# Reading, Writing, and Breathing

## *Schools, Air Toxics, and Environmental Justice in California*


Manuel Pastor, Jr.
*Center for Justice, Tolerance, & Community*
*University of California, Santa Cruz*

James Sadd
*Environmental Science*
*Occidental College*

Rachel Morello-Frosch
*Department of Community Health.*
*School of Medicine &*
*Center for Environmental Studies*
*Brown University*


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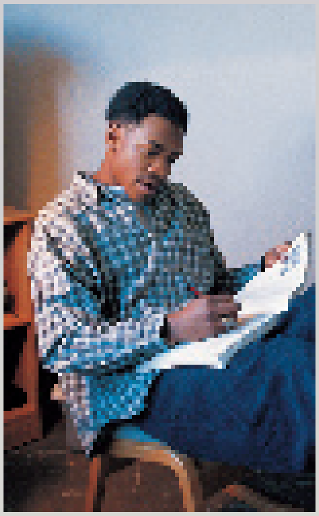
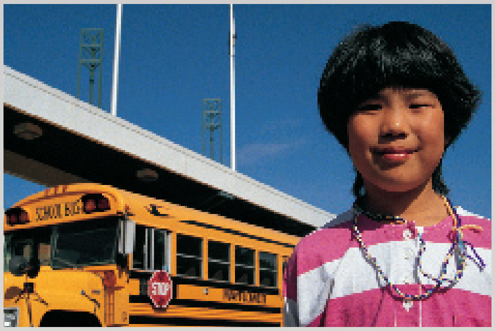




Center for Justice, Tolerance & Community
University of California Santa Cruz

# Acknowledgements

Reports are often long in the making. This one has taken longer than most, partly because of the complexities of assembling the data and undertaking the analysis, but also because the field of environmental justice has expanded rapidly in the last several years. With state leaders promoting new legislation and regulations to insure that all our residents share in both the natural bounty and industrial burdens of California, we have found ourselves busy responding to research requests from communities, policy makers, and others. It's been a distraction welcomed in the name of justice – and so we thank most of all those community advocates who have helped politicians, policy makers, and business and civic leaders understand the imperatives of environmental equity.

This report is funded by a grant from The California Wellness Foundation (TCWF). Created in 1992 as an independent, private foundation, TCWF's mission is to improve the health of the people of California by making grants for health promotion, wellness education and disease prevention programs. We thank the Foundation for its support, with special appreciation to Program Director Fatima Angeles for her guidance on this project. Able research assistance was provided by Justin Scoggins of the Center for Justice, Tolerance and Community at UC Santa Cruz as well as by Marium Lange, Breana George, and Julie Jacobs, also of the Center. For helping to nurture this project in its infancy with comments, insights, and other support, we thank Carlos Porras, former director of Communities for a Better Environment (CBE) as well as Yuki Kidokoro, Bahram Fazeli, and A.J. Napolis of CBE and Michele Prichard of the Liberty Hill Foundation. For help with outreach to key community leaders and the design and convening of workshops to secure early feedback, we thank Martha Matsuoka of UCLA's Urban Planning Program. We also offer special thanks to Mildred Thompson of PolicyLink, Martha Dina Arguello of Physicians for Social Responsibility, Derek Shendell of Community Action to Fight Asthma, Romel Pascual of U.S. EPA Region 9, and Joe Lyou of the California Environmental Rights Alliance for insightful and provocative comments at various points in our research process.

As we were completing the basic research that informs this brief, we conducted two workshops to present the results, one at Occidental College in Los Angeles and another at PolicyLink in Oakland. Both were attended by a diverse and inspiring array of children's health advocates, public health researchers, and environmental justice activists. We thank the attendees for their feedback on these early presentations and trust that they will find this research useful as they continue their good work on behalf of all of California's children.

Finally, we thank our own children for tolerating our absences while we drew maps, calculated toxicities, and ran regressions. Camilo, Joaquín, Anna Eliza, Jamie, and Marie, this one's for you.

Manuel Pastor

James Sadd

Rachel Morello-Frosch

# Abstract

With recent research showing that children are more susceptible to adverse environmental conditions, parents, educators, and policy makers have begun paying increasing attention to environmental conditions in California's schools. Advocates for environmental and educational justice have brought a special lens to the problem, suggesting that lower-income students and students of color often face particularly acute problems of school environmental quality.

This report examines one measure of environmental quality, the level of respiratory hazard associated with estimated outdoor air toxics near school sites. We find that there are indeed differences, with children of color and poorer children seeming to face higher respiratory hazards. Aside from potential health concerns, there is also evidence suggesting a relationship between our respiratory hazard measure and school-level academic performance, even after accounting for many of the other factors that often explain such performance.

We argue for a nuanced interpretation of the results, noting that the overcrowding in California's urban schools and an emerging strategy of more compact residential and commercial development in the state means that school construction will need to occur in many areas where environmental quality is an issue. In seeking to balance educational and environmental imperatives, we highlight many of the existing efforts of state and local actors and argue for several new policy directions. These include better data collection, faster progress on clean school buses, continuing attention to indoor air quality, a focus on remediation as well as the screening of new sites, enhanced health services at schools, a comprehensive approach to school environmental quality, and stepped-up efforts at source reduction. We close by calling for new alliances and collaborations across agencies and communities to ensure high-performing and healthy schools for all of California's children.



*Mothers line up their children at the gate into the schoolyard at Park Ave. Elementary School in Cudahy, a poor industrial city southeast of Los Angeles. The school was closed for a year when toxic waste seeped up through cracks in the pavement in the schoolyard.*

# Introduction

In recent years, parents, educators and others have become increasingly focused on the environmental conditions at schools in California. Concerns have run the gamut, with some pointing to mold in school buildings and its possible impacts on asthma, others worrying about the health impacts of pesticides used in nearby agricultural fields or in the maintenance of school yards, and still others focused on the respiratory risks posed by the proximity of schools to freeways and busy roads, and by exposure to diesel emissions from school buses.

State and national policy makers have tried to respond to these various concerns through policies and regulations that address environmental hazards inside and outside the school fence line. For example, the U.S. Environmental Protection Agency has provided information and guidelines on mold remediation in schools and the construction of certain California schools has been slowed while identified mold issues were addressed. In 2000, the state passed a Healthy Schools Act that encouraged the voluntary adoption by school districts of Integrated Pest Management (IPM) strategies to inform parents and reduce pesticide use on-site. In 2003, the state also passed legislation mandating that no new schools be constructed in areas within 500 feet of freeways and busy roads, and new regulations passed in 2003 have sought to limit idling by school buses and commercial vehicles near school facilities.

