



EPP Rapid Research

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Alternatives for Dry Erase Markers

Requested by Gatewood Elementary School, Seattle Washington

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Request

At this elementary school, about 15 of the 20 classrooms have students using personal slates and dry erase markers for math and other subjects, to minimize use of paper. Even though the markers say low-odor, we are still concerned with exposure of fumes to the students. Are there alternatives?

Key Findings

- PPRC coordinated testing of three alternatives: paper, dry-erase crayons, and a refillable, extremely-low-odor marker from [Auspen](#)[®]. All three options greatly reduced or eliminated odor in the classrooms and reduced waste from dried-up markers.
- The functionality and convenience of alternatives must usually be near-equivalent or improved for teachers to want to make the switch.
- While more expensive initially, the refillable markers may cost less in the long run.
- Many teachers reported strong negative opinions about the odor in classrooms when all students are using markers, and in fact, one teacher has to discontinue use of the slates before the lesson is over.
- Despite odors, many teachers have students use the personal-sized slates to minimize paper waste, and/or so they can immediately assess whether students comprehend the exercise.
- Students and teachers may have reduced sensitivity to the solvents in the traditional markers, due to everyday use and "olfactory fatigue," however, they are still being exposed to the same level of solvents.
- The Auspen[®] is not available from local office supply stores.

Background

About 75 percent of teachers at this school use slates with students to minimize paper waste, and/or so they can immediately assess if students are comprehending a lesson. Math is the most common subject for which slates and markers are used.

The school district budget does not allow for the school to provide markers to teachers who use slates. Markers are either purchased by teachers or parents, and most of the markers currently purchased are labeled "low odor" and "AP non-toxic", because parents are trying to purchase the lowest-toxicity products available to them at local office supply or general stores. However, these still produce significant smell and odor when all students are using them at the same time, and some teachers feel the smell may contribute to headaches in the classrooms.

After hearing parent and teacher complaints about odors in the classroom – especially when all students are using traditional dry erase markers at the same time – a green team conducted a test to compare alternatives with traditional markers.

Gatewood received a small grant from King County to try out alternatives to the "low-odor" markers used by students in many classrooms. We identified three alternatives and trialed them in classroom(s):

Alternative	Trial
Auspen® markers: Very low odor, refillable, re-tippable	One 4 th grade classroom for 10 weeks; 30 minutes/day
Dry-erase crayons intended for white boards	Three K & 1 st grade classrooms for six weeks each Three additional classes for only a few days.
Paper	One 5 th grade classroom for 10 weeks. A few other teachers were already using paper and pencil rather than slates.

In addition, five other teachers were given an Auspen® for their own use when writing on white boards. The trial of these alternatives and comparison of costs and functionality was captured by survey results, informal smell testing, and discussions with teachers using the alternatives and those interested in the Auspen®.

Results of Pilot

Toxicity

The traditional markers that parents are purchasing for student use claim to be AP non-toxic and "low-odor." However, they still contain alcohol-based solvents, (in lieu of aromatic solvents such as xylene), and definitely generate a noticeable and irritating odor when 20+ students are using markers at one time in a confined classroom. In addition, if these pens are not capped tightly, they can continue to offgas slightly in the classroom.

Labeling of art supplies is regulated by the US Consumer Product Safety Commission under two statutes: 1) Federal Hazardous Substances Act (FHSA), and 2) the Labeling of Hazardous Art Materials Act (LHAMA). Neither of these laws requires manufacturers to disclose what is in their products.

The definitions of AP Non-Toxic and Low Odor are as follows:

"AP Non-Toxic" means that university toxicologists under contract with the [Art & Creative Materials Institute \(ACMI\)](#) have conducted safety testing of the product and certified the product does not contain toxic or injurious materials in sufficient quantity to harm children or adults. The ACMI methodology of testing is not readily available for review, however, so the accuracy and quality of the testing is a bit of an unknown.

"Low-Odor," "Low-VOC," or "No-Odor" means that the product is either water-based or made with alcohol rather than aromatic solvents such as xylene or toluene.

