

Illinois Department of
**Public
Health**

Jim Edgar, Governor • John R. Lumpkin, M.D., M.P.H., Director

4302 North Main Street • Rockford, Illinois 61103-1209

June 13, 1997

Case# 104299701

Mr. Art Commare
Belvidere School Administrative Office
1201 5th Ave
Belvidere, IL 61008

Dear Mr. Commare:

The indoor air quality study at Kishwaukee School in Garden Prairie has been completed. Temperature, humidity and carbon dioxide levels were recorded from April 29 through May 13, 1997. Mold, bacteria and dust samples (for allergens) were collected on May 13, 1997. The results of our study are described below.

Three Ventilation Efficiency Measurement Systems (VEMS) were used to monitor temperature, humidity, and carbon dioxide (CO₂). The instruments monitored indoor air quality for fifteen days and were located in the library, Room 9, and in Room 6. The results have been plotted on the attached graphs and are explained below.

The American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE) Standard - Thermal Environmental Conditions for Human Occupancy (ASHRAE 55-1992) recommends an optimal indoor temperature between 68 and 79 degrees (depending on relative humidity and other climatic conditions). During periods of building occupancy, it appears that the thermal environment of the school building was adequate.

ASHRAE Standard, ASHRAE 55-1992 recommends a relative humidity of 30 - 60%. As you can see from the attached graphs, the humidity levels in the school varied between 17 and 54%. Common health complaints associated with low humidity include nose, throat and respiratory irritation, dry skin, dry eyes, lethargy and headaches. Based on the past history of moisture problems in the school and our mold sample results, we do not recommend that you do anything to increase humidity levels.

CO₂ is a common inert gas that is used as a general indicator of indoor air quality. At low concentrations, it is not a significant health risk. As an indicator, it can identify areas of inadequate ventilation where potential indoor pollutants, if present, can build up. Normal outdoor concentrations can range from 350 - 450 parts per million (ppm). In a properly ventilated building or classroom the indoor levels of CO₂ will remain below 1,000 ppm.

As the level increases, the number of indoor air quality complaints generally increase. Indoor air quality complaints are usually minimal when CO₂ levels are maintained below 800 ppm and a comfortable temperature and humidity are maintained.

As you can see from the attached graphs, the CO₂ levels increase rapidly when the rooms are occupied in the morning. The levels generally increase to above 1,000 ppm and then drop back to about outdoor levels when the building is not occupied. Based on the CO₂ data, it appears that the school building is under ventilated. Current ASHRAE guidelines (ASHRAE 62-1989) recommend that classrooms be supplied a minimum of 15 cubic feet of outdoor air per minute per person.

The mold and bacteria samples were collected using an Andersen Sampler. Three sets of plates were used for each sample; malt extract agar for fungi, cellulose agar for cellulose digesting fungi (e.g. *Stachybotrys* and *Trichoderma*) and soy-casein media for bacteria. These plates were analyzed by Luke Curtis, MS, IHIT at the University of Illinois at Chicago. The results of the mold and bacteria samples are listed in table 1. Mr. Curtis also provided some comparison values which are listed in table 2.

The total bacterial concentrations for all the samples were low. The total fungal concentrations in this study were generally moderate to moderately high for this time of year. As you can see in table 1, the total outdoor concentration for fungi was 378 colony forming units per cubic meter of air (cfu/m³) while the indoor levels ranged from 792 to 2412 cfu/m³. These results suggest an indoor amplification of fungi and considering the past history of moisture problems, the results are probably not unusual. The 2 most prominent fungi noted were *Penicillium chrysogenum* and *Penicillium brevicompactum*. Other fungi isolated from the samples included such common genera as *Trichoderma*, *Cladosporium* and several *Aspergillus* species. Again, there are no indoor air standards for total counts of fungi and bacteria. However, some researchers have suggested a standard of 1,000 to 5,000 (cfu/m³).

The cellulose samples noted one colony of *Stachybotrys* (or about 19 cfu/m³). While this level is low and unlikely to cause health problems, *Stachybotrys* is also difficult to isolate from air samples. That it was isolated at all is of some concern. *Stachybotrys* has a high moisture requirement and grows vigorously where moisture has accumulated from roof or wall leaks or chronically wet areas such as plumbing leaks. As such, this organism is often hidden in walls, above ceilings and behind tack boards or wallpaper, etc. Studies have indicated that exposure to high levels of *Stachybotrys* can cause lung problems, lung hemorrhage, dermatitis, chronic fatigue, general malaise, headaches and psychological depression.

The dust samples from the school were analyzed for dust mite, cat

and cockroach allergens. The dust samples were collected from the return air filter in the gym and from the air filters in the unit ventilator in room 10. These samples were also analyzed by Luke Curtis and are listed in table 3.

The allergen concentrations were low in all cases except for the cockroach allergens measured from the gym return air filter (0.109 units per milligram dust). A recent study noted that cockroach allergens concentrations exceeding 0.008 units per milligram of dust have been associated with more asthma symptoms in asthmatic children.

Based on visual inspection and sample results, our recommendations concerning the indoor air quality of the school are as follows;

- 1) The ventilation equipment should be properly maintained and the air filters should be changed or cleaned on a regular basis.
- 2) The carbon dioxide levels in the school were slightly high. We recommend that you provide additional fresh air and maintain carbon dioxide levels at less than 1,000 parts per million. During our sampling for mold (5/13/97) it was noted that the unit ventilator in room 7 was shut off. These units are the only source of fresh air, we recommend that they not be shut off. If the units are being shut off because of high noise levels, then they should be repaired.
- 3) The gym is located next to the food preparation area and the elevated cockroach allergen level may be from past infestations. Unless you have a current cockroach infestation, we would not recommend that you just randomly apply an insecticide. Studies have indicated that insecticides can also trigger asthma attacks. If it is necessary to apply insecticides, we would recommend that it be done at a time when the school is not occupied. To reduce airborne dust, we recommend frequent cleaning, and cleaning methods that do not generate a lot of dust (e.g. damp dusting or mopping).
- 4) It is our understanding that you have made some engineering and operational modifications to the unit ventilators that should reduce the moisture levels in the school. One of the operational modifications involves operating the unit ventilators throughout the summer months. We urge you to continue this policy. Several teachers remarked during our investigation of past problems with wet floors, carpet, moldy books, etc. when returning to school in late August. This would be an ideal environment for *Stachybotrys*. Mold problems can best be controlled by controlling moisture problems in the school.