While the focus on school siting, facility remediation, and school bus emissions has generally been on the health impacts for all children, important issues have emerged with regard to both the environmental justice dimensions of children's exposure and the potential impact of environmental quality on academic performance. The environmental justice dimension is straightforward: a broad range of studies suggest that the state's minority residents face higher levels of pollution and environmental hazard exposure. As a result, mandates beginning with landmark legislation passed in 1999 have required California to consider environmental inequities in all aspects of environmental decision-making. There is little reason to suspect that the young are spared from the established pattern of environmental inequality. In fact, research on the proximity of schools to busy roads, which helped to prompt the 2003 legislation, indicates that there are significantly higher levels of traffic exposure for Latino and African American school children.

School performance has likewise taken center stage in public thinking and policy, particularly as the state has required districts and schools to provide academic performance data under the Public Schools Accountability Act of 1999 and to show steady improvement under the federal No Child Left Behind Act of 2001. While lagging school performance is explained by many factors, including differences in household income and educational resources, varied levels of teacher preparation and district management, and the challenges immigrant children often face in learning English, there is also concern that poor environmental conditions may be one important area for improvement. This was the thrust behind the recently settled *Williams v. the State of California*, a lawsuit in which attorneys representing over one million low-income California schoolchildren argued that the failure of state agencies to provide adequate supplies of books, and safe and decent school facilities, was standing in the way of academic achievement.

This research brief seeks to make a modest contribution to the discussion about schools, students, and environmental justice.[1] In it, we review research that considers differential exposure by race and income to certain air pollutants, known as air toxics, and the relationship between these estimated respiratory hazards and academic achievement.[2] We find significant disparities in terms of which groups of children bear the highest risk burden, and we also find evidence of a relationship between respiratory hazards and the school level performance reported under California's Public Schools Accountability Act. We suggest that this offers parents, policy makers, and educators yet another reason to be concerned about environmental quality at our state's schools, and we conclude with directions for future research and policy.

## Children, Air Quality, and Schools

While policy on environmental exposures has sometimes treated children as simply little adults, there is now increasing evidence that children may have special vulnerabilities to environmental toxics and air quality. The effects can start early: a pioneering study from researchers at UC Berkeley and MIT suggests that variations in air pollution may be associated with statistically significant changes in infant mortality, especially in the first month of life. The effects can also be lasting: a landmark Children's Health Study from the University of Southern California examined 1800 children over eight years in a dozen Southern California communities and found that air pollution can have chronic adverse impacts on lung function and development, as well as trigger asthma symptoms and the onset of asthma itself.

Researchers have also suggested that exposures occur both at home and in the larger environment, including the school facilities where children spend much of their day: a study conducted by California's Environmental Protection Agency and Department of Health Services considered more than 1,000 children in the Bay Area and found that living and going to school near busy roads was correlated with exacerbation of asthma and chronic bronchitis. A recent study of indoor air quality (IAQ) in California's portable classrooms found numerous problems and suggested a potential association between IAQ, asthma, and school absenteeism.

Previous work on children's health and air quality has focused on particulates, ozone, and other criteria air pollutants. This is an important arena for action, particularly given consistent associations found between exposures and adverse health outcomes in children and adults. In this report, however, we focus on another category of air pollutant, known as air toxics. These pollutants are chemicals which tend to concentrate at lower levels than criteria air pollutants but can cause adverse human health effects, such as respiratory problems, cancer and reproductive issues. Congress has identified 188 of these pollutants under the 1990 Clean Air Act Amendments. Air toxics are emitted from mobile sources such as cars and trucks, and stationary sources such as small and large industrial facilities, dry cleaners, gas stations and other facilities.

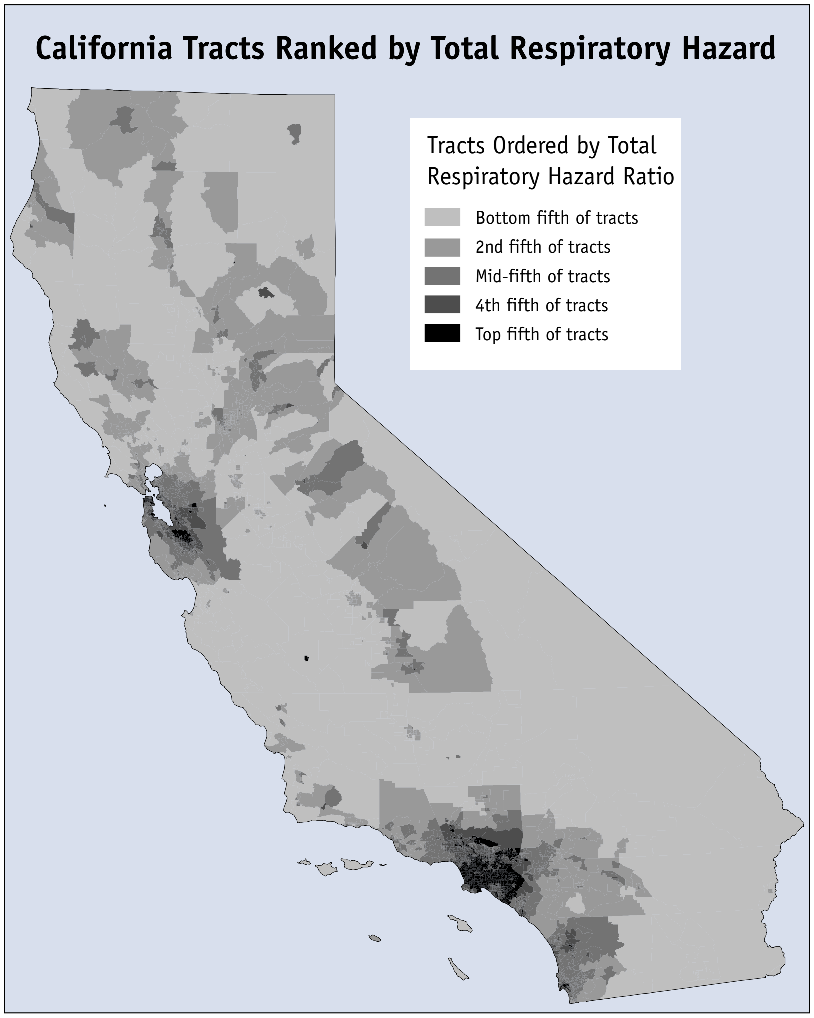



**Figure 1**

inequalities, particularly when comprehensive health outcome data is not available. A map of the resulting air toxics respiratory "riskscape" for the entire state is depicted in Figure 1.[3]

The advantage of using modeled air toxics data is that it gives us concentration estimates for every census tract in California that hosts a school. While criteria pollutants are measured through a statewide monitoring network, these air monitors are often located far apart from each other and certain locations have no monitoring information. This can leave us guessing about the variations in pollutant levels that can be associated with each school site. Also, while criteria air pollutants tend to be ubiquitous and spread out across a region, air toxics tend to concentrate and create "hotspots" in certain locations, helping to highlight patterns of unequal exposure.

