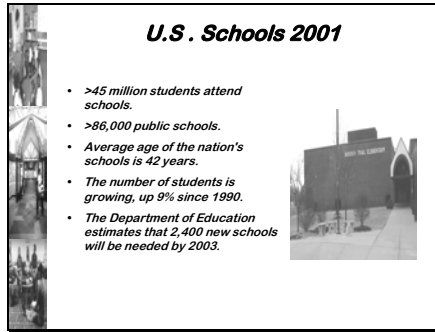


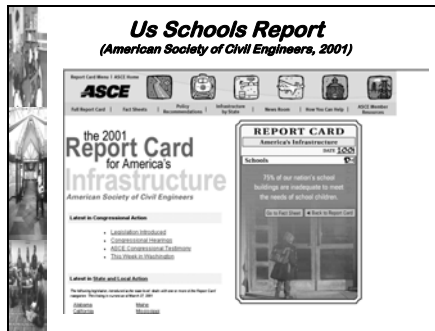
Slide 1



Slide 2




Slide 3



Slide 4

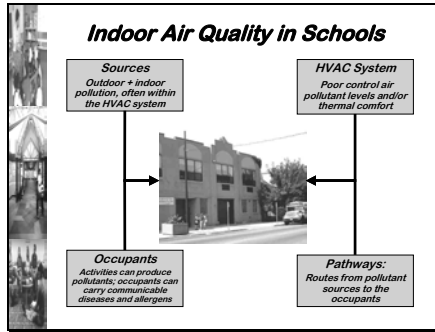
### Schools Repairs Report: D-Grade

- 75% of schools need repairs.
- Total budget need = \$268 billion.
- Average repairs per school = \$2.2 million (\$3,800 per student).



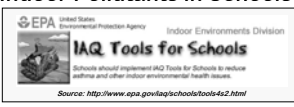
The screenshot shows a newspaper clipping from 'SCHOOL CONSTRUCTION NEWS'. The main headline is 'Average School Needs \$2.2 Million in Repairs'. Below the headline, there is a sub-headline '50% Construction Index' and a small table with columns for 'Year' and 'Index'. The article text discusses the state of school infrastructure and the need for significant funding.

Slide 5



Slide 6

### Indoor Pollutants in Schools





The screenshot shows a document from the EPA Indoor Environments Division titled 'IAQ Tools for Schools'. The text states: 'Schools should implement IAQ Tools for Schools to reduce asthma and other indoor environmental health issues.' Below this, there is a source URL: <http://www.epa.gov/iaq/schools/tools4s2.html>

- **Gases**
  - radon, volatile organic compounds (VOCs)
- **Biologicals**
  - Bacteria, fungi, allergens
- **Particulates + fibers**
  - Fiberglass, asbestos

Slide 7

**School Floor Covering Issues**



- **Source**  
Are floor coverings a source of some air pollutants?
- **Sink**  
Are floor coverings a reservoir for some air pollutants?
- **Safe**  
Are floor coverings a trap for some air pollutants?



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**Source: Carpet Emissions**



- **Volatile emissions:**
  - Across all types of carpet
  - ~160 different VOCs, but most at trace levels



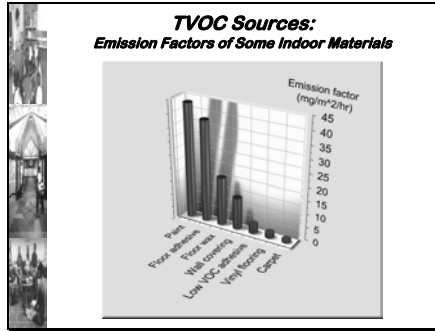
Slide 9

**EPA Carpet Emissions Studies**  
(EPA, 1993)

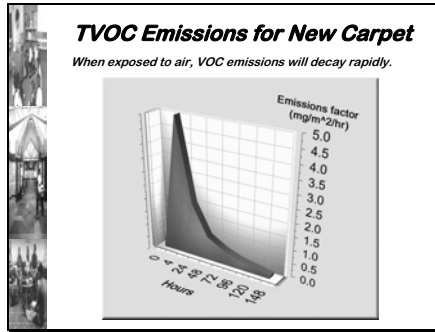
- 52 studies, 172 carpets, ~250 mice
- No effects of carpet emissions on:
  - Animal appearance
  - Animal behavior
  - Serum clinical chemistry
  - Lung/organ pathology
  - Neurotoxicity measures
  - Mortality
- Other studies have failed to find health effects of carpet emissions.



