

# Student Research Campaign 2009 Scandinavia: Indoor Air Quality in Schools

IN CONJUNCTION WITH:

*Forskningsdagene*

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## Introduction

The Student Research Campaign is an annual event in conjunction with The Norwegian Science Fair. This year's campaign ran from week 39-41 in Norway, Denmark, and Sweden, and was facilitated by the campaign website at [www.miljolare.no](http://www.miljolare.no). The topic of this year's campaign was indoor air quality in schools, as a follow up to the 2003 indoor air quality campaign in Norway. The students measured **CO<sub>2</sub>** values in their classrooms (as in 2003), as well as **mold** growth - which was not measured in 2003. Norway and Sweden share similar results, while Denmark results differ in that there are much higher indicators of poor air quality. Norway also shows better air quality indicator results when compared to 2003. These results are factors of ventilation differences between countries, and also possible improvements in ventilation routines and/or systems in Norway since 2003.



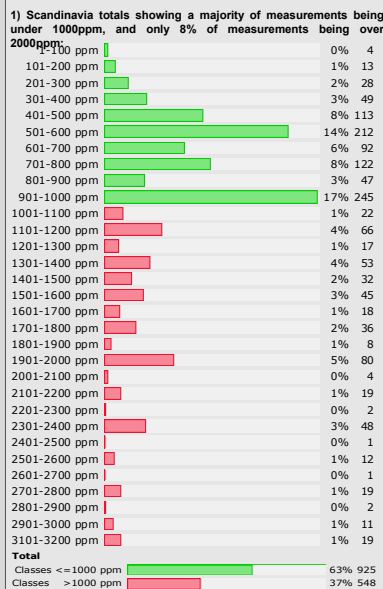
## Discussion

It should be noted that CO<sub>2</sub> and mold were chosen as easy measurements for students to perform in order to determine if the classes had **indicators** for bad air quality. Based on this preliminary analysis, Norwegian indoor air quality indicators have dramatically improved since 2003, and it would be interesting to see how many schools have improved their ventilation systems/routines since the 2003 campaign; this information may also give credit to the success of the past campaign in actually improving the student's air quality!

Comparing Denmark to Norway and Sweden for CO<sub>2</sub> values, a majority of the Danish classes have indicators for problematic air quality and almost ¼ are near the range of unacceptable (2000+ppm), where a large majority of the classes in both Norway and Sweden are within the acceptable ranges (<1000ppm). Denmark also shows much higher mold growths and concentrations than Norway. These differences are supported by the more advanced ventilation systems present in Norway than in Denmark; and the great temperature differences also are potentially congruent to the ventilation numbers. It is interesting to note that 82% of the Norwegian classes have ventilation systems, and 81% also have values below 1000ppm; and 49% of the Danish classes have ventilation systems, and 45% also have values below 1000ppm.

It is hoped that the campaign was an educational exercise for the students that participated, and that the results are used to improve the ventilation systems in Denmark, and continue improving the systems in Norway (and Sweden) to ensure better air quality environments for the students across Scandinavia.

## CO<sub>2</sub> Results



2) Scandinavia totals broken down between each country showing that Denmark has 35-40% more measurements greater than 1000ppm in comparison to Norway and Sweden, and 24% of these measurements are greater than 1900ppm:

	Denmark	Norway	Sweden	Andel over/under 1000 ppm
Classes <= 1000 ppm	327	782	728	45%
Classes > 1000 ppm	179	520	511	81%
Classes > 1900 ppm	136	245	222	84%

3) Norwegian comparison between 2003 and 2009, showing a 23% improvement in values less than 1000ppm:

CO <sub>2</sub>	2003	2009
<= 1000ppm	629 classes 58%	372 classes 81%
>1000ppm	456 classes 42%	85 classes 19%

## Mold Results

1) Scandinavia totals showing the average number of colonies of each mold type per petri dish (for both DG18 and V8):

	Colonies DG18 (avg.)	Colonies V8 (avg.)
Cladosporium	7.3	5.8
Penicillium	3.7	2.5
Aspergillus	3	2.4
Alternaria	2.4	3.3
Trichoderma	0.2	0.9
Eurotium	0.5	0.6
Yeast	3	2.9
Other molds	1.3	1.4

2) Scandinavia totals showing the percent presence of each mold type per petri dish (for both DG18 and V8):

	Petri Dishes DG18	Petri Dishes V8
Cladosporium	75%	67%
Penicillium	69%	65%
Aspergillus	69%	61%
Alternaria	34%	52%
Trichoderma	7%	12%
Eurotium	18%	21%
Yeast	55%	57%
Other Molds	24%	30%

3) Scandinavia totals showing the percentage of petri dishes which contained each range of total colonies (for all mold types, for both DG18 and V8):

# Colonies	% Petri Dishes DG18	% Petri Dishes V8
0	1.1% (12)	0.8% (9)
1-5	23.1% (254)	21.8% (238)
6-10	15.6% (172)	19.4% (212)
11-15	14.7% (162)	15% (164)
16-20	12.1% (133)	12.6% (138)
21-25	8.6% (95)	6.5% (71)
26-30	5.8% (64)	6.7% (73)
31-35	2.9% (32)	3.8% (42)
36-40	3% (33)	3% (33)
41-45	2.1% (23)	1.6% (18)
>50	10.9% (120)	8.6% (94)

4) Differences in average colonies per petri dish between Denmark and Norway (for both DG18 and V8):

	Schools	Measurements	Rooms	Colonies DG18 (avg)	Colonies V8 (avg)
Denmark	328	802	752	25.8	22.9
Norway	162	320	298	7.7	9.1

## Other Results (Temperature and Ventilation)

1) The indoor air temperatures show that almost ¼ of the Danish schools are outside of the optimal range, where a majority of Norwegian and Swedish schools are inside the range (or within 2 degrees C of the range). 29% of the Danish schools are greater than 24 degrees C, where only 8% and 7% where greater for Norway and Sweden respectively.

Temperature	Denmark	Norway	Sweden
Optimal 20-22C	343 classes 26%	371 classes 54%	91 classes 39%
Outside optimal	953 classes 74%	322 classes 46%	141 classes 61%

2) Ventilation systems differ dramatically between Denmark and Norway. A majority of Danish schools only use natural ventilation, where over 80% of Norwegian classes have a mechanical ventilation system.

Ventilation*	Denmark	Norway
Only natural	387 classes 51%	38 classes 18%
Only exhaust	137 classes 18%	42 classes 20%
Exhaust and supply	236 classes 31%	130 classes 62%