On the other hand, by focusing on air toxics, our research emphasizes an environmental issue that is particularly acute for urban areas in the state. For example, while San Francisco, Los Angeles, Orange, Santa Clara, Alameda, and San Mateo Counties are among the top six when California's counties are ranked by our respiratory hazard ratio, the top six counties when ranked by days exceeding the National Ambient Air Quality Standards (NAAQS) for criteria air pollutants are Los Angeles, San Bernardino, Riverside, Kern, Fresno, and Tulare Counties, with the latter five counties located in the less urbanized Inland Empire and San Joaquin Valley. Therefore, although the large data surface associated with the air toxics data makes a

We examine air toxics by using the U.S. Environmental Protection Agency's National Air Toxics Assessment (NATA) data for 1996. The NATA estimates outdoor concentrations for diesel particulates and 32 air toxics, utilizing various pollution inventories and combining these with an air dispersion model. Air toxics concentration estimates from both mobile and stationary emission sources are then assigned to local neighborhoods. We combined toxicity data with these outdoor air toxics exposure estimates to generate estimates of the total respiratory hazard ratio for each neighborhood (or census tract) in California. While there is healthy public skepticism about the utility of this sort of risk-based approach, it can serve as a useful tool to assess the potential health implications of environmental large-scale geographic equity analysis possible, it implicitly lends a particular urban bias to our approach. To address this issue, we examine environmental equity patterns statewide as well as within urban counties, air basins and school districts.

Our estimates of respiratory hazards associated with ambient air toxics were coupled with school information on demographics and academic scores. To do this, we first geocoded all schools in the state and then focused on a subset for which we had both full demographic information and an Academic Performance Index (API) based on the Spring 2000 administration of the Stanford 9 achievement tests. The year 2000 was chosen because it was close to the 1996 NATA observations but it was also the second year the school-level data was collected and so many of the controversies that emerged in the inaugural 1999 API had been resolved.

A first pass at the pattern by race and income is shown in Table 1 in which we break California's schools into the half with the highest respiratory hazard ratio (as calculated from the NATA data) and the half with the lowest respiratory hazard ratio. As can be seen, respiratory hazards are not distributed equally: the schools in areas with a higher respiratory ratio contain a substantially higher percent of Latino, African American, and Asian Pacific Islander students and a slightly higher percentage of students qualifying for the free or reduced price school lunch program. Since this could reflect the urban bias of our data, we also tried confining our attention to schools in locations that the U.S. Census Bureau designates as "urban," a category that includes suburbs but excludes rural areas. Racial disparities between areas of higher and lower respiratory hazards are only slightly less in this urban geography while income disparity (as measured by the proportion of students participating in the school lunch program) rises sharply. Interestingly, the race and income disparities shown at the state level are even larger if we look just at point sources; this suggests that while on average mobile sources are a major contributor to existing patterns, community concerns about disparity in stationary source emissions, especially "hot spots," may be well-placed.

Of course, part of the reason for the overall pattern for both mo-

**Table 1**

Schools Ranked by Respiratory Hazard Ratio, California

| | % white | % Latino | % Black | % Asian Pacific | % Other | % free or reduced lunch |
|---|---|---|---|---|---|---|
| Below Median | 48.1 | 34.2 | 7.3 | 7.9 | 2.6 | 43.2 |
| Above Median | 29.7 | 45.4 | 9.0 | 14.3 | 1.6 | 48.8 |

California's Non-Rural Schools Ranked by Respiratory Hazard Ratio

| | % white | % Latino | % Black | % Asian Pacific | % Other | % free or reduced lunch |
|---|---|---|---|---|---|---|
| Below Median | 45.2 | 34.4 | 8.7 | 9.7 | 2.1 | 42.3 |
| Above Median | 25.1 | 49.1 | 9.2 | 15.1 | 1.5 | 52.4 |

**Table 2**

Schools Ranked Within County Sets for Counties Where Respiratory Hazard Ratio Exceeds Ten

| | % white | % Latino | % Black | % Asian Pacific | % Other | % free or reduced lunch |
|---|---|---|---|---|---|---|
| ALAMEDA | | | | | | |
| Below Median | 35.4 | 16.7 | 23.1 | 21.2 | 3.6 | 28.2 |
| Above Median | 31.5 | 24.3 | 16.2 | 24.8 | 3.1 | 34.4 |
| LOS ANGELES | | | | | | |
| Below Median | 27.2 | 50.6 | 9.1 | 11.9 | 1.1 | 54.1 |
| Above Median | 13.2 | 62.1 | 13.2 | 10.4 | 1.1 | 67.7 |
| ORANGE | | | | | | |
| Below Median | 49.2 | 32.3 | 1.8 | 15.7 | 1.1 | 32.7 |
| Above Median | 37.5 | 46.3 | 2.1 | 13.1 | 0.9 | 41.7 |
| SAN FRANCISCO/SAN MATEO | | | | | | |
| Below Median | 41.8 | 24.8 | 4.6 | 25.5 | 3.3 | 20.1 |
| Above Median | 14.9 | 25.1 | 14.3 | 36.1 | 9.6 | 46.4 |
| SANTA CLARA | | | | | | |
| Below Median | 46.6 | 23.8 | 3.1 | 24.4 | 2.1 | 18.2 |
| Above Median | 23.2 | 38.8 | 4.3 | 32.5 | 1.2 | 37.4 |

bile and stationary sources is simply that the respiratory hazards measured by the NATA are higher in certain areas, particularly in the six counties mentioned above (Alameda, Los Angeles, Orange, San Francisco, San Mateo, and Santa Clara Counties). These counties certainly stand out in the state: they exhibit a cumulative hazard ratio at least ten times greater than the benchmark level for potentially adverse respiratory effects (where the benchmark levels are equivalent to concentrations at which long-term exposure is not anticipated to result in any adverse effects). To see whether the racial and income inequalities simply reflect differences between these counties and the rest of the state or perhaps something more, we then examined demographic and other differences within those counties with high respiratory hazard ratios.

To do this, we once again sorted all schools by their associated respiratory hazard ratio, this time ranking each school within its respective county location. However, we collapsed the contiguous counties of San Francisco and San Mateo Counties into one area in order to be parallel to the other counties, each of which has a central city and some surrounding suburbs; this also raises the number of schools in that combined county set to be closer to the number of schools in the other counties under consideration. As can be seen in Table 2, for each of the areas considered, those schools facing relatively higher respiratory hazard ratios have a higher percentage of minority and poor students. Environmental justice concerns about unequal exposures, at least to the sort of respiratory hazard we are measuring, would seem to have some justification.

