

# Mountain Surveying and the Classroom

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The teacher smiled inside as the last bag of M&M's went into the shallow hole in the playground. A few shovel s full of dirt, tamped in so no one could find the hole just by feeling the ground, and the prize was hidden. Not quite – the big blue tarp had to be spread over the hole and surroundings so that the students could not home in on the prize by looking for disturbed soil. Tomorrow, the student surveying teams would use they surveying equipment they had built and the techniques learned – at least presented -- in the mathematics, geography, and history unit the teachers had decided to call Mountain Surveying -- the Railroad to Cloudcroft. Each team would receive instructions written in the terse language of 1898 surveyors, instructions that – if carefully and correctly followed – would lead the team to the exact spot of the prize. Of course, there can be many ways to reach the same spot, and each team would have different instructions to the same end point. One of the other teachers had suggested that the competition take place the first thing in the morning, with each team placing a little flag at the point they reached by surveying. Then regular class work would resume, and at the end of the day, the tarp would be removed and the winning team, the team whose flag was the closest to the true end point, would reap the prize. Of course the students would have their minds on the prize, but much of the day was a review of surveying and surveying techniques, so maybe some of the review would “get inside their brains”. Thinking back on the unit, the teacher smiled again. Who would have predicted the wails -- and innovative excuses -- when the teachers informed the students that surveyors in 1898 did not have electronic calculators, and hence, they would not be allowed to use them? And who would have thought that the student who could not multiply two digit numbers could build the best surveying equipment?

[The author's website <http://www.lincoln-nf-trails.org> has instructions for making inexpensive surveying equipment and materials to help set up a competition.]

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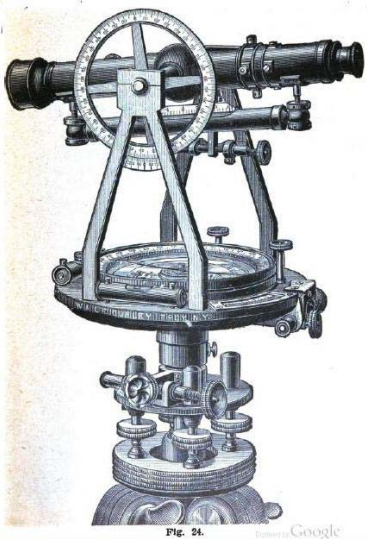
**How much could your students learn if they wanted to learn so that they could do something neat?** I suggest that teaching surveying, a skill of clear relevance in itself, pulls students into learning to measure angles and distances, to plot maps, to think spatially, to carry out calculations and measurements with care (repeating not because the teacher said so, but because they wanted to do better), and many other skills that are in the mathematics and science standards. If your teacher colleagues are amenable, surveying the Alamogordo and Sacramento Mountains Rail Road can be part of a unit on geography (people and the land) and history (settlement of the Sacramento Mountains).

Your students and you can build an instrument (theodolite) that functions likes the ones used in 1898 in the construction of the A&SM RR. It will not be as precise, but it will cost only \$10-15, depending on how good you are at scrounging.

## Theodolite

A theodolite is a device for measuring two angles, one in a horizontal plane and the other in a plane perpendicular to the horizontal plane. The theodolite head – containing the devices for leveling and for setting bearings and measuring angles – is generally mounted on a tripod.

A theodolite such as might have been used in surveying the A&SM RR, is shown in the figure below (T.U. Taylor, *Surveyor's Handbook*, page 39). The instrument shown in the picture to the right includes all the functions of the instrument shown, with the most significant exception being the use of a sight tube rather than a telescope. I think the theodolite and other items can be built by students in a class room. No power tools are required. The most significant danger is in the cutting operations with a saw or PVC cutter.



## About the Author

Lynn Melton is not a professional surveyor. He taught chemistry at the University of Texas at Dallas for many years, and since 2007 has been a member of the Science/Mathematics Education Department there. He is now on a half-time assignment, which requires him to be in Dallas for the Spring semester. He has a fervent interest in helping teachers to improve the delivery of science/mathematics material, particularly in the pre-high school grades. He became interested in hiking the route of the old Alamogordo and Sacramento Mountains Railroad – abandoned in 1948 and partially buried under HW 82 -- -- and learned to read the old survey maps in order to find the original route. He has combined these two themes in the hope that “**doing** mathematics, geography, and history” engages and rewards our students.