Sources: [City of Seattle, Toxic Solvents in Office Products, 2008](#)
And, communication with [Washington Department of Ecology Toxics Free Tips](#)

The above document from the City of Seattle recommends several dry-erase marker brands: Low Odor Expo, Foray Dry Erase, and Bic Great Erase, because they are labeled "low-odor" and "AP Non-Toxic." From experience at Gatewood however, the Expo "low-odor" markers are still noticeably stinky when used by a classroom full of students.

In reviewing disclosed ingredients from the available material safety data sheets (MSDS) for these low-odor markers, and the Auspen® are listed below.

Marker	Label Claims	Listed Ingredients	Link to MSDS or Product Info
Foray	Odorless	Unknown	http://www.officedepot.com/a/products/224285/Foray-Dry-Erase-Marker-Kit-4/ (cannot locate MSDS)
Expo Low Odor	AP Non-Toxic	***contains ethanol, isopropyl alcohol, butanol, pigments, resins, release agents, and additives"	http://www.discountofficeitems.com/pub/manu_folders/SAN/ExpoLowOdorMarkers.pdf
Bic Great Erase	AP Non-Toxic	Propan-1-ol (<80%) Ethanol (<80%)	http://www.officeworld.com/msds/BICDEC11GN.pdf
Auspen®	doesn't smell	2-Propanol (10-15%) Ethanol (<80%)	Available upon request from http://auspenmarkers.com/

**No weight percentage or further description of other ingredients are provided.

They contain alcohol-based solvents and the Expo also contains butane. The properties of these solvents in the low odor markers are similar. They are all volatile hydrocarbons, made up of carbon, hydrogen and oxygen. The good news is that these compounds are safer than xylene, still used in some dry erase markers, but they are still not toxin-free. For example, isopropanol is metabolized in the liver into acetone.

With the limited data available for these markers, it is difficult to state that one is less toxic than another. From actual use situation, however, all participants claimed there was no olfactory-detected odor or attributable health symptoms while using the Auspen®, while previous use of the Expo marker had noticeable odor, caused some reported irritation, and in one case, is believed to be the cause of daily headaches in a sensitive individual.

Comments on Traditional “Low-Odor” Markers:

All teachers surveyed had issues with the traditional markers, both from an odor and waste perspective. Some can and do open windows during use to improve ventilation. Some report stopping a lesson due to the overpowering smell. One teacher perceives that the green “low odor” markers are especially smelly and requests parents not purchase green markers for use at school.

Collectively, a school of about 400 students, with about 75 percent of them using slates and markers at least twice per week, results in an estimated 1,900 dried-up markers during the course of a school year. Assuming an average price of about \$1.25 per pen, since these are not purchased in volume, this is a collective cost to the student families (and in some cases the teachers themselves) of around \$2,375 per school year.

There is a phenomena called [olfactory fatigue](#), whereby a person, after some level of continuous exposure, can become desensitized to an odor or aroma over time. While this was not studied, it was found that students and teachers in the classrooms seem much less aware of the odor than someone entering the classroom when all the markers are in use.

Comments on Functionality and Odor Reduction of the Alternatives

Crayons: Several teachers tried out the crayons, and all but one found them functionally unusable for their classroom. One teacher will continue to use because of the reduced odor and because it is hard for the students to wipe off, they have drastically reduced doodling and are paying attention.

Reported complications that made them unusable for their classrooms were:

- usage results in too much wax residue on the slates, on slate and crayon storage containers, on the erasing device, and on the classroom floor (especially problematic when ground into the carpet);
- crayon writing on slates is too hard for younger students to clean
- the crayons break easily
- yellow and orange are hard for the teacher and students to see
- potential 'fighting' over who gets what color
- replacement of towels for erasing is more frequent than traditional markers

All teachers reported that they liked the feature that the crayons were odor-free.

Paper: One 5th grade teacher agreed to switch from slates and markers to paper journals. In the future, she may continue to use this option, and the school will look into recycled content paper for this use. This teacher was experiencing serious headaches about once per week. She perceived that this may have been attributed to inhalation of the airborne solvent from the markers, as the headaches would occur about three days per week, and after the session with the traditional markers. This teacher has not had this same type of headache since switching to paper.