- 5) As mentioned above, Stachybotrys was identified in one of the air samples. This organism is a potential health hazard and we recommend that you conduct a thorough visual inspection of the building. All water leaks should be repaired and the relative humidity controlled. Any mold stained ceiling tiles, carpets, books etc. should be replaced. Moldy surfaces should be disinfected. As was discussed by telephone, samples of the tack boards should be removed to make sure there is no mold growth between the boards and walls. If large moldy areas are discovered, we recommend you contact our office for further advice. Removing contaminated drywall, large tack boards or other materials without proper personal protective equipment or barriers may do more harm than good.
- 6) Mold levels generally increase through the summer months and considering the comments received regarding the past moisture problems, we recommend that you consider resampling for molds and bacteria in late August or early September.

If you have any questions or we can be of any further service, please feel free to contact our Rockford Regional Office located at 4302 North Main Street, Rockford Illinois, 61103, telephone 815/987-7511.

Sincerely,



Roger J. Ruden, P.E.
Regional Engineer

SJ:sj

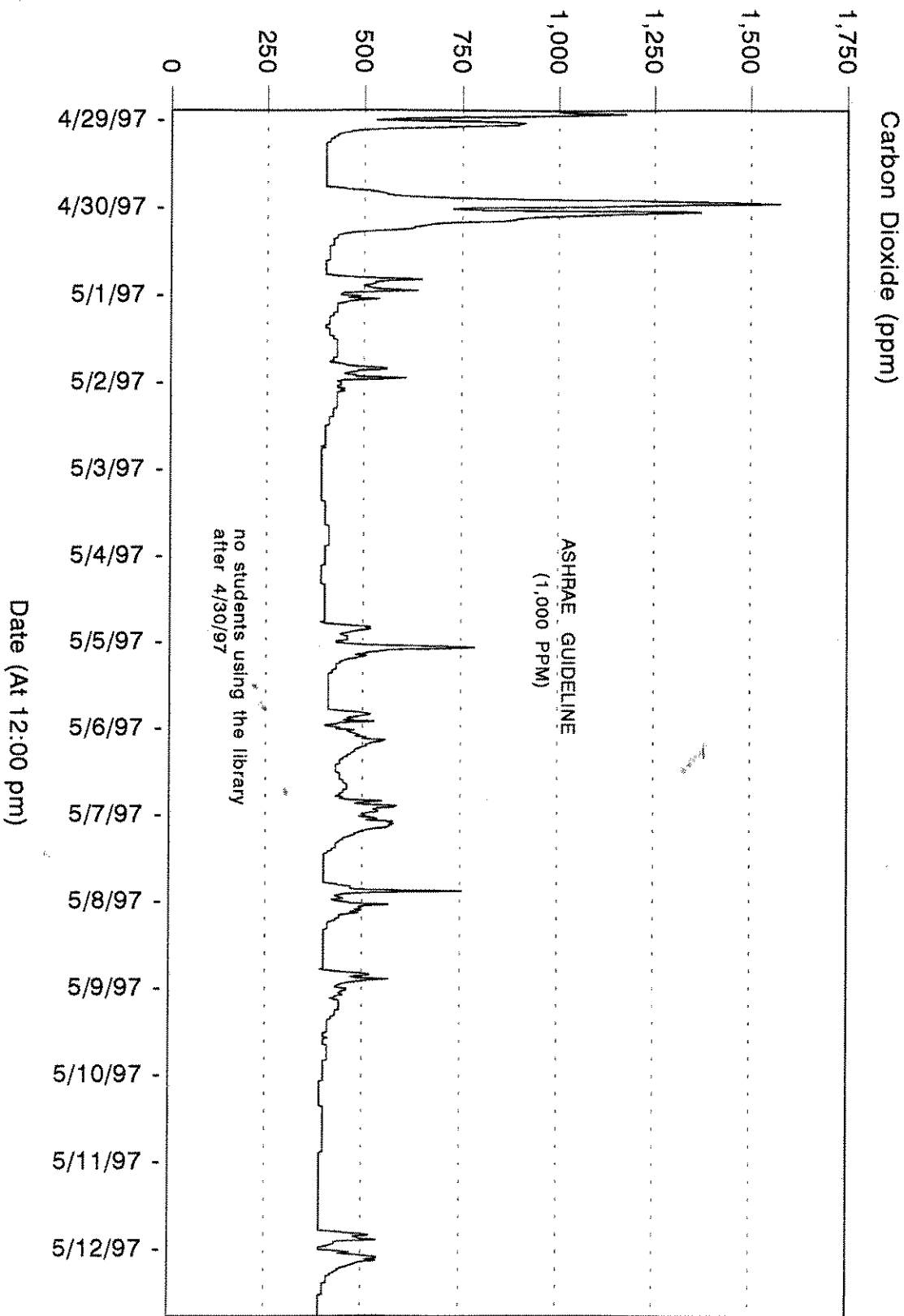
cc - Central Office
- Rockford Regional Office
- Boone County Health Dept.

enc.

