# *Public Comment Release*
# Evaluation of Indoor Environmental Conditions and Potential Health Impacts
## New Bedford High School
September 27, 2011

**Massachusetts Department of Public Health**
**Bureau of Environmental Health**

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**Director, Bureau of Environmental Health**

# Presentation Outline

- Introduction and Background
- IAQ Investigation
- PCB Exposure Assessment
- PCB Serum Testing Results
- Health Concerns and Cancer Incidence Evaluation
- Questions and Discussion

# MDPH Bureau of Environmental Health

Indoor Air Quality Program

**NBHS Evaluation**

Environmental Toxicology Program

Community Assessment Program

# Scope of NBHS Evaluation

- Evaluation of indoor environmental conditions and health concerns
  - Comprehensive IAQ assessment
  - Interviews with staff regarding health and IAQ concerns
  - Evaluate health concerns and pattern of cancer among staff members diagnosed with cancer
  - Evaluation of indoor PCB sampling data collected at NBHS to estimate potential health risks
  - Blood serum PCB testing offered as a public service

# Indoor Air Quality Program

## Indoor Air Quality Evaluation

# Methods – IAQ

**Assessment Dates**

- April 29-30, 2008 – General Indoor Air Quality Assessment
- July 9, 2008 – Assessment of moisture conditions after several days of wet weather

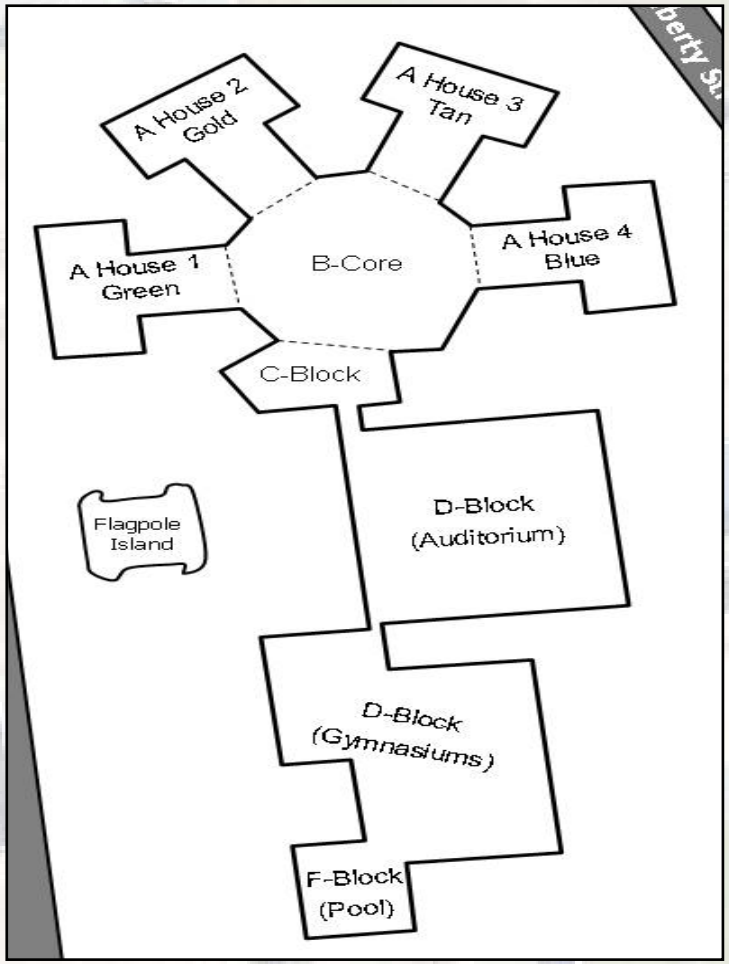
# Methods – IAQ

- Visual inspection for water damage and/or microbial growth
- Measurements taken under normal operating conditions of:
  - Carbon dioxide (CO2)
  - Ambient temperature
  - Relative Humidity
  - Particulates (2.5 micrometers and less)
- Surface temperature of walls, floors, univents

# Results – IAQ

- Ventilation
  - On 4/29/2008, $CO_2$>800 ppm in over half (115) of the 223 areas surveyed – indicating lack of adequate air change
  - On 4/30/2008, no areas exceeded 800 ppm $CO_2$ – however, half of these areas (E and F Blocks) were empty or sparsely populated

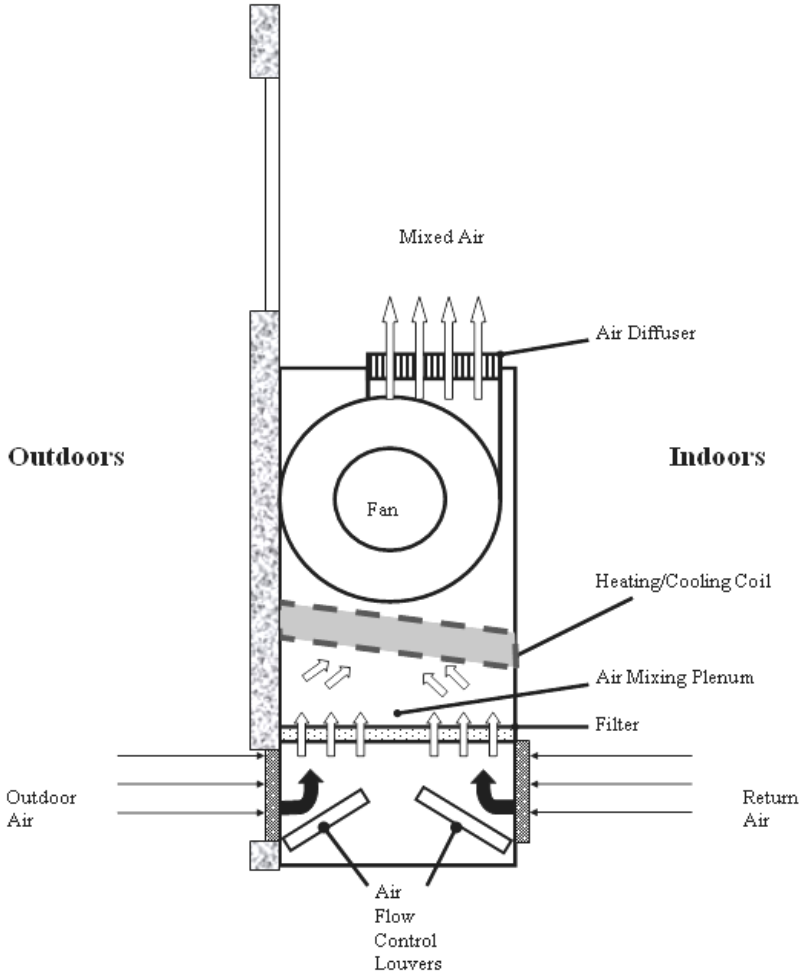
# New Bedford High School Building Layout - HVAC system




- Univents
  - A Houses
  - D-Block Classrooms on exterior walls
- Air Handling Units
  - B-Core
  - C-Block
  - D-Block
  - E-Block
  - F-Block

# Results – IAQ