## Air Quality and Academic Performance

What is the impact of such exposure on health and academic performance? The best way to investigate this would be a detailed epidemiological approach such as that taken in the aforementioned Children's Health Study conducted by USC researchers. This would include, for example, a focus on individual student achievement and the tracking of children over time. Because such research is very resource intensive, it is often limited in its geographic scope and undertaken only after preliminary statistical analysis indicates an association worth investigating. Our ecological approach enables us to conduct such a preliminary analysis. We specifically sought to assess the potential association between our estimates of air toxics related respiratory hazard ratio and summary measures of academic performance at the school level.

Along the way, we also considered the relationship between the respiratory hazard ratio and reported cases of hospitalizations due to asthma. The asthma exercise was conducted largely to investigate one plausible link between the respiratory hazard measure and school outcomes. While there is some research demonstrating that indoor air quality influences concentration and learning, it seems intuitive that a higher incidence of asthma might also affect school attendance and scores. For that reason, assessing the potential association between our riskscape and asthma hospitalizations seemed like a worthwhile preliminary step in our analysis.

Utilizing data made available to us by researchers at Community Action to Fight Asthma (CAFA), we examined age-adjusted asthma hospitalization rates by zip code for Los Angeles County, portions of the Bay Area, the San Joaquin Valley, and San Diego and Imperial Counties for the years 1998-2000. Reshaping our underlying NATA data to fit the zip code geography, we found a significant correlation between our respiratory hazard measure and the incidence of hospitalization. Of course, hospitalization is an extreme on a continuum of care, one often dictated by a lack of financial and healthcare resources to obtain better asthma management. To control for this, we utilized a set of statistical techniques to control for a community's level of income (which could affect the ability to obtain health care), the value of housing (which could proxy the quality of the housing stock, a factor often associated with asthma), population density (which affects crowding and activity), and race (since there seem to be some ethnic difference in asthma incidence, even after accounting for socio-economic factors). Controlling for all these different influences, the respiratory hazard ratio was still associated with asthma hospitalization in a statistically significant way.

We then sought to examine the relationship between the respiratory hazard ratio and academic performance. Our first cut on the issue paralleled the approach taken above: we looked within the counties with the higher respiratory hazard ratios (Alameda, Los Angeles, Orange, San Francisco/San Mateo, and Santa Clara) to see if there were differences between schools with respiratory hazard ratios above and below the median for their respective county sets. While the pattern is as expected – higher scores dominate in the areas with a lower hazard ratio – there are two problems with these results. The first has to do with potential confounding factors: the areas with the highest respiratory hazards also have more low-income and minority children, and this may be independently impacting scores, a methodological challenge we take up below. The second has to do with scale: many observers believe that school district leadership and management can have a significant impact on school performance, and much of the educational literature either looks at schools within districts or introduces district controls to account for these effects.

For that reason, we decided to look at the ten largest school districts in California and compare the scores for those schools above and below the median respiratory hazard ratio for the district in question. To make matters simple, we focus here on the state-assigned school rank. The school rank is a number ranging from 1 to 10 based on how the school's Academic Performance Index (API) compares to those in the rest of the state. Weighting the rank by school population, we then compared the averages for schools above and below the district hazard median. A "negative" number in this gap measure indicates that state ranks were lower in the areas of the district with a higher respiratory hazard ratio. The results, given in Figure 2, are striking: nine out of the ten districts (with San Francisco Unified the exception) show a markedly lower state rank for those schools facing higher respiratory hazards.

What about the issue of confounding factors? The state also issues a "similar schools" rank. The similar schools rank is generated through a complicated process, one that first generates an index for schools based on certain socio-economic characteristics, such as pupil mobility, ethnicity, socioeconomic status, and English learner status, as well as percentage of teachers with full or emergency credential, average class size, and whether the school operates multitrack year-round educational programs. The school is then placed in the middle of a distribution of the one hundred schools in the state with the most similar socioeconomic characteristics, and given a score for the decile ranking of

**Figure 2**

Gaps in School Ranks for Ten Largest Districts, with Two Groups Set by Whether Respiratory Hazard Ratio is Above or Below Median for District

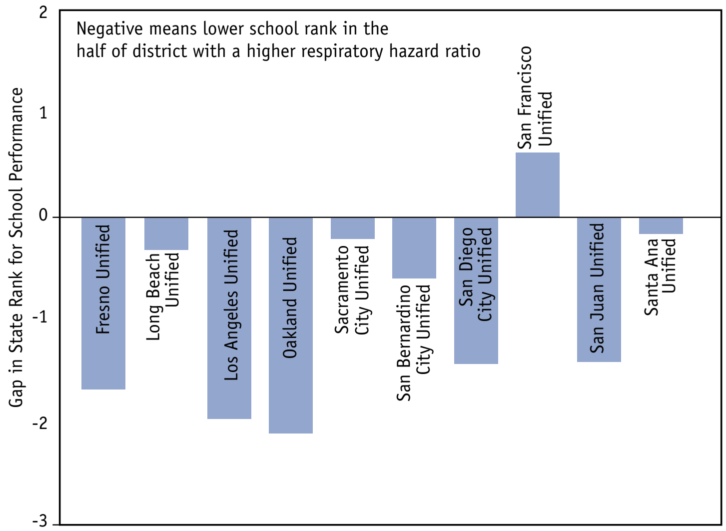
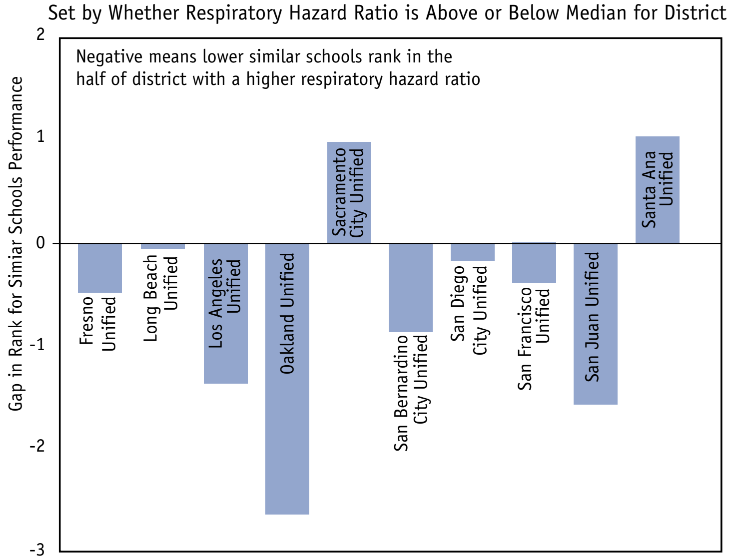



**Figure 3**

Gaps in Similar Schools Ranks for Ten Largest Districts, with Two Groups Set by Whether Respiratory Hazard Ratio is Above or Below Median for District




its Academic Performance Index within this group of one hundred.

