

# The Relationship Between Math & the Ear

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Interestingly enough, some of my best insights come forth in the midst of my greatest struggles. Take for example the school year that my youngest daughter began first grade. For reasons that I did not understand at that time, I could not keep her healthy. She suffered ear infection after ear infection with high fever throughout the ten months of school. This was a stressful time for us both as I was a Waldorf high school mathematics teacher and Chair of the Math Department at that time. Together we missed many school days while nursing her back to health. On some of these stay-at-home days, I lamented about my mathematically-challenged students back at the high school who were waiting for my return in order to take up fully their next section of material. Invariably, upon my return to the classroom, my students would call for the details of my absence. After one of these accountings of my nonattendance, one of the students began to recall his childhood journey

through multiple ear infections. His story sparked that of another student who then told her tale of childhood ear illnesses. That story then sparked the memory of another student and then another and then another. I felt as though I was being bombarded with some universal phenomena relating childhood ear troubles with adolescent math struggles.

The ear is a very fascinating organ. That it could be related to math deficiencies is downright exciting! It turns out that  $\frac{2}{3}$  of my mathematically challenged students suffered from ear infections during their younger years. Hearing is, of course, very important for learning in school. If a child cannot hear well due to a fluid-filled middle ear or swollen eardrum they cannot take up the teacher's instruction. If the eardrum cannot vibrate, the students cannot hear clearly and then has a hard time learning. However, hearing impediments are not the only difficulty to be aware of in terms of the ear. The ear is also important because it is the main source for our senses of balance and movement.

How does the sense of movement and the balancing mechanism in the

ear work? Within the inner ear are the utricle and the saccule. These organs both contain fine hairs and an amount of viscous fluid. They are designed to detect head orientation and linear acceleration. When we tilt our head, gravity pulls on the fluid that is in these two organs. This fluid moves over the hair cells, which then send electrical signals to our brain to inform it of the head's new orientation. Similarly, when we start or stop moving in a straight line, the fluid inside the utricle and the saccule sloshes around, affecting the hair cells further.

The semicircular canals in the inner ear control balance. The canals detect angular acceleration, or turning movements of the head. There are three roughly D-shaped canals in each ear; they are all perpendicular to each other so that they can detect turning in any axis, for example, nodding your head up and down, shaking it left to right, or tilting it from side to side. These canals also work by affecting hair cells through the movement of fluid inside the semicircular canals as the movement occurs. When you rotate your head, the fluid in the canals aligns in the direction of the movement, thereby stimulating the hair cells. The hair cells sense the movement and communicate to the brain that there is head movement. When spinning around and around, the fluid may keep moving,

even for a time after the spinning has stopped. The hair cells keep telling the brain that you are still moving, even when you are not, which is why you get very dizzy and fall down!

The brain then takes all the input from these organs, the up, down, side and so forth, and sorts them out so we know how we're oriented and which way we're moving. Hence, the sense of balance and sense of movement are created.

In his lecture, *Man as a Being of Sense and Perception* (Steiner Book Centre), Rudolf Steiner writes, "Now let us consider mathematical truths. A superficial observer would say: Oh yes, of course man gets his mathematics out of his head. But it is not so. Mathematics derives from an altogether different sphere. And if you study the human being, you will get to know the sphere from which mathematics comes. It is from the sense of movement and the sense of balance." As mentioned above, our sense of movement and sense of balance are both derived from this fluid moving over the hair cells in our inner ear.

Our balance and movement in our body or our experience of the dimensions of space around our body is mirrored in our thinking. It is commonly known that when a hindrance exists in being able to think something through, moving it with our body is often the remedy. In this same vein, when our thinking is underdeveloped in some area, we may look to an area of our body that may also be underdeveloped. (See side bar.) When we then develop the body, the thinking commonly will follow suit, such as the slogan suggests: "The hand educates the brain." Where math is concerned, to be able to move to the right and left of the equal sign as in,  $3 + 4 = 7$ , requires that we have an amount of flexibility in moving to the right and left in our body, as well as in our thinking. To move above and below the fraction bar, such as with  $144/12$ , requires the same ability to move up and down in our body, as well as in our thinking. This is not to mean that a person unable to physically move will

not be able to move in their thinking either. However, some correlation does exist between physical movements and thinking movements.

To further explain, in order to fluidly move around or with a longer mathematical problem, such as long division, requires our sense of movement to be strong and flexible, so that we can hold on to where we began and where we are moving towards, similar to our body following a path. If our inner sense of movement is weakened, this ability to move around or in an equation is also often weakened. If our sense of balance is diminished it becomes more difficult to balance a spreadsheet or work with equivalencies as well. We sometimes cannot experience in our thinking what we cannot experience in our bodies first. If our sense of balance or sense of movement is impaired, we may have a more difficult time with those same qualities in our thinking. Therefore, as math is connected to movement and balance, and movement and balance are connected to ear health, we can deduce that ear health is important to math.

From the work of Audrey McAllen in her book *The Extra Lesson*, we can read what she suggests as supports for the sense of balance and the sense of movement. She has written that games where children spin around, swing, spend time on balance boards or one-legged stools, and any activity that gets the head hanging down for 30-60 seconds followed by a slow rise are beneficial for these two senses.

Students who need support for these two senses can be spotted in the classroom by their frequent ear infections, difficulties in fluid thinking with math, a frequent need to readjust in their chairs or inability to sit still for lengthy periods of time. These are also often the students that will sit with a leg or two tucked under them while in a chair or push back in the chair, wobbling on only one or two of the four available chair legs. These students may also regularly lay their head down on the desk during the daily lesson as well.

All of these latter mentioned tactics in the classroom are simply ways in which the students are attempting to get the fluid moving in the ear canal to stimulate the hair cells again.

In other words, when the sense of movement and sense of balance is underdeveloped due to illness or the like, the body will begin to stimulate those senses in attempts to develop them further. Unfortunately, those attempts by the body to develop in the middle of a class lesson can result in distraction to neighboring students and to a lack of focus or concentration by the student. Instead of being used in learning, the forces of the student who has the ear illnesses are being used to stimulate the ear system in order to integrate his or her sense of balance and sense of movement.



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