KISHWAUKEE GRADE SCHOOL

April 29 - May 13, 1997

Library

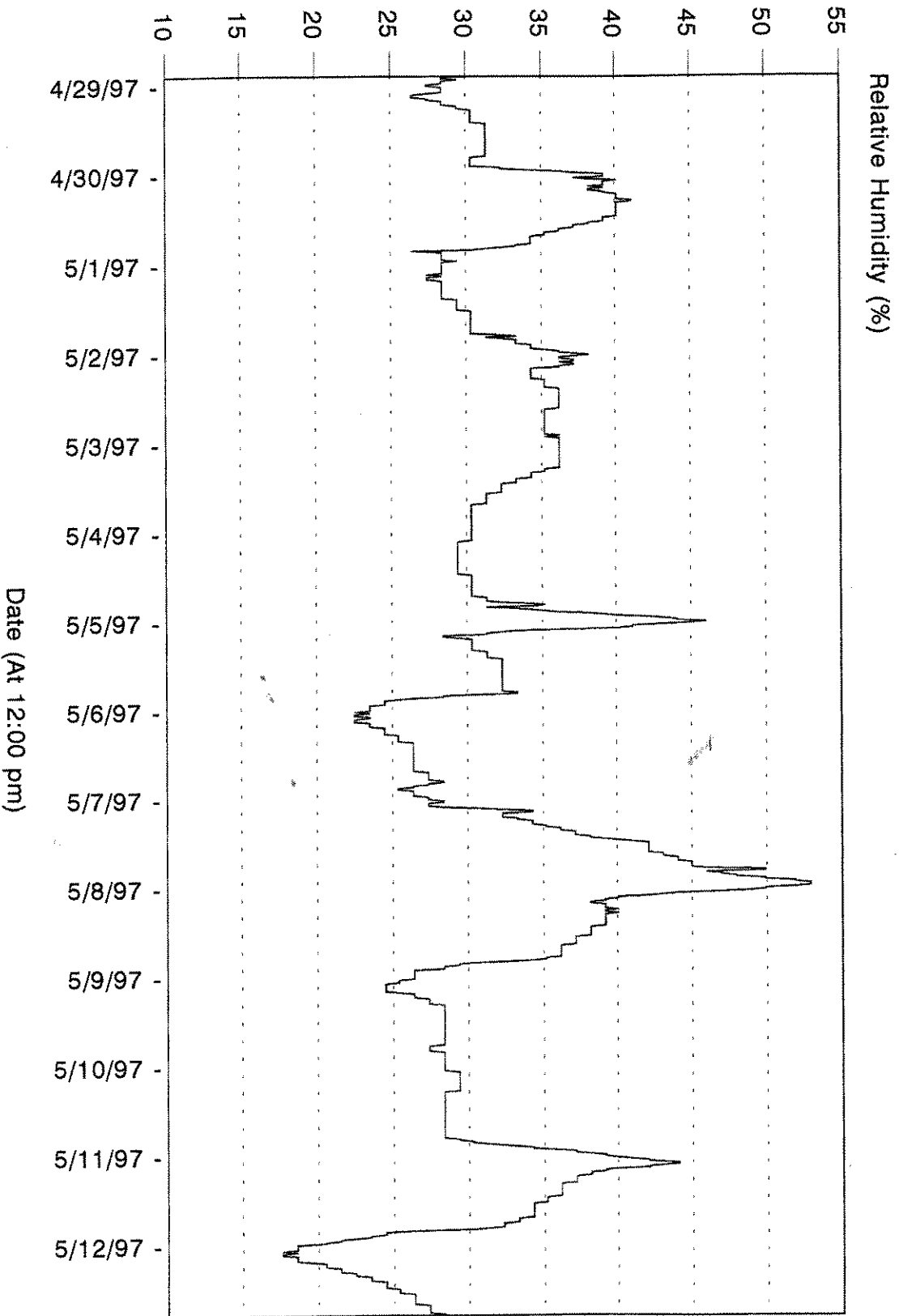


Sample Rate = 20 minutes
Minimum Value = 392 ppm
Maximum Value = 1578 ppm

KISHWAUKEE GRADE SCHOOL

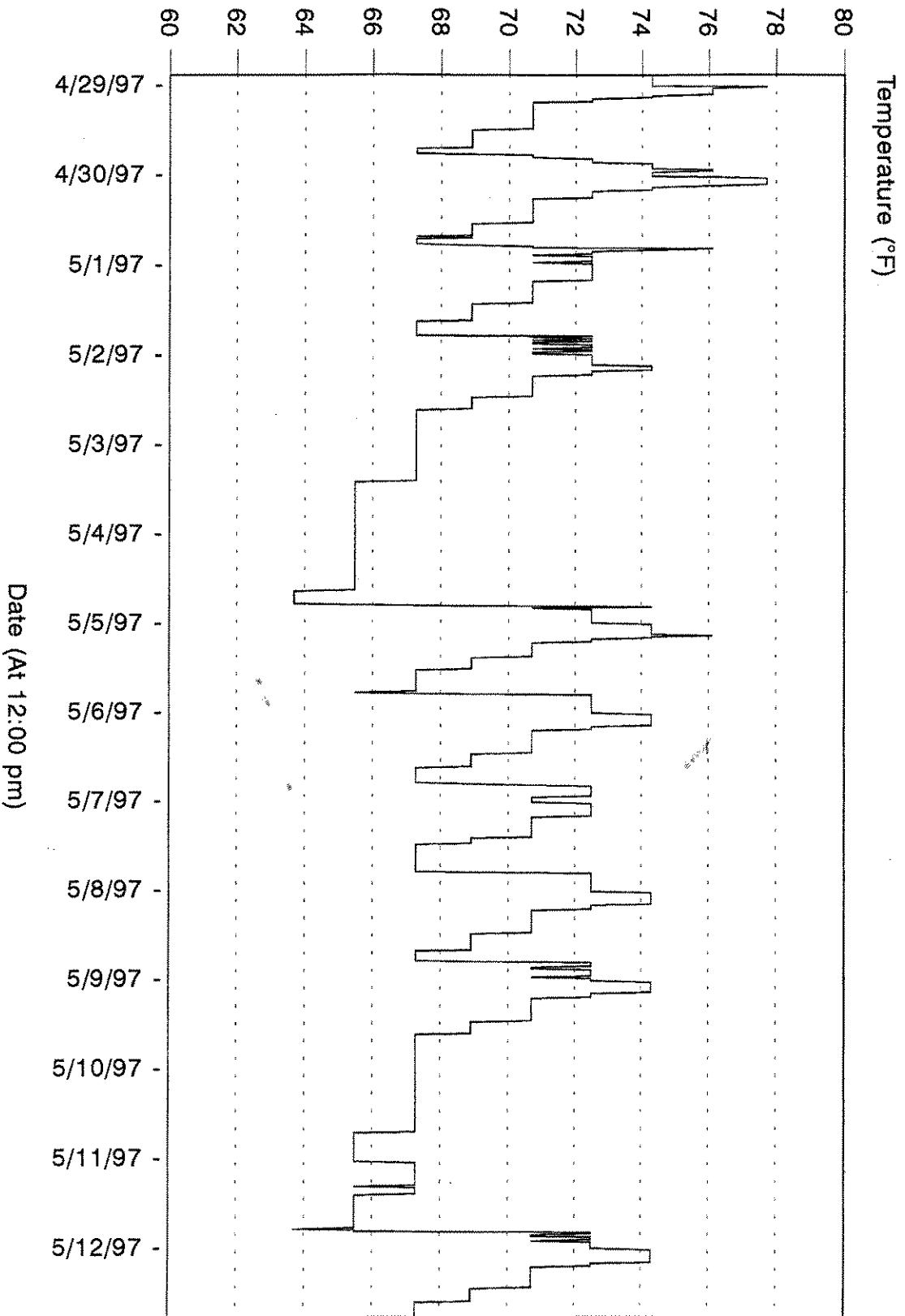
April 29 - May 13, 1997

Library



Sample Rate = 20 minutes
Minimum Value = 17.6%
