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## Bottles from here to the moon and back

## Tim Wees

My mathematical prowess extends to the basics of Algebra and geometry, enough to track my own needs and do some basic financial forecasting. My mind never could get wrapped around anything more mathematically intricate than that.

My son, David, has moved beyond my barriers, and he has taken on the mathematics task with a will. He has become a math teacher even, and is having much fun with it too.

So how do you package the complicated mathematical paradigm so that kids can understand it and want to pursue the subject? One day last year, while he was chalking formulas on the blackboard, Dave noticed how many students were drinking water from bottles, and how many of these same bottles were being left in the classroom for the him to recycle. Hmm. There is an opportunity here, he thought.

He cleared the top shelf and started quietly storing the bottles. Over the course of the semester the collection of water bottles grew and grew. Eventually Dave had two entire shelves and the top of a filing cabinet covered with plastic water bottles.

Near the end of the year, one of his students asked about the water bottles, "Are those just from our class?" He responded, "Yes." Over the course of just four months, he collected over 300 water bottles from the class.

Dave says, "Each of these water bottles is the product of an industrialized age, in which we consume commodities created by machines in faraway places. We never really see the impact of our consumption because the water bottles are carefully ferreted away and hidden in landfills. We also do not realize the environmental impact of making the plastic bottles.

"The water bottles take three to five times as much water to produce as they contain. If each water bottle were filled with the oil required to make the plastic from which the bottle was formed, it would be one-quarter full.

"There is no doubt that our planet is experiencing a period of global warming. Many argue about the possible causes of global warming, but the scientific consensus is that it is a direct result of human activity. One of the major factors in global warming is our use of fossil fuels.

"When we consume oil and other fossil fuels, we are releasing carbon into our surface biosphere, carbon that used to be stored deep underground. Much of this carbon eventually makes its way into our atmosphere in the form of carbon dioxide, which is a greenhouse gas.

"From studies of statistical trends over the last 600,000 years, scientists are able to determine that there is a strong relationship between greenhouse gases and the temperature of the planet."

How much of an impact?

Dave gave his students an exercise, "Assuming that our classroom's usage of water bottles is approximately the average number used by classrooms throughout the world, guess how many bottles of water are consumed each year globally."

Some students worked out how many water bottles each day each person consumed and then multiplied the figure by the 6.7 billion people in the world and then by the number of days in a year. Some first calculated how many water bottles were drunk annually as a class, then used a proportion to calculate the world's consumption.

Here is David's analysis.

"If you assume that 300 bottles in four months for 20 people in the class is average, then we can use this basis to determine the total number of bottles of water each year globally:  $300 \times 3 = 1,200$  bottles as a class per year, so about 60 bottles per year each. We then multiply that by 6.7 billion people in the world. The result is a total of 402 trillion bottles of water!"

How many bottles is this?

"Assuming each water bottle is about 20cm high, then five water bottles make a metre, and 402 billion bottles would be 80.4 billion metres, which is 80.4 million km. The moon is about 384,399km away from us on average, so these water bottles would stretch to the moon and back about 209 times.

"The mass of a one-litre bottle of water is one kilogram. The mass of Mount Everest, the tallest mountain, is about 304 trillion kg. Therefore, all of the bottled water consumed annually in the world weighs about as much as 1/1,000th of Mount Everest, which is a large amount.

"What is surprising about this comparison is not the sheer size of the numbers involved, but that we have talked about only one thing that we consume as a society. If we were to add up all of the other by-products of crude oil that we create each year, we would arrive at some much larger numbers."

A canteen is on my next week's list.



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