This similar schools rank measure has a number of problems: schools are being compared statewide rather than to schools in the same district, county, or air basin, the comparison group is relatively small, and the nature of the characteristics index, including the relative weights for each factor, is not made explicit by the state. Nevertheless, it is illustrative and so we show the "gap" in the similar schools rankings for the ten largest districts in Figure 3; as can be seen, eight of the ten show a negative gap (schools in the areas with the higher respiratory hazard ratio have lower similar schools rank) and San Francisco Unified now follows the general pattern with a negative gap evidenced for those schools in the areas with a higher respiratory hazard ratio.

Of course, the best approach to untangling potential confounding is to control for socioeconomic characteristics directly, as well as to control for district-level effects. This sort of strategy is called a regression analysis: several variables are examined simultaneously to see which are major explanatory factors for an outcome of interest, such as school academic performance. This technique also helps gauge the relative importance of any one variable, including whether that variable is so overwhelmed by other factors that an apparent correlation is just that: apparent. Disentangling the relative importance of different explanatory variables is exactly what we do here, assessing whether the respiratory hazard ratio still matters for school performance, even after we take into account other factors normally associated with academic achievement.

What are the usual factors considered in explanations of educational outcomes? They include the percent of students receiving free school lunches (a proxy for student poverty and household resources), the percent of teachers with emergency credentials (a proxy for teaching quality), the percent of students just learning English (important since the tests are administered in English), student mobility (since continual turnover in a school could produce lower performance), school size (since smaller schools often

**Los Angeles Unified School District, Schools by 2000 API Score and Tracts by Respiratory Hazard**

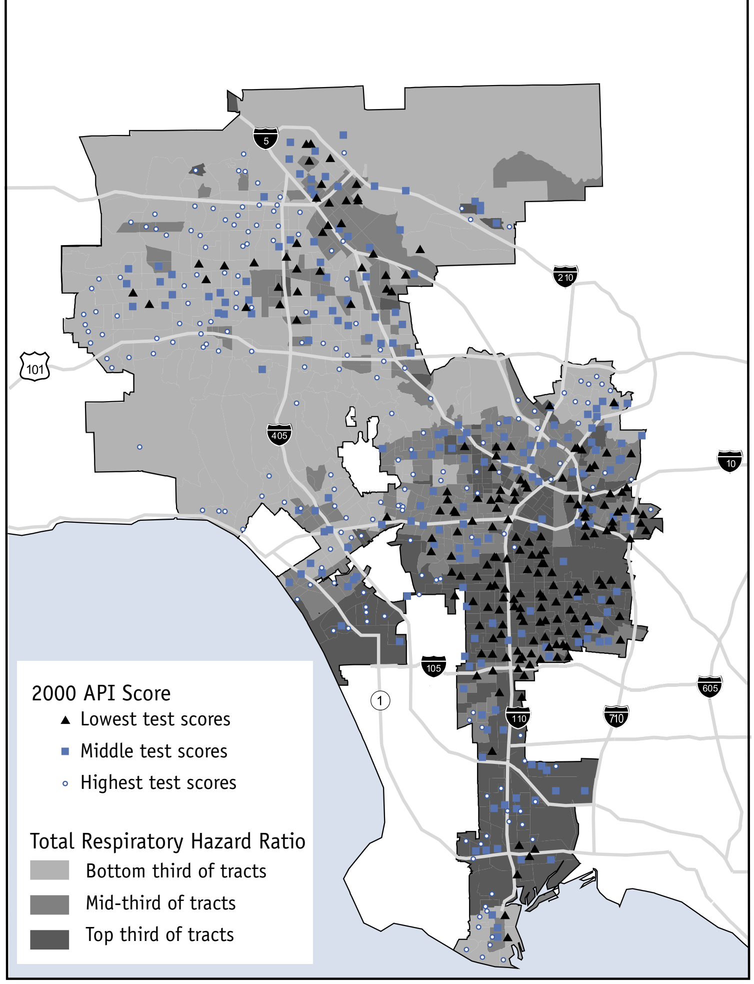



**Figure 4**

generate better results), and parents' educational background (measured by the percent of parents lacking a high school diploma). Many studies also introduce measures for the percent Latino, African American, and Asian Pacific students in the school, on the grounds that this will pick up some unexplained demographic differences in performance.

A key issue, of course, is the level at which we should test for school-level education outcomes. Because districts matter, it would make sense to test at the district level or to at least introduce controls to allow districts to have their own background performance levels apart from the demographic factors described above. Since this study is about air quality, it might also make sense to control for location in any particular air basins since this may set the background level of respiratory hazards. We take two approaches to this issue. First, we eliminate the control problems altogether by concentrating on the Los Angeles Unified School District, the state's largest district (accounting for around twelve percent of all the state's students) and one that is conveniently included entirely within one air basin. Second, we adopt a statistical strategy that allows us to control for both air basin location and district, allowing each to generate their own background contribution to scores and hazard levels.

Figure 4 depicts the visual pattern for the Los Angeles Unified School District (LAUSD). As can be seen, there is an apparent correlation between the areas with the highest respiratory hazards and the schools that rank at the bottom of test scores for the district. This pattern is also present when we include all the various explanatory variables discussed above in a more formal regression analysis. Table 3 presents these results, with the first column offering up a baseline model in which we include all reasonable variables aside from race and respiratory hazard, and the second and third columns introducing the respiratory hazard ratio and then the racial composition of the student body. To simplify the presentation, we only indicate the direction of effect and whether the effect is considered to be statistically significant; as can be seen, all variables achieve a reasonable level of statistical significance. Moreover, the negative impact of the respiratory hazard ratio on school scores remains statistically significant even when we control for the school's racial composition, a factor which, as our earlier analysis showed, is itself highly correlated with respiratory hazards.

