Northwest Math Sightings - Tidal Math

Students in our math classes legitimately ask us sometimes, "When will I ever need to know this stuff?" It's a question that has many answers depending on who has asked the question and why. Over the years good teachers develop a skill at fishing out the response that will work for this or that student at this or that moment. Sometimes it concerns an application in "real life," sometimes it has to do with requirements for the next course down the curricular line, or for tests the student must pass and so forth. My favorite answer, though, is this: "When you understand this math your life will be more interesting. Let me explain…"

7:30 AM I was sitting on the beach of Hammersley Inlet. The water line was at my feet and the tide was receding as I watched. Rocks that had been submerged were gradually being uncovered. Barnacles that had been waving their feathery legs to ensnare the food borne by the current were closing up shop as their ceiling lowered.

7:35 AM I made a mark on a reed and pushed the reed into the sand a few feet out in the water so that the water line was at the mark.

7:45 AM The water was nearly down to the bottom of the reed. I removed the reed and broke it off at the water line so as to make a record of how far the water level had fallen in 10 minutes. It looked to me like about 10 cm, a handy number, so I made some mental calculations. Ten centimeters in 10 minutes is a rate. Could Hammersley Inlet really be draining at the rate of 1 cm per minute?

I had looked at tide tables the night before and knew that there had been a high of about 15 feet, and that we were headed toward a low of about -1 foot. That was a swing of about 16 feet. Since there are roughly two lows and two highs in any 24-hour period, that swing must be accomplished in about six hours – a little longer for the larger swings and a little shorter for the smaller but six hours makes a reasonable estimate when you are on the beach. Six hours is 6 x 60 = 360 minutes. At the rate of one cm per minute the water level would change by about 360 cm or 3.6 meters in six hours. If a meter is roughly a yard or three feet, this is equivalent to about 11 feet. That's not enough. The rate must be even greater!

This made me think; I was there at a time not far past the high water mark. At the exact moment of the high tide, the rate at which the water was receding had to have been zero and must now be picking up steam, as it were. It made sense, then, that the rate was a little slower at this time. This reminded me of how the speed of the current in the inlet is affected by the tides. Everyone who travels on the waters of the inlet is aware of this. Barges that ply the water between the mill in Shelton and the wider waters of the Puget Sound use the currents to ease the strain on their engines. Kayakers do the same.

8:30 AM As I was leaving I paced off the distance between the current water's edge and where it had been one hour earlier – about 22 feet. I wondered about the average slope of the beach. Knowing that the rate at which the water level was falling must be a

little more than one cm / minute, I estimated 1.2 cm / minute and multiplied by 60 minutes to conclude that the water level had fallen a little over 70 cm in one hour. Twenty-two feet is a little over 6.5 meters or 650 cm. So the slope, in this case quite literally the rise over the run, was a little more than a 1:10, a 10% grade. The maximum allowable grade on our freeways is 6%. For wheelchair ramps it's a little over 8%.

8:35 AM I got back to the cabin and fetched a tape measure in order to determine the actual length of the reed. The water had fallen 5 and 1/8 inches, about 13 cm. Later that day I consulted an online tide table and looked at a graph of water level versus time. I could see how the rate of rise and fall resembled sinusoidal waves.

What is to be gained by thinking these thoughts and doing these calculations? Is the quality of my life improved in any way if I can apply simple mathematics to the situations that surround me? The same question may be asked with regard to history, literature, science, art and all of the subjects we study in school and beyond. Does knowing the dates of the potato famine in Ireland and understanding the consequences for immigration rates in mid-nineteenth century America enable me to speculate more productively about the current furor over immigration? Does a basic understanding of northwest geology and the role played by volcanism make the drive from Seattle to Spokane a little more interesting? When knowledge of facts is supported by an understanding of the implications of these facts, conclusions may be drawn and predictions made. Sometimes these predictions and conclusions are important and sometimes they are trivial, but the ability to make them and the inclination to do so are some of the things that schools should foster.

When we are able to observe, explain and predict using the tools of any discipline we enrich our lives. Walking back up from the beach I realize that my day is made a little larger and more interesting by the fact that I know, understand and can apply some simple mathematics in order to make sense of the world.

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