Calculus for Middle School? Why Not?

Right from the start, there is a difference between explaining Calculus and teaching Calculus to someone. A twelve-year-old would have to be quite precocious indeed to have mastered the skills of algebra, as well as understanding various functional relations, needed to be able to learn how to do Calculus.

That being said, there is no reason why a middle schooler could not be challenged with the *ideas* of Calculus—ideas such as a limit, a core concept that undergirds all of Calculus.

Ask the students, “How close can you come to something without touching it?”

This is the basic idea behind an infinitesimal and one of the fundamental ideas used to introduce the Calculus of limits. In a science class it could also be the springboard to talking about very small things like living cells, molecules, and atoms.

Tell the students to imagine walking across a room in a strange way. Go half way across and stop. Now go half of the remaining distance. And again? Getting close to the wall yet? If you go exactly halfway each time—**exactly** half, not just close—will you ever actually get to the other wall? How close is close enough?

This explores the idea of limit a little more rigorously and is the way the idea is introduced in a Calculus class. A question of this type can lead to some interesting philosophical discussions with students. Don’t shoot over their heads, but curiosity is curiosity, and middle schoolers have it in abundance.

Here’s another problem that looks at limits a little differently. “Suppose a farmer’s field is bordered by a meandering stream. How could you figure out the area of the field?”

This is a typical way Calculus books approach integral Calculus. By repeatedly summing smaller and smaller subdivisions of the field, one can calculate the area to any desired accuracy. But again, how accurate is accurate enough? Oop! Slipped into philosophy again.

Say to the students, “Take out your calculators. Divide 23 by 2. Now divide 23 by 1.” Then start asking questions. How do the two answers compare? Divide 23 by .5. How does that answer compare to what you get when you divide 23 by .25? Why? What happens if you divide it by .005? By .00005? (Now the key questions:) Describe happens to the answer as you divide 23 by a number that keeps getting closer to zero. So what happens if you divide by zero?”

Okay, the dividing by zero gets into a whole other territory of talking about infinity, but it seems so natural a question to ask at that moment.

My point here is that you do not have to have a great deal of arithmetical and algebraic experience to talk about the *ideas* behind the Calculus. As a Calculus teacher for many years, I would have been thrilled if more of my students had come to their first class having played around with the ideas of limits, infinitesimals, infinity, and so on.

Brains can (and should!) be boggled as soon as students can understand the basic concepts. If more students understood that mathematics is a science where we ask very intriguing questions, maybe more students would be intrigued by math rather than repelled.