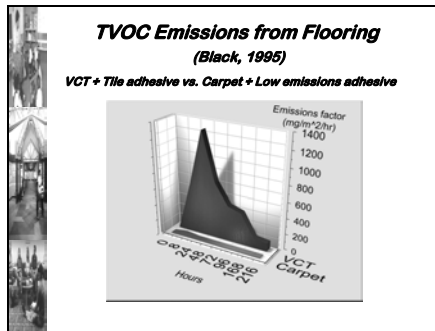
Slide 10



Slide 11



Slide 12



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### TVOC Emissions from Flooring

(Myhrvold, 1997, Rogland Research Report RF-97034)

- Compared VOC levels in 4 classrooms in Norwegian school (2 with PVC, 2 with carpet)
- Average daytime TVOC levels were:
  - PVC = 320  $\mu\text{g m}^{-3}$
  - Carpet = 306  $\mu\text{g m}^{-3}$
- Average nighttime TVOC levels were:
  - PVC = 651  $\mu\text{g m}^{-3}$
  - Carpet = 471  $\mu\text{g m}^{-3}$

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### School Floorcoverings

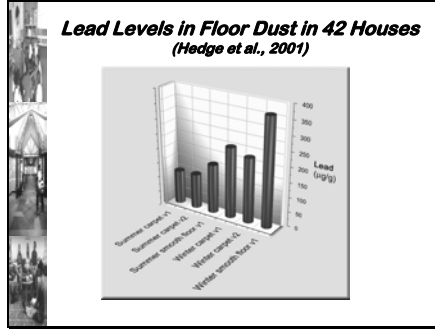
(Angelova et al., 1989, Probi Khig, 14, 154-61)

- Investigated health status of 429 3-5 years old kindergarten children in Sofia, Bulgaria.
- Compared effects of classrooms with PVC floor (203 children) and hard wood floor (226 children).
- Measured levels of immunoglobulins (IgG, IgA, IgM).
- Immunoglobulin levels were approx. twice as high in PVC floor group.
- PVC floor group had highest morbidity from acute respiratory infections and tonsillitis.

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### Sink: Carpet as a Toxic Reservoir?


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**Sink: Carpet and Biologicals**

- **Bacteria (gram negative)**
- **Fungi**
- **Allergens**
  - Dust mites
  - Pets (Cats, dogs)

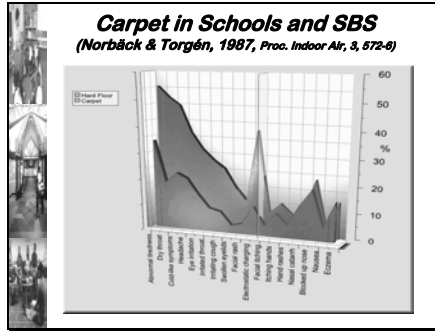


Slide 18

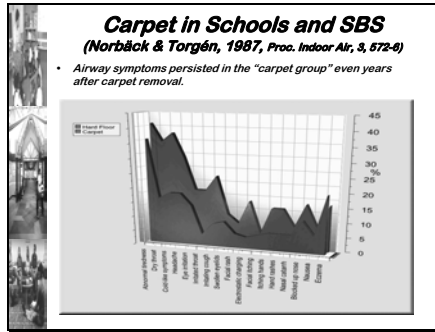
**Carpet in Schools and SBS**  
(Norbäck & Torgén, 1987, Proc. Indoor Air, 3, 572-4)