**Table 3**

Academic Performance Index as a Function of School Variables and Respiratory Hazard Ratio

(Los Angeles Unified School District)

| Variables | Base regression<br>sign | Regression with respiratory hazard ratio<br>sign | Regression with respriatory hazard ratio, and race variables<br>sign |
|---|---|---|---|
| students on free lunch | (-)* | (-)* | (-)* |
| students learning English | (-)* | (-)* | (-)* |
| teachers w/ emergency credential | (-)* | (-)* | (-)* |
| student mobility | (-)* | (-)* | (-)* |
| school size | (-)* | (-)* | (-)* |
| parents w/o high school degree | (-)* | (-)* | (-)* |
| percent Latino | | | (-)* |
| percent African American | | | (-)* |
| percent Asian Pacific | | | (+)* |
| respiratory hazard ratio | | (-)* | (-)* |
| explanatory power | 0.702 | 0.733 | 0.828 |
| number of observations | 537 | 537 | 537 |

* significant at the .01 level

How well does the regression model fit? A standard measure of explanatory power rises when we introduce the respiratory hazard measure and the final model in the third column seems to explain about eighty percent of the cross-sectional variance in school scores. To explore the fit further, we calibrated the model with actual numbers, and performed a series of simulations in which we sequentially shifted the value of each variable from the 75th percentile of its distribution to its median (i.e., from being in the middle of the half of the schools with the highest percent English learners to being in the exact middle of the whole distribution). We then used impact estimates to obtain the predicted difference in academic outcomes.

Of course, there are many changes not likely to come about through school- or district-level policy: reducing students on free lunch, lowering student mobility, altering student racial demographics, reducing school size, and increasing parent education levels can all improve scores but the major influences on these variables are often well beyond the control of school administrators. On the other hand, the model suggests that moving from the 75th percentile to the median for percent English learners (which might be accomplished by more effective language transition programs) would yield a modest increase in test scores that is about twice what might come from the same relative improvement (from the 75th percentile to the median) in either the share of teachers with emergency credentials (which might be achieved through incentives for more qualified teachers and improved teaching training) or in the respiratory hazard ratio (perhaps through emissions source reduction, careful consideration of air quality when siting new schools, and other strategies discussed below).

As it turns out, changes in academic performance year-to-year are usually driven not so much by changes in the underlying variables as by gains in efficiency – schools figure out how to achieve better results with the same resources. Technically, the estimates offered here essentially describe how to shift ranks within the cross-section of schools in any particular year. Still, it seems that improving environmental quality could be considered as part of a broader strategy to promote academic success.

Does the pattern hold beyond this single large and important district? We ran variants of a similar model in which we examined all districts in the state with controls used for each individual district; we then pooled just the ten largest districts in the state (depicted earlier in Figures 2 and 3), again utilizing controls for district-level background effects; we then returned to all schools in the state, utilizing controls for location in particular air basins; and finally, we ran a model for the whole state in which we utilized controls for both district and air basin. The basic story is similar to that reported for the LAUSD although the model is less robust and the size of the effects is a bit smaller for all the variables. There also seems to be some evidence that the effects of the respiratory hazard ratio may be more pronounced in areas with higher hazard ratios than in areas with lower hazard ratios. This points to an avenue for future research.

## Directions for Policy

California's schools face many challenges. Overcrowding is widespread, particularly in our urban schools; funding shortfalls have left many proven programs gasping for resources; and excessive expectations and reporting requirements have sometimes made it difficult to celebrate the small but important gains that occur everyday in our state's classrooms, study halls, and playgrounds.

While environmental conditions are but one aspect of the overall package of school improvement, we hope that this research adds credence to those pressing to have environmental concerns included rather than left aside at the policy table. After all, addressing environmental challenges can sometimes be seen as yet one more barrier in the way of rapid school construction or one more drain on already tapped monies. Yet, as the plaintiffs argued in the *Williams* case – a case in which Governor Arnold Schwarzenegger recently directed state lawyers to negotiate an amicable settlement – environmental conditions are important, and it is low-income students of color, who already face other challenges to learning and achievement, that often confront the worst of these conditions.

Certainly, the research offered here squares with that picture: the respiratory hazard from air toxics seems to disproportionately impact minority and low-income students, and the impacts appear to include effects on health as well as school performance. What, however, is to be done?

It may be important first to stress what should not be done. It is tempting, for example, to conclude that new schools should only be built in pristine locations. But this could be a recipe for both failing to address the most urgent school space needs and encouraging further abandonment of our state's inner cities. Most of the state's critically overcrowded schools are, after all, in our major urban areas: for example, Los Angeles County, with about one-fifth of the state's school population, has more than sixty percent of the state's students in overcrowded facilities. A recent estimate from the Public Policy Institute of California makes clear the racial dimensions of the problem: while about five percent of the state's white students are in overcrowded facilities, one in four Latino and African American children are in such facilities.

The balance between meeting these needs and respecting environmental constraints was made clear by the recent conflict over the Belmont Learning Center, a high school complex in Los Angeles. Designed to relieve severe overcrowding in a largely Latino immigrant neighborhood, the new, state-of-the-art school was sited in a former oil field with active methane gas leaks and soil contaminated with carcinogenic compounds, a fact which came to public light halfway through the construction process. While the district initially halted construction in response to the environmental outcry, parents and community groups pressed for site remediation so that construction could eventually proceed and meet the pressing demands for neighborhood-accessible education. Building where the need is may require siting in areas with lower air quality and other environmental disamenities; the challenge is to balance the need for educational justice with the imperative of environmental justice.

A second important caveat involves recognizing that environmental factors at schools may be important but they are not necessarily the main driver of either health or educational outcomes. Addressing the challenges of asthma, for example, requires a multifaceted approach that targets indoor air quality in homes and schools, and a stronger commitment to providing health insurance and accessible care to all of California's children. Likewise, moving the needle on school achievement requires enhanced teacher training, more educational resources, expanded programs for English learners, and the full engagement of parents, educators, and community and business leaders. Our point here is simply that improving environmental conditions is one aspect of improving the well-being and realizing the educational aspirations of all the state's childr en.

Fortunately, community vigilance and state leadership has raised environmental awareness and various agencies at local and state levels have responded with promising practices. Community concern, for example, helped to ensure that the Los Angeles Unified School District put in place new policies, based on precautionary strategies, to minimize and regulate the use of pesticides on school property. Community advocacy has also raised the importance of land use and the siting of polluting industries near school sites such as the Suva Elementary School in Huntington Park and Tweedy Elementary School in South Gate. Legislative leaders have put in place state mandates such as Senate Bill 25 (Escutia, D-Huntington Park) passed in 1999 that required the state to study the unique impacts of air pollution on children's health throughout California.

The California Air Resources Board as well as the South Coast Air Quality Management District have taken steps to harness regulatory resources to address children's health. Collaboration between Cal/EPA, the Department of Health Services and an external advisory group consisting of representatives from business, public interest groups, academia, and local government has established the Environmental Protection Indicators for California (EPIC) project, an effort to develop and maintain a set of "environmental indicators" for the state. Cal/EPA has also recently adopted an Environmental Justice Action Plan that will include a set of four pilot projects, each focused on addressing issues of children's health. These recent efforts build on the Governor's Children's Environmental Health Initiative, a $9 million initiative for children's environmental health programs throughout Cal/EPA organizations.