Maximum Value = 52.9%

KISHWAUKEE GRADE SCHOOL
April 29 - May 13, 1997
Library

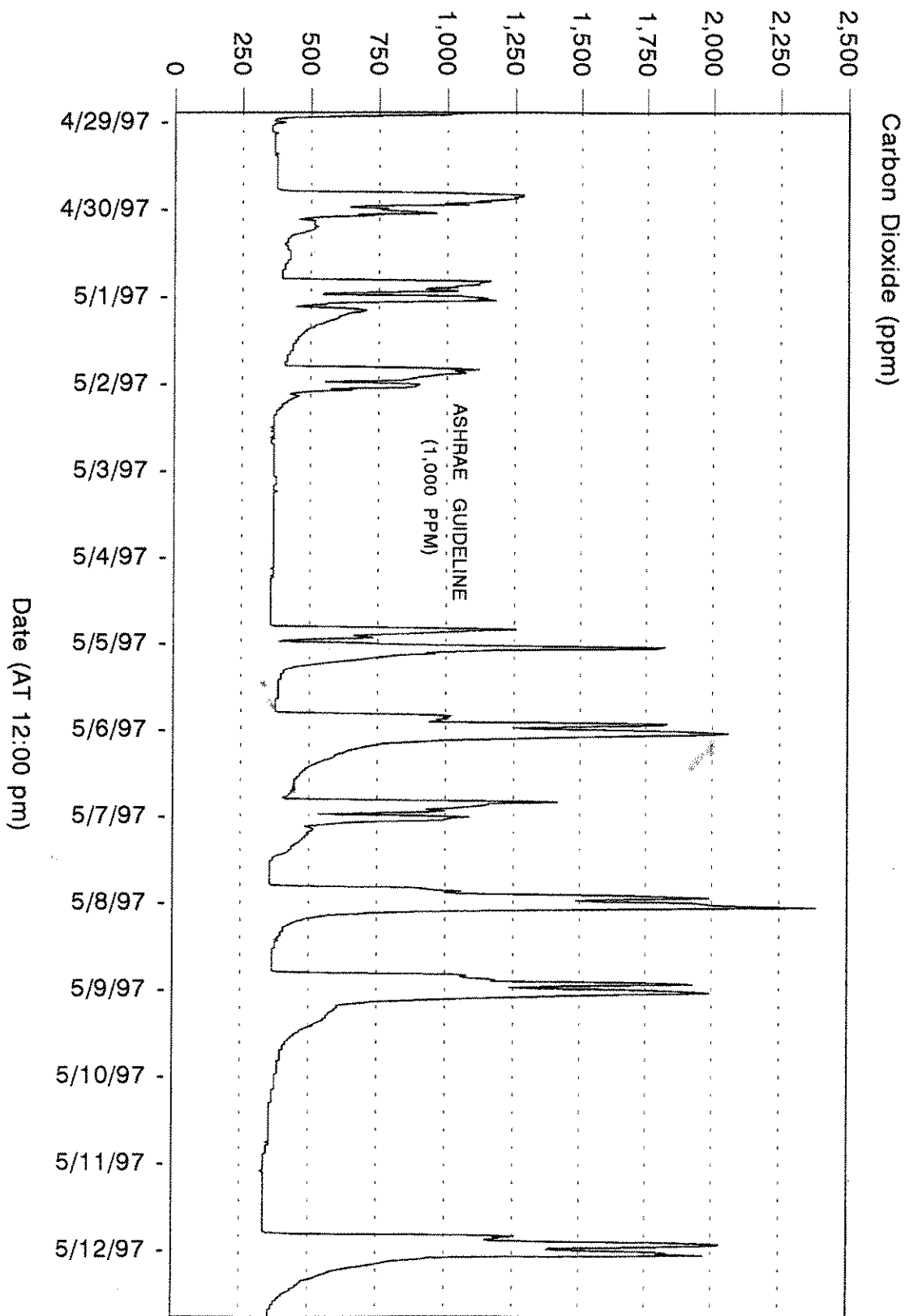


Sample Rate = 20 minutes
Minimum Value = 64 °F
Maximum Value = 78 °F

KISHWAUKEE GRADE SCHOOL

April 29 - May 13, 1997

Room 6

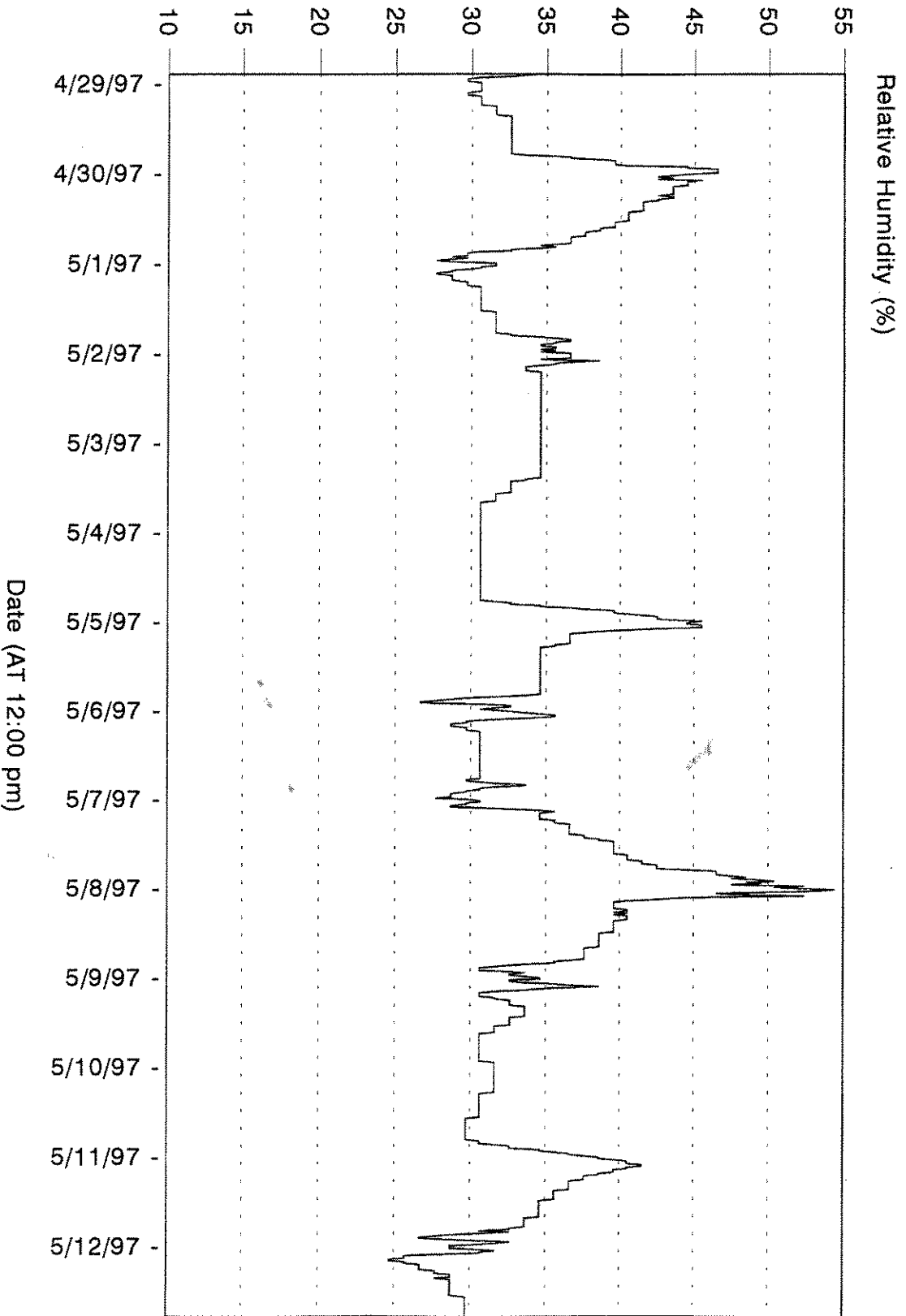


Sample Rate = 20 minutes