- **6 primary schools**
  - 2 schools, 8-10 years old with carpet in classrooms and corridors
  - 4 schools (2 older + 2 newer) with hard PVC floors.
- **Only vacuuming for dirt removal.**
- **Mechanical ventilation (not HVAC).**
- **School renovation – ventilation systems, ceiling tiles, and carpet replaced.**
- **Self-report surveys of 192 school personnel (59 from carpeted schools).**

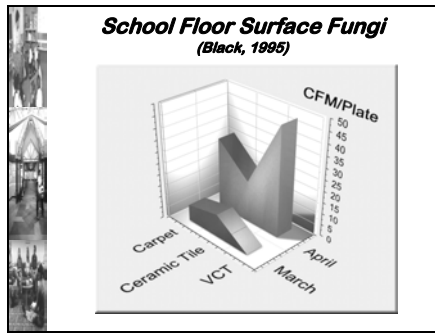
Slide 19



Slide 20



Slide 21







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**Safe: Carpet as a Trap**

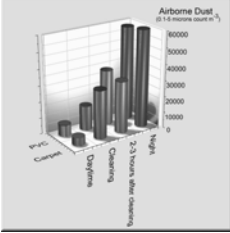
- Floor covering maintenance?
  - Vacuuming
  - Cleaning methods



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**Airborne Dust and Flooring**  
(Myhrvold, 1997, Rogland Research Report RF-87034)

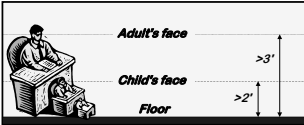
- Compared airborne dust levels in 4 classrooms in Norwegian school (2 with PVC, 2 with carpet)
- Airborne dust counts comparable between classrooms



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**Respiratory Effects of Biologicals, Particulates and Fibers**

- Exposure depends on pollutants in the breathing zone, not what is trapped in surface materials.



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**Safe: Floor Dust Removal**  
(Vaughan et al., 1999, *J. Allergy Clin. Immunol.*, 104, 1079-83)


- Use of a high-efficiency cleaner (with at least a double-layer microfiltration bag) is important. A 3-layer bag performs best to recover allergens (cat allergen).
- Effectiveness of vacuums is now tested.



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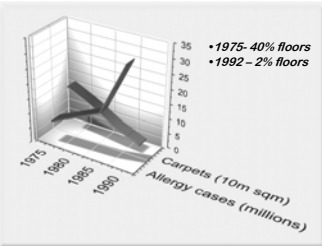
**Safe: Floor Dust in Schools**  
(Dybendal et al., 1989, *Clin Exp. Allergy*, 19, 217-24)

- Floor dust samples tested from classrooms in 12 schools.
- No differences qualitatively or quantitatively between floor dust from carpet or linoleum.
- Dust mite allergen levels highest in air over smooth floors.
- School environment typically has low levels and is protective against mite allergen.



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**Carpet and Asthma in Sweden**  
(Shishoo and Bøjesson, 1996)





Year	Carpets (10m sqm) (%)	Allergy cases (millions)
1975	40%	~10
1980	~30	~15
1985	~20	~20
1990	~10	~25
1992	2%	35

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**Swedish Schools**  
(Wälinder et al., 2000, *Indoor Air*, 11, 2-9)



- 234 primary school personnel in 12 elementary schools in mid-Sweden.
- Measured nasal symptoms using:
  - Acoustic rhinometry
  - Nasal lavage
- 50% reported at least one nasal symptom per week.
- Nasal symptoms significantly higher in classrooms with:
  - Mechanical ventilation
  - Higher settled dust levels
  - Lower cleaning frequency
  - Use of wet mopping
  - Use of PVC floor covering
  - Signs of water damage

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**Swedish Schools**  
(Smedje & Norbäck, 2000 *Indoor Air*, 11, 127-133)




- 1,476 pupils surveyed in 1993 and 1995 from 39 randomly selected elementary through high schools in Sweden.
- Between 1993 to 1995 there were significant increases in:
  - Pollen/pea allergy (14.2% to 17.1%)
  - Doctor diagnosed asthma (6.3% to 8.3%)
  - Current asthma (5.1% to 6.3%)
  - >1 asthmatic symptom (6.4% to 8.5%)
  - No significant change in any asthmatic symptoms (16.7% to 18.4%)
- New ventilation systems had been installed in 12% of classrooms. Results showed:
  - Improved air exchange, relative humidity and IAQ
  - Decrease in any asthmatic symptom (11.1% to 3.4%)
  - No effects on the prevalence of allergy or asthma.