Auspen®: One 4th grade teacher trialed the Auspens for the full six-week period and continues to use them. Several teachers were provided with one or two for their own use when writing lessons on the wall board. And, after the six-week trial, the school provided two more classrooms with markers. All have glowing reports on how well they write and almost no detectable odor. Several teachers reported fewer odor complaints from students, but have only anecdotally surmised that headaches or coughing (or other respiratory conditions) were reduced as a result of switching from traditional dry erase markers to Auspen®.

An additional bonus is the teachers feel better about avoiding disposal of the traditional markers that tended to dry up quickly. If an Auspen® tip (or nib) dries out because the cap was not placed tightly enough, the nib is easily re-inked.

In using these with students, the teachers have stressed how important it is to make sure students understand that these markers are expensive and as such, need to be treated with care, kept in special containers and capped tightly after use. They are not to be used for doodling on the slates and the students cannot be tapping the nibs on the slates (the equivalent of making dots on the slate), or pressing too hard - because that reduces the lifespan of the nib.

The refill and nib replacement instructions for the Auspen® can be found [here](#). Re-inking takes about one minute per marker. Refilling the ink appears to be necessary about once per month in a classroom that uses the markers for about 20-30 minutes daily. Frequency of replacing nibs is somewhat dependent on how the student uses the marker but appears to be necessary about every six weeks (on average). Replacing the nib along with refilling the ink requires about 90 seconds, but re-inking is usually done at the same time. For a class of 27 students, it is estimated that refilling and re-nibbing require one to two hours of volunteer time per month. It is recommended that an adult perform this task.

The ongoing maintenance of the Auspen® markers seems to be the only issue with this alternative, and users need to understand that this will require some additional time compared to the other alternatives.

Cost Comparison

The following cost estimations are based on a classroom headcount of 27 students.

Based on this trial, it is believed that Auspen® markers would last an entire school year, with refilling and re-nibbing about once per month. *(Note: We will assess the pen's functionality after about one year's use to see if this expectation holds true).*

While the Auspen® is more expensive than others on the market, a class of 27 students can be supplied with Auspens and ink refill and nib replacements for about \$225 to \$300 for the year including shipping (Auspen® products are only available from one US distributor and must be purchased online).

Assuming that the traditional markers are not purchased in bulk, the cost of the traditional markers are \$1.25 each, and that they need to be replaced at a rate of 2 per week per classroom. The initial purchase of 27 markers, and the ongoing supply for the year, is estimated about about \$169 *(Costs to dispose of these, any packaging waste are not included in this value, nor are any other potential costs that might be associated with any health impacts of the higher-odor markers).*

The crayons are fairly inexpensive at a ~\$4.50 dollars per box of eight crayons (including shipping). Based on the six-week trial, it is assumed (1) that the crayons would require replacement about every two months, (2) that only seven of the crayons in each box are usable (discard yellow), and (3) parents would supply old towels that can be cut up and used for cleaning - to replace heavily waxed wipes. This brings the annual cost of crayons to \$90.

The cost of using paper and pencils and erasers is estimated at \$255 per year, based on 2 sheets per student per day, and replacement pencils and erasers.

In summary, the estimated costs for the different choices for one year are as follows:

Choice:	Estimated Annual Cost for Class Size of 27
Traditional dry erase	\$169
Auspen®	~\$250*
Crayons	\$90
Paper & pencil	\$255

**Variable based on the amount of ink used and number of nib replacements.*

Conclusions

The use of paper, Auspen® markers, or white board crayons, in lieu of students using dry-erase markers and personal slates, greatly decreases or completely eliminates odors from solvents in the inks of the low odor markers. It is important for young students as well as teachers to reduce exposure to solvents and toxics, especially in classroom settings where mental focus is important and additional ventilation to reduce the exposure to the solvents may not be possible.

This pilot project demonstrated that these alternatives are also viable from a functional standpoint, comparative in cost, and that they can greatly reduce the waste stream of dried up markers.

While the Auspen® markers cost more and require a bit of time to refill, they last longer, and are better for everyone's health. Gatewood Elementary hopes to apply for grants to supply more classrooms with these markers for upcoming school years.

For those hoping to eliminate the traditional dry-erase markers, it is up to an individual class and teaching style, and in some cases, financial or purchasing flexibility - as to which alternative might best suit a given situation.