Minimum Value = 326 ppm
Maximum Value = 2386 ppm

KISHWAUKEE GRADE SCHOOL

April 29 - May 13, 1997

Room 6

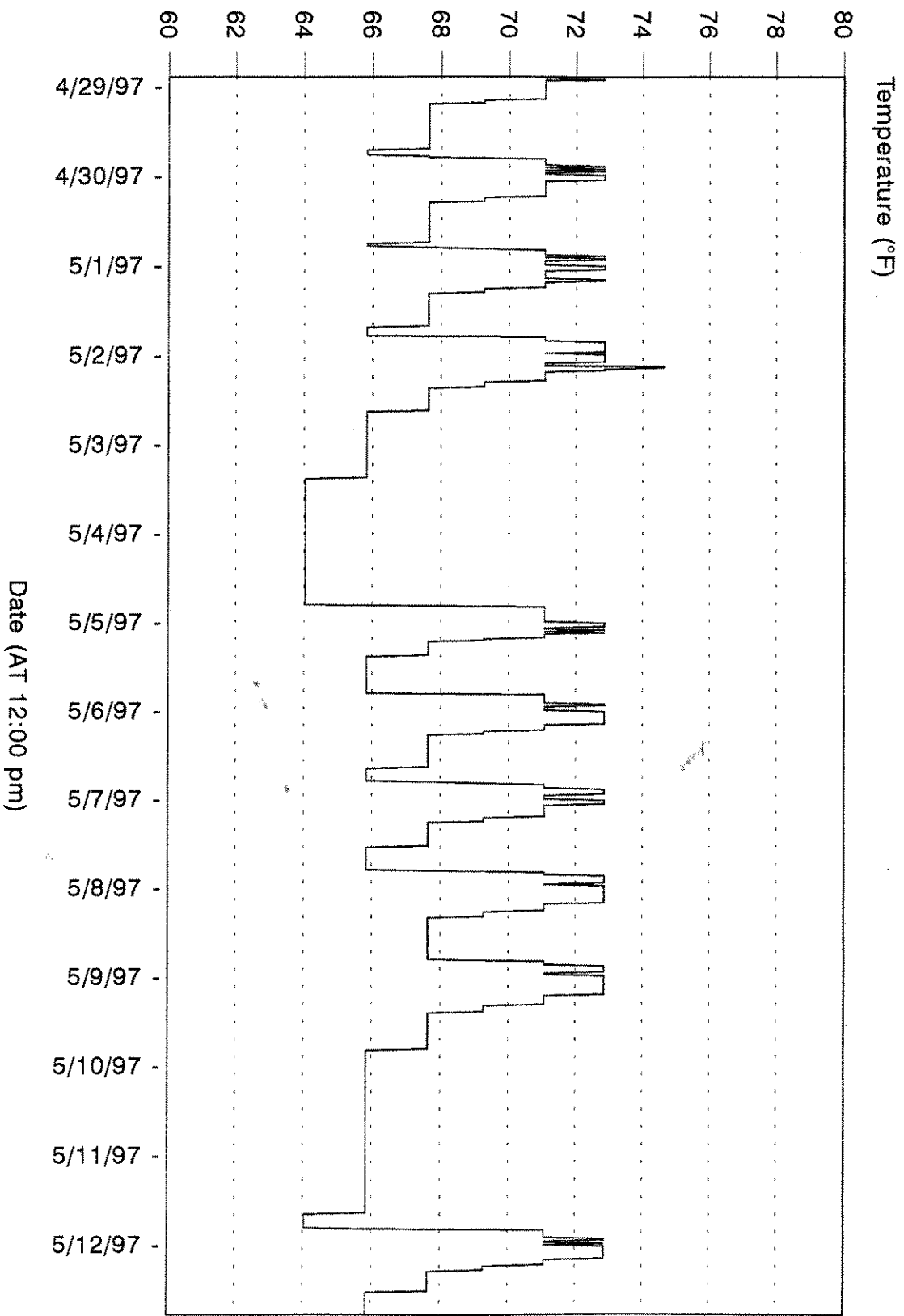


Sample Rate = 20 minutes
Minimum Value = 24.7%
Maximum Value = 54.4%

KISHWAUKEE GRADE SCHOOL

April 29 - May 13, 1997

Room 6

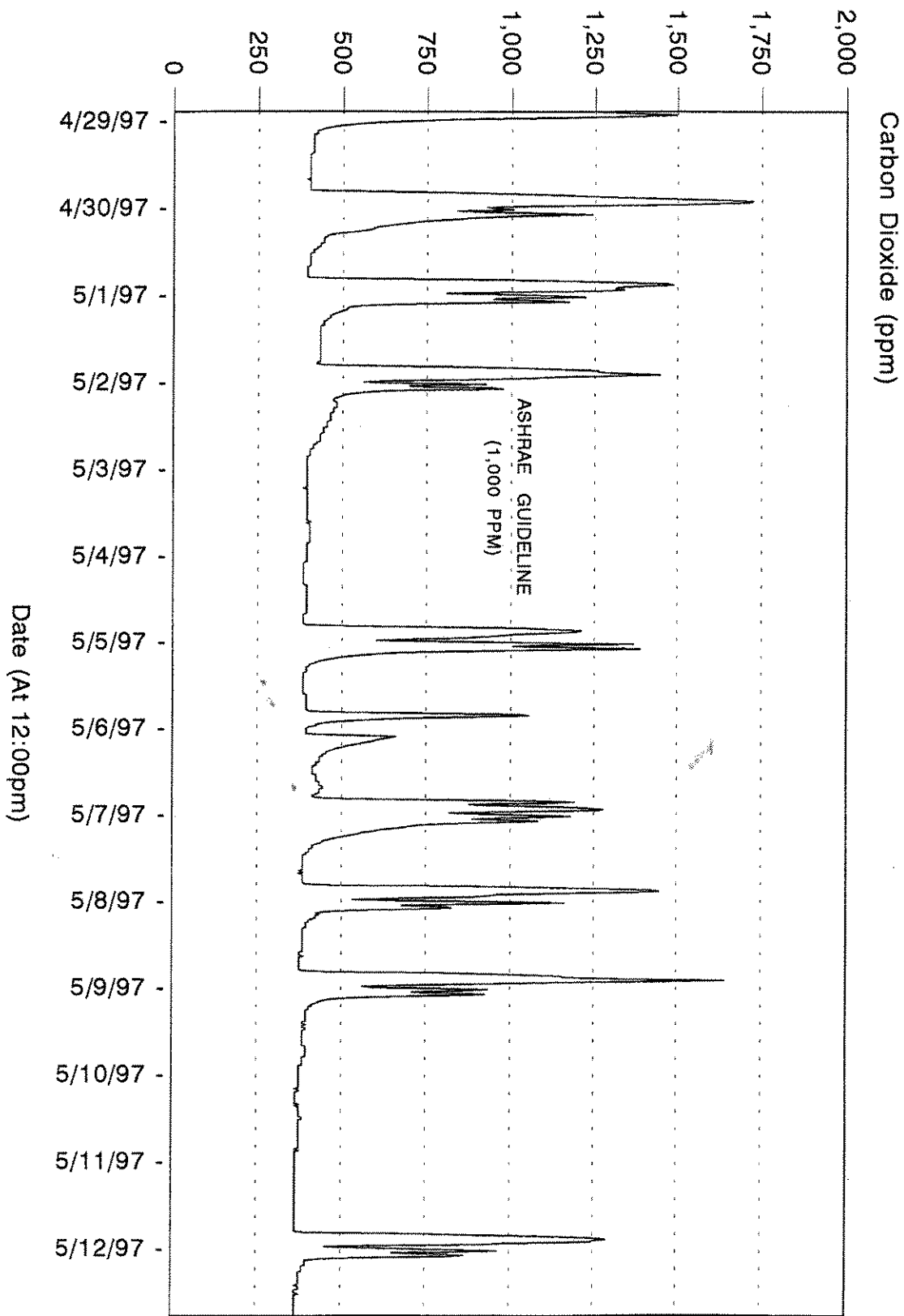


