Was the Force behind Leicester's football success?

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For many fans around the world May 4th is Star Wars Day, playing on the popular phrase 'May the Force Be With You' uttered by many characters in the films including Luke Skywalker's mentor, Yoda.

However, despite his esteemed position as a Jedi Master in the Star Wars universe, Yoda may have struggled to pull off some of his trickier Force-related feats due to lack of energy, according to students from the University of Leicester.

In the Star Wars cinematic series 'the Force' is used in the universe to accomplish great feats of strength, agility and even telekinesis. The only explanation given for these abilities is that there are micro-organisms called 'midi-chlorians' living inside all living cells.

Natural Sciences students Leah Ashley, Rowan Reynolds & Robbie Roe from the University of Leicester aimed to calculate whether the standard energy production molecules of the body would be able to provide enough energy to produce a feat of Force strength such as that seen in the Star Wars series.

In order to measure this they decided to choose one Force usage moment in the series. In Episode V, The Empire Strikes Back, Jedi Master Yoda lifts Luke Skywalker's X-Wing fighter from a swamp on Dagobah. A previous calculation for the amount of power produced by Yoda found that 19.2 kW was produced over a period of 3.6 seconds, which amounts to 68.12 kJ in total.

In the human body, different molecules are used to gain energy at different points during energy expenditure, based on the most efficient type of metabolism at that time. The students modelled Yoda as a scaled-down human, assuming that human Force users would have similar abilities to Yoda.

Yoda, weighing 13 kg, would have 5.2 kg of muscle, based on an average muscle mass percentage of 40% in humans. The human body contains 250g of Adenosine Triphosphate (ATP), a chemical compound that releases energy after being hydrolysed, at any given time. By assuming this is for a 70kg human, scaling down to Yoda's mass means he would have 46.4g ATP in his body.

Using a power output of 19.2 kW when Yoda lifts an X-Wing and ignoring ATP recycling, it was found that the hydrolysis of all the ATP both initially present and able to be created in Yoda's body would not be sufficient to provide the energy for this feat.

The students concluded that by using all the energy sources available to humans, Yoda would only be able to produce 5.58% of the power he is calculated to expend in the film. The students therefore suggest that the energy he draws on must come from another source and that the energy channelled by the Force does not come from the user alone.

Clearly in the case of Leicester City and their phenomenal sporting success, the Force is the sum of all parts.

The students presented their findings in a paper for the *Journal of Interdisciplinary Science Topics*, a peer-reviewed student journal run by the University's Centre for Interdisciplinary Science. Students from the University of Leicester (UK) and McMaster University (Canada) have contributed to this year's journal. The student-run journal is designed to give students practical experience of writing, editing, publishing and

reviewing scientific papers.

Dr Cheryl Hurkett from the University of Leicester's Centre for Interdisciplinary Science said: "An important part of being a professional scientist (as well as many other professions) is the ability to make connections between the vast quantity of information students have at their command, and being able to utilise the knowledge and techniques they have previously mastered in a new or novel context. The Interdisciplinary Research Journal module models this process, and gives students an opportunity to practise this way of thinking. The intention of this module is to allow students to experience what it's like to be at the cutting edge of scientific research.

"The course is engaging to students and the publishing process provides them with an invaluable insight into academic publishing. It also helps students feel more confident when submitting future papers. I find it a very rewarding module to teach and I am always pleased to see my students engaging so enthusiastically with the subject. I encourage them to be as creative as possible with their subject choices as long as they can back it up with hard scientific facts, theories and calculations!"

More information: The paper 'How Might the Force Work?' is available here: www.physics.le.ac.uk/jist/inde … article/view/162/100

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