While the forward motion of state policy raises the policy bar to meet children's environmental health needs, there are many remaining challenges involving jurisdictional authority, interagency cooperation, and certainly funding. Still, there are significant opportunities within existing policy frameworks. For example, through its pilot projects, Cal/EPA will explore the complex issues of cumulative impacts and precautionary approaches, and will help develop new tools for public participation and community capacity-building. The proposed Children's Environmental Risk Reduction Plan (ChERRP) Pilot Projects reflect themes in the Governor's Environmental Action Plan and a focus on environmental risk factors (including emissions/discharge, exposure, and health risk) that impact children's health. Efforts like these to explore application of practical strategies for reducing children's environmental risk will inform as well as advance school-based efforts to address children's health.

In order to build on this momentum, we suggest seven policy directions that combine interventions inside and outside the school fence line. While we emphasize statewide approaches, many of these suggestions build on promising efforts not just by state agencies but also by local school districts, air quality management authorities, and others. They are:

## 1 Improve Data on Air Quality

The databases used here capture only one limited aspect of the air quality issues facing children, and documenting the distribution of particulates, criteria air pollutants, and agricultural pesticides is critical to a full understanding of the problems communities may face. The California Air Resources Board (CARB) is committed to better and more complete modeling and has supported groundbreaking research on the effects of air pollution on children's health. Still, many experts believe that current emissions inventories are outdated and significant improvements could be made to enhance accuracy and address other shortcomings. CARB is also working with the Office of Environmental Health Hazard Assessment (OEHHA) to assess whether current state guidelines for criteria air pollutants and toxic air contaminants are sufficient, given the special susceptibility of infants and children, and certain standards have been tightened to reflect these assessments. Based on SB 702 (Escutia, 2001) and the recommendations of an Expert Working Group, the state has proposed an innovative multi-agency California Environmental Health Tracking Program which will establish new baselines for connecting environmental data with health end-points. Given the need, more rapid progress on this project, particularly on the sharing of existing data, would be welcome.

Researchers and agencies should also continue to contribute to the design of new and richer databases, particularly ones that include demographic data and reflect regional specificities with regard to key pollutants. Collection of data should also be shared across sectors to strengthen the links between regulatory, public health, and environmental agencies. California researchers will want to coordinate with national efforts to gauge the impact of environmental exposures, including the National Children's Study, an emerging initative to follow 100,000 children and their families from before birth to age 21. We would also suggest bolstering current California data benchmarks to consider cumulative exposures as well as to collect better information on the health status of students within districts and schools. This information could be of use to various stakeholders, including community advocates, policy-makers, and researchers.

## 2 Speed Progress on Clean School Buses

In our NATA data, diesel-related emissions are a major contributor to respiratory hazards. Numerous studies have pointed to the risks posed to students who ride in older school buses, and activists, community residents, and state policy makers are paying increasing attention to diesel reduction. New regulations already underway limit bus idling at school sites and the state has launched a program to replace older buses with lower-emissions vehicles. In Southern California, the South Coast Air Quality Management District has an aggressive program to replace and retrofit school buses, utilizing a combination of state, federal, and local funds. Increased funding for these initiatives could help, and they would likely have important consequences for environmental justice given the interaction between race, overcrowded schools, and busing out of the local neighborhood.

## 3 Enhance Indoor Air Quality at Schools

Indoor air quality is a complex subject. While it is affected to some degree by the penetration of pollution from the outdoor sources studied here, there are both unique dynamics and unique sources that help determine indoor air quality. The state has recognized the issue of indoor air quality in schools as well as in other facilities, and studies have been conducted on air quality in both permanent and portable classrooms. Evidence suggests that the portable classrooms often placed in overcrowded facilities suffer from lower air quality than permanent facilities, offering another reason why building new facilities in our urban areas is important. The Collaborative for High Performance Schools provides guidelines for energy-efficient and healthy schools, including specific recommendations for HVAC (heating, ventilation, and air condition) systems that can improve indoor air quality. Particularly important is insuring quiet operation of HVAC systems; a recent California study of portable classrooms found that many teachers shut down their HVAC systems because noise levels made it difficult for teaching and learning.

## 4 Focus on Remediation as well as New Siting

In the burst of attention to new school construction, it is easy to lose sight of environmental remediation at existing locations. Recent legislation, for example, has prohibited new school construction within 500 feet of busy roads but it does not address those schools built before the regulations – and often before the placement of the freeways that are raising concern. Now that the problem of traffic-related pollution has been recognized, it would be useful to devote funds to improved air monitoring at these school sites, enhanced ventilation systems, and aggressive implementation of diesel emissions reduction efforts at the most overburdened schools.

Remediation applies to other arenas as well. Some school districts, for example, are taking proactive approaches to reducing the use of toxic cleaning products and pesticides in their janitorial and maintenance activities. LAUSD passed a landmark Integrated Pest Management (IPM) policy in 1999 that has enabled the district to stop using some highly toxic pesticides and to cut down overall pesticide use from 136 different chemicals to only 36. LAUSD has also stopped broadcast spraying and the use of pesticide bombs which greatly increase the risk of children's exposures. The district's policy is now being used as a model for schools in California and across the country.

For school sites located on contaminated property, the Department of Toxics Substance Control (DTSC) has authority over current state policy related to remediation and cleanup standards as well as party responsibility. New land use and zoning efforts need to recognize the relationship between educational uses and potentially polluting industrial uses, and the Cal/EPA environmental justice recommendations suggest collaborations between the state Office of Planning and Research and community groups, local governments/elected officials, and other stakeholders to develop appropriate guidance for local authorities. In all of these remediation efforts, meaningful community participation is key to ensuring that decisions reflect community priorities and that school sites are safe for children as well as for the overall community.

## 5 Enhance School-Based Health Services

School administrators are pressed by many demands, and adding one more implementation burden may seem just that – a burden. But with research showing the connections between health and academic performance, understanding student health status and maintaining access to health services, particularly for low-income and immigrant children who may lack health insurance, is critical. The state recently provided a very useful set of guidelines for the management of asthma in schools, offering directions to students, school nurses, and school administrators. Other health advocates have focused on child obesity; if unhealthy air is curtailing physical activity, a focus on improving the nutritional content of school-provided meals is all that more important. Of course, implementing services requires investments in staffing, particularly school nurses. Unfortunately, California's ratio of students to nurses is more than three times the level recommended by the National Association of School Nurses, and nursing positions are often cut back by school boards facing limited budgets and expanded costs for academic testing under the No Child Left Behind Act. Still, finding new resources for health and achievement is important, and schools should be supported and encouraged to be proactive partners with families and communities in promoting children's environmental health.