Sample Rate = 20 minutes
Minimum Value = 64 °F
Maximum Value = 75 °F

KISHWAUKEE GRADE SCHOOL

April 29 - May 13, 1997

Room 9

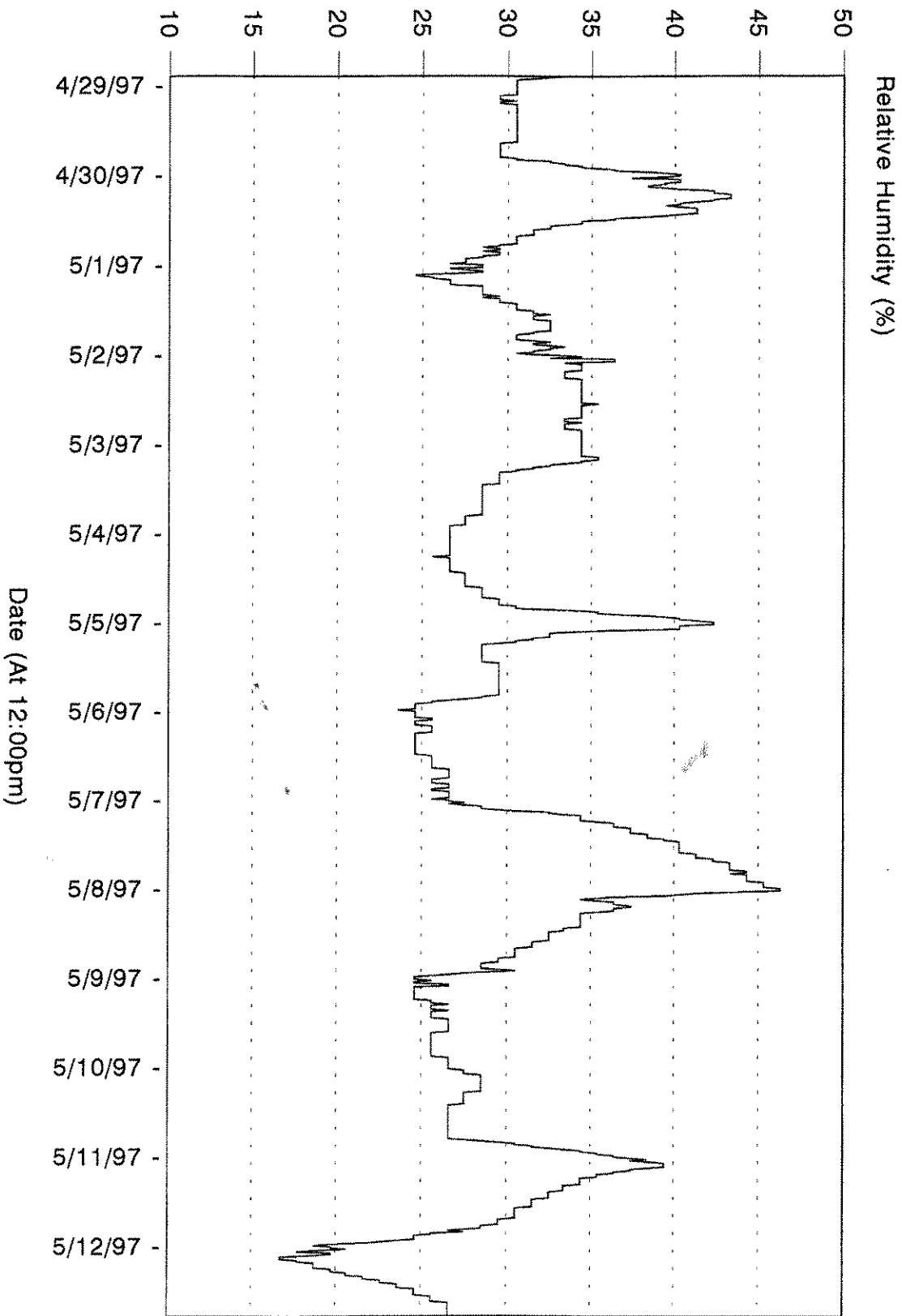


Sample Rate = 20 minutes
Minimum Value = 364 ppm
Maximum Value = 1724 ppm

KISHWAUKEE GRADE SCHOOL

April 29 - May 13, 1997

Room 9

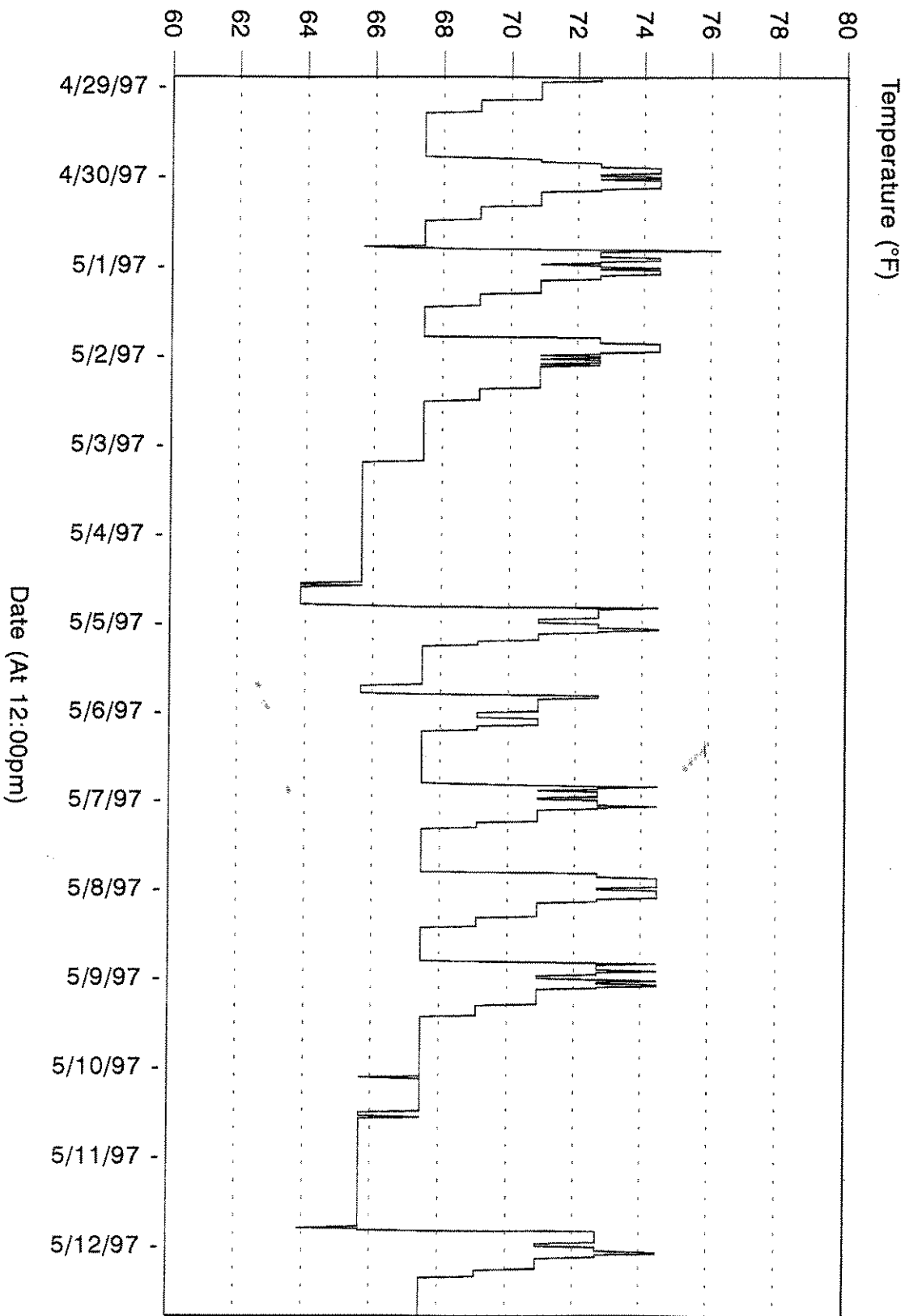


Sample Rate = 20 minutes
Minimum Value = 16.7%
Maximum Value = 46.3%

KISHWAUKEE GRADE SCHOOL

April 29 - May 13, 1997

Room 9



Sample Rate = 20 minutes
Minimum Value = 64 °F
Maximum Value = 76 °F

Table 1 - Bioaerosol Sampling at Kishwaukee School in Garden Prairie, Illinois 5/13/1997
 All Results in CFU/M³

