREMELY DANGEROUS. DO NOT ATTEMPT ANY OF THESE STUNTS ON YOUR OWN!

Summing Up

1. During which stunts does MacAskill ride *without* his helmet?

2. Estimate the maximum potential energy that MacAskill attains when riding up the tree in Stunt 2.

a. Which two quantities must you estimate to carry out the calculation?

b. Estimate those two quantities and record your estimates.

c. Carry out the calculation and record your result.

	Chemical PE to Grav PE	Chemical PE to Kinetic E	Kinetic E to Grav PE	Grav PE to Kinetic E	Dyn Unstable Equilibrium	Centripetal Acceleration	Rotation Vert Axis	Rotation Horiz Axis	Increase † Decrease F
1. "Death" Fence									
2. Up a Tree									
3. Barricade Hop (x2)									
4. Step Up, Over, and Down									
5. Steps, Jumps, and Spins									
6. Nighttime Pink Barricade									
7. Gate Jumper									
8. Sidewalk-Benchrail-Grass									
9. Traffic Island Hopping									
10. Nighttime Wall to Wall									
11. Ten Steps Down									
12. Lateral Spot Jumps									
13. The Trees (With a Twist)									

	Chemical PE to Grav PE	Chemical PE to Kinetic E	Kinetic E to Grav PE	Grav PE to Kinetic E	Dyn Unstable Equilibrium	Centripetal Acceleration	Rotation Vert Axis	Rotation Horiz Axis	Increase † Decrease F
14. Rear Wheel Barhopping									
15. Up-Front...and Down									
16. Back (Wheel) and Forth									
17. Monorail									
18. Round the Corner Steps									
19. Up a Narrow Ramp									
20. Way Down 1									
21. Two-pylon Straddle									
22. More Cool Stunts									
23. Bike Shop—Copy Stop Hop									
24. Way Down 2									
25. Unicycle Up Over Up Down									
26. Way Down 3									