## 6 Take a Comprehensive Approach to School Environmental Quality

While we have focused here on air toxics, there are a broad set of environmental health concerns, ranging from pesticide use to chemicals used in school cleaning to the proximity of schools to landfills, transfer stations, brownfields, and other perceived hazards. A comprehensive cumulative approach to school environmental quality would include all these issue areas and embrace a wide variety of approaches. Fortunately, the U.S. EPA has provided leadership in the form of its Tools for Schools for Indoor Air Quality program, and the National Clearinghouse for Educational Facilities provides a wide selection of resources for the full gamut of school environmental challenges. Ultimately, questions around land use conflicts and zoning are crucial. Legislation passed in 2001 requires General Plan elements to include environmental justice considerations, thus setting a broad frame for considering both land use and equity in school environmental quality. State environment justice guidelines also stress the importance of community participation, a key element in any comprehensive approach to improving health equity.

## 7 Continue Efforts at Source Reduction

Finally, we believe that the state's main goal should be to continue California's commitment to preventing and reducing pollution at its various sources. Study after study has demonstrated the negative impacts that poor air quality can have on children's development. Exposure reduction is essential: moving children away from the danger – and moving the danger away from the children – is one part of an immediate strategy. We also need to pay special attention to "hot spots," that is, the sort of places often found in minority communities where the accumulation of environmental hazards from air, soil, and water result in excessive cumulative health risks. But in the long-term, we need to envision and realize a California where parents can send their kids to schools without worrying that environmental conditions will impact their children's health and well-being.

Getting there will require new alliances and new collaborations. Agencies and stakeholders that have not always worked together will need to find common ground, building on promising practices and experimenting with innovative strategies. Children's advocates, public health officials, educators, and parents will have to nurture a groundswell of public support that can sustain forward momentum in policy. And environmental justice advocates will need to stress children's health as central to their struggle for equity, recognizing that inequality must be addressed not only across race and class but also across generations.

The future of the state, after all, depends on our youth. Investing in well-functioning and healthy schools will guarantee a more prosperous economy for everyone and a more sustainable California for decades to come.

# Endnotes

1. A fuller version of the research on which this report is based is available from the Center for Justice, Tolerance & Community (http://cjtc.ucsc.edu); that version also contains the references for the research papers and analytical procedures noted in passing in this version. Also, for a broader picture of the environmental justice research and methods that form the background for this work, see Rachel Morello-Frosch, Manuel Pastor Jr., Carlos Porras, and James Sadd, "Environmental Justice and Regional Inequality in Southern California: Implications for Future Research," *Environmental Health Perspectives,* vol. 110, Supplement 2, April 2002 (http://ehp.niehs.nih.gov/members/2002/suppl-2/149-154morello-frosch/EHP110s2p149PDF.PDF).
2. The Clean Air Act Amendments of 1990 define two categories of air pollutants. The first is criteria pollutants which include small and large particulates, carbon monoxide, sulfur oxides, nitrogen oxides, ozone and lead. The second category is air toxics, of which there are 188 listed under the Clean Air Act. Although the health effects of criteria pollutants have been well studied and are linked to adverse health outcomes in adults and children, less is known about the health impacts of environmental exposures to air toxics as they have not been as extensively researched.
3. Details on the dispersion model and other assumptions are available in the fuller paper on which this report is based. Note that the 1996 NATA data is available for the census tract shapes of 1990; we utilized a weighting scheme and standard Geographic Information Systems (GIS) procedures to shift this data over to the 2000 census tracts for use in this study.

# Selected Resources:

- California Environmental Health Tracking Program (CEHTP) (a multi-agency collaborative to monitor health effects and environmental hazards and exposures at the state level): http://www.catracking.com
- California Environmental Protection Agency (especially the section focused on environmental justice in the state, including recommendations for state agencies): http://www.calepa.ca.gov/EnvJustice
- California Safe Schools (a resource for new approaches to pest management at school sites): http://www.calisafe.org
- Children's Environmental Health Network (a resource guide on children's environmental health, including model ordinances and legislation): http://www.cehn.org/cehn/resourceguide/infoindex.html
- Collaborative for High Performance Schools (a collection of state agencies and civic leaders focused on better and more energy-efficient design of school environments): http://www.chps.net
- Community Action to Fight Asthma (a collaboration of twelve community-based partnerships): http://www.calasthma.org
- Communities for a Better Environment (one of several leading environmental justice organizations in the state): http://www.cbecal.org
- Department of Toxics Substance Control (DTSC) (includes initiatives and guidelines for cleanup of potentially contaminated school sites in California): http://www.dtsc.ca.gov/Schools/Schools.html
- Environmental Protection Indicators for California (EPIC) (a multi-agency collaborative to development environmental indicators): http://www.oehha.ca.gov/multimedia/epic/index.html
- Healthy Schools Campaign (designed to eliminate the widespread use of pesticides in schools): http://www.calhealthyschools.org
- Just Schools California (a UCLA-affiliated project that promotes public engagement for a more equitable and fully resourced system of state public education): http://justschools.gseis.ucla.edu/
- National Clearinghouse for Educational Facilities (a broad set of resources for safer schools): http://www.edfacilities.org
- New Schools, Better Neighborhoods (a civic advocacy group offering innovative ideas on new schools as centers for community-building): http://www.nsbn.org
- Natural Resources Defense Council (a special section available on children's health and school buses): http://www.nrdc.org/health/kids
- PolicyLink (an Oakland-based national intermediary working to advance policies to achieve economic and social equity, offering a recent annotated bibliography on the influence of community factors on health): www.policylink.org
- Smart Schools, Smart Growth Initiative (a national group seeking to tie together issues of smart growth and school equity): http://www.smart-schools.org
- State Architect's Sustainable Schools Resource (contains useful links to state resources and references related to building design and construction): http://www.sustainableschools.dgs.ca.gov/sustainableschools/
- U.S. Environmental Protection Agency (EPA) (a special section devoted to "Tools for Schools" and indoor air quality): http://www.epa.gov/iaq/schools
- U.S. EPA, America's Children and the Environment (ACE) (a web site with a recent report on children's environmental health and other data): http://www.epa.gov/envirohealth/children
- U.S. EPA, Healthy School Environments (a one-stop center for information on school environmental issues, with numerous links): http://cfpub.epa.gov/schools/index.cfm
- U.S. EPA, Office of Children's Health Protection (for general information on environmental health issues in schools): http://yosemite.epa.gov/ochp/ochpweb.nsf/homepage

For additional copies of this brief, please contact:

Center for Justice, Tolerance & Community [CJTC}
University of California, Santa Cruz
1156 High Street, Santa Cruz, CA 95064

phone: (831) 459-5743, Fax: (831) 459-3125
Web site: http://cjtc.ucsc.edu
E-mail: cjtc@ucsc.edu