Sample	Fungi		Total Bacteria
	in standard malt extract media	in cellulose media	
K1 outside - partly cloudy, low 50's °F, gentle breeze	378 - Total fungi 151 - <i>Penicillium brevicompactum</i> 113 - <i>Eurotium Aspergillus glaucus</i> 38 - <i>Cladosporium herbareum</i> 38 - <i>Trichoderma</i> 19 - <i>Aspergillus flavus</i> 19 - <i>Scopulariopsis</i>	540 - Total fungi 279 - <i>Penicillium brevicompactum</i> 112 - <i>Trichoderma</i> 112 - <i>Eurotium Aspergillus glaucus</i> 37 - <i>Cladosporium herbareum</i>	54
K2 Room 9 - Occupied, tile floor	1278 - Total fungi 954 - <i>Penicillium chrysogenum</i> 171 - <i>Cladosporium herbareum</i> 76 - <i>Trichoderma</i> 38 - <i>Penicillium brevicompactum</i> 19 - Yeast 19 - <i>Emericella Aspergillus nidulans</i>	432 - Total fungi 132 - <i>Cladosporium herbareum</i> 113 - <i>Trichoderma</i> 75 - <i>Penicillium chrysogenum</i> 75 - <i>Aspergillus versicolor</i> 37 - <i>Penicillium brevicompactum</i>	72
K3 Library - carpeted, 2 people working	1980 - Total fungi 1731 - <i>Penicillium chrysogenum</i> 165 - <i>Cladosporium herbareum</i> 83 - <i>Trichoderma</i>	594 - Total fungi 269 - <i>Penicillium chrysogenum</i> 173 - <i>Cladosporium herbareum</i> 115 - <i>Trichoderma</i> 38 - <i>Aspergillus versicolor</i>	252
K4 Room 7 - Occupied, tile floor, unit ventilator was turned off	918 - Total fungi 605 - <i>Penicillium brevicompactum</i> 162 - <i>Penicillium chrysogenum</i> 162 - <i>Cladosporium herbareum</i> 40 - <i>Eurotium Aspergillus glaucus</i>	414 - Total fungi 150 - <i>Penicillium chrysogenum</i> 113 - <i>Penicillium brevicompactum</i> 75 - <i>Cladosporium herbareum</i> 75 - <i>Trichoderma</i>	126
K5 Room 6 - Occupied, tile floor	792 - Total fungi 567 - <i>Penicillium chrysogenum</i> 76 - <i>Trichoderma</i> 76 - <i>Penicillium brevicompactum</i> 56 - <i>Cladosporium herbareum</i> 19 - <i>Verticillium</i>	450 - Total fungi 168 - <i>Cladosporium herbareum</i> 75 - <i>Aspergillus versicolor</i> 75 - <i>Trichoderma</i> 56 - <i>Penicillium brevicompactum</i> 38 - <i>Penicillium chrysogenum</i> 19 - <i>Stachybotrys</i> 19 - <i>Eurotium Aspergillus glaucus</i>	198

Table 1 - Bioaerosol Sampling at Kishwaukee School in Garden Prairie, Illinois 5/13/1997
All Results in CFU/M³

Sample	Fungi		Total Bacteria
	In standard malt extract media	In cellulose media	
K6 Small Room, tile floor, occupied (3 people), no vents, evidence of water leak in corner of ceiling tile	2412 - Total fungi 1909 - Penicillium chrysogenum 421 - Penicillium brevicompactum 89 - Penicillium glabrum 66 - Cladosporium herbareum 22 - Trichoderma 22 - Aspergillus niger	396 - Total fungi 208 - Penicillium chrysogenum 75 - Penicillium brevicompactum 75 - Trichoderma 38 - Unknown	180
K7 Room 10, not occupied, tiled floor	1044 - Total fungi 811 - Penicillium chrysogenum 77 - Trichoderma 58 - Penicillium glabrum 39 - Penicillium brevicompactum 39 - Cladosporium herbareum 19 - Verticillium	432 - Total fungi 188 - Penicillium chrysogenum 94 - Cladosporium herbareum 75 - Penicillium brevicompactum 56 - Trichoderma 19 - Pythium	324
K8 Library, sample in book stands	****	576 - Total Fungi 335 - Penicillium brevicompactum 93 - Cladosporium herbareum 74 - Penicillium chrysogenum 56 - Trichoderma 18 - Unknown	****
K9 Room 14, not occupied, tile floor, room down hall from complainant area	****	1188 - Total Fungi 858 - Penicillium brevicompactum 273 - Penicillium chrysogenum 39 - Trichoderma 19 - Cladosporium herbareum	108

Sample flow rate - 2 minutes at 1 cubic foot per minute
 CFU/M³ - colony forming units per cubic meter of air
 **** - no sample

Table 2 - Comparison Samples		
Sample	Fungi (standard malt extract media)	Total Bacteria
18 Indoor samples - Chicago 4/17/97 to 5/6/97	Mean values 881 - Total Fungi 441 - Eurotium Aspergillus glaucus 161 - Penicillium chrysogenum 159 - Penicillium brevicompactum 16 - Cladosporium 14 - Penicillium glabrum 5 - Trichoderma 4 - Aspergillus flavus 81 - Others	****
20 Outdoor samples - Chicago 4/17/97 to 5/6/97	Mean Values 506 - Total Fungi 174 - Eurotium Aspergillus glaucus 125 - Penicillium brevicompactum 45 - Cladosporium 44 - Penicillium chrysogenum 21 - Trichoderma 8 - Alternaria 2 - Aspergillus flavus 87 - Others	****
15 Indoor Bacteria samples May 1994 - Quad Cities, Illinois	****	Average 911 (Range 80 to 3220)
15 Outdoor Bacteria samples May 1994 - Quad Cities, Illinois	****	Average 987 (Range 120 to 3600)

Comparison results provided by Luke Curtis
 **** - no sample results

Table 3 - Allergen Concentrations at Kishwaukee School in Garden Prairie Illinois
5/13/97

Location	Dermatophagoides farinae dust mite allergen (ppm)	Dermatophagoides pteronyssinus dust mite allergen (ppm)	Cat allergen (ppm)	Cockroach bla G1 allergen (units per milligram of dust)
Unit vent filter (room 10)	0.22 (low)	-0.02 (very low)	-0.08 (very low)	-0.003 (very low)
Gym	0.19 (low)	0.00 (very low)	-0.08 (very low)	0.109 (moderate)

Dust samples analyzed by ELISA
ppm - parts per million