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**Childhood asthma risks**  
(Annapolis Center, 2001 - <http://www.annapoliscenter.org/asthma/ama.htm>)

- Asthma risks in infancy and childhood:
  - Gender (males vs. females)
  - Maternal asthma
  - Maternal smoking
  - Atopy - Hay fever, eczema
  - Ethnicity (Caucasian, African American)
  - Early respiratory infection (RSV)
- Sensitizers:
  - Molds and fungi
  - Allergens - cockroaches, cats, dogs, dust mites
  - High fat diet
  - Inactivity; Exercise
  - Cold air
  - PVC and plasticizers
  - Acetaminophen, antibiotics
  - Air pollutants (e.g. NO<sub>x</sub>, O<sub>3</sub>)






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### Managing Biocontaminants

(Washington + Florida AQS Studies)

- Floor surface biologicals are similar to airborne biologicals for carpet and hard surfaces.
- Airborne indoor biologicals track levels in outdoor air.
- Replacing carpet does not reduce indoor airborne biologicals.
- Even after considerable mechanical disturbance of carpet, airborne allergen levels are short-lived.
- Contaminants in carpet can be removed with simple, effective maintenance.

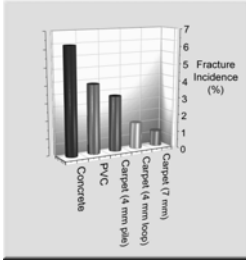


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### School Safety: Floors and Falls

(Booth et al., 1996, Br Orth Res Soc Proc., Sept.)

- Studied relationship between the type of floor covering and the incidence of hip fractures in proportion to the percentage of falls (864 falls, 18 hip fractures).




Floor Type	Falls (%)	Fracture Incidence (%)
Concrete	~65	~6.5
PVC	~25	~2.5
Carpet (4 mm pile)	~5	~0.5
Carpet (4 mm loop)	~2	~0.2
Carpet (7 mm)	~1	~0.1

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### School Safety: Floors and Falls

(Gardner et al., 1987, Med. Eng. & Physics, 20, 57-65)

- Peak impact force of a body dropping onto the floor varies by 23% from a soft to a hard surface.
- Thicker floor covering decrease impact force by at least 7%.


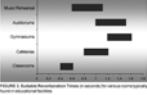


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### **Classroom Acoustics**

*(Technical Committee on Architectural Acoustics of the Acoustical Society of America, 2000)*

- A long reverberation time (RT) creates poor classroom acoustics.
- Classrooms should have RTs in the range of 0.4-0.6 seconds.
- "Soft" materials, such as carpet and acoustical ceiling tiles, increase sound absorption and decrease the RT.
- Carpet alone decreases classroom RT by 0.1 second (Myrthvold, 1997)
- Carpet absorbs sound, reduces surface noise (e.g. footsteps and furniture movement), and helps block sound transmission.



Sources: <http://www.noise.org/education/booklet.htm>  
[http://www.schooldesign.com/constr\\_Soundchoices.html](http://www.schooldesign.com/constr_Soundchoices.html)

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### **School Floor Coverings Issues**


- Choice of school floor coverings should be based on considerations of many issues, including:
  - Indoor air quality.
  - Acoustics.
  - Cleaning and maintenance.
  - Safety (slips, trips, falls).
  - Comfort (sitting surface).
  - Appearance - color, softness, texture, quality.



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### **Our Responsibility**

- To create safe learning environments for our nation's most important asset, our children.



Slide 40

