
Mechanics in the Real World

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In the fall semester of 2004, I taught six discussion sections of a large calculus-based introductory mechanics class at the University of Michigan. I therefore interacted with approximately 200 students twice a week. One of my priorities as a discussion instructor was to help students make the connection between the formulae they were required to memorize and the real world with which they interact every day. Near the end of the term, I gave the students an assignment intended to assess how strongly the ideas of introductory mechanics had affected their thought processes. I asked them to write a paragraph describing a real-world event or process for which they now realized they had a better understanding.

I report here on their responses to this assignment. I will describe the range of examples the students chose, and I will share the most common examples. It is my hope that these results will help other physics teachers as they search for ways to present introductory mechanics that will grab their students' attention. These are the everyday moments of life in which physics seemed most relevant to this sample of students.

The Assignment

I asked the students to write a brief paragraph describing a situation that they had encountered "in their real life" outside of class. This situation should involve physical principles that they had not understood before, either because they never thought about it or because they had an incorrect conceptualization of the process before. I wanted them to tell me of a moment when they suddenly realized, "Hey! I know how that works!"

They were to think about this over the Thanksgiving holiday and bring in their paragraphs the following Monday. "If you haven't had a moment like this yet this term," I told them, "you'll have to construct one over the weekend."

Results

Of the 192 students enrolled in Physics 140, 143 turned in paragraphs for this assignment. Although some students did not understand what I was asking for and echoed topics from the text (Young and Freedman's *University Physics*) without explaining how it applied to their lives, 128 students reported eye-opening real-world encounters with physics. Many students even mentioned multiple examples.

By far the most commonly cited examples had to do with the motion of vehicles. The fact that friction with the road is what accelerates (or decelerates) vehicles clearly made a large impression on many students. If one includes the stability gained through rotation of the wheels, then the bicycle is far and away the most vivid illustration of mechanics available to the students. Several mentioned a demonstration I had performed where I pushed backward on a pedal when that pedal was at the lowest point in its circle. The vast majority of the students expected the bicycle to move forward, since they associate rotation of the pedals in that direction with forward motion. They were very startled when the bike moved backward. This demonstration helped them separate out the internal forces and torques that move the pieces of the bicycle from the external forces that move the entire bicycle.

The physics of fluids also made a large impression on the students. Buoyancy, pressure, and applications of Bernoulli's equation account for 26 anecdotes. Of these, the three most common examples were sucking liquid through a straw (seven times), the lift force on an airplane wing (six times), and applying the continuity equation to fluid flow from a nozzle (five times). The submissions regarding the straw example all conveyed a sense of astonishment at the insight that air pressure pushes fluid up the straw from below, rather than their suction pulling from above. One student even compared drinking a thick milkshake with drinking soda pop, and noted that her straw in the former case needed to be stronger to withstand the greater pressure she needed to push up the more viscous fluid.

Several students wrote of how their improved understanding of physics aided the pursuit of their passions. An avid snowboarder said she now understands why moving her arms and torso affects the spins and flips she can perform on the board. Two musicians spoke about how they now understand better what their equalizers and amplifiers were doing. A dancer spoke eloquently about envisioning the forces and torques her body endures as she performs various steps and poses.

Conclusions

I was gratified that the vast majority of the students perceived connections between what we were doing in the classroom and the processes that surround them in their daily lives. The examples they chose ranged from the trivial (torque opens jars) to the practical (one student saved his mother's favorite tree by recognizing that lopping off some branches would reduce the torque caused by fallen snow, making the tree less likely to snap and fall over) to the artistic (music and dance). Many students expressed appreciation of the assignment, as it made them conscious of how much they had learned. Perhaps their answers will be a useful resource to instructors seeking examples of physical principles that will engage their own students.

Acknowledgments

I would like to thank the students in the fall 2004 class of Physics 140, as well as my fellow instructors, Noemi Mirkin, Carl Akerlof, Roy Clarke, Jay Chapman, and Tim McKay of the University of Michigan.

PACS codes: 01.40.Di, 01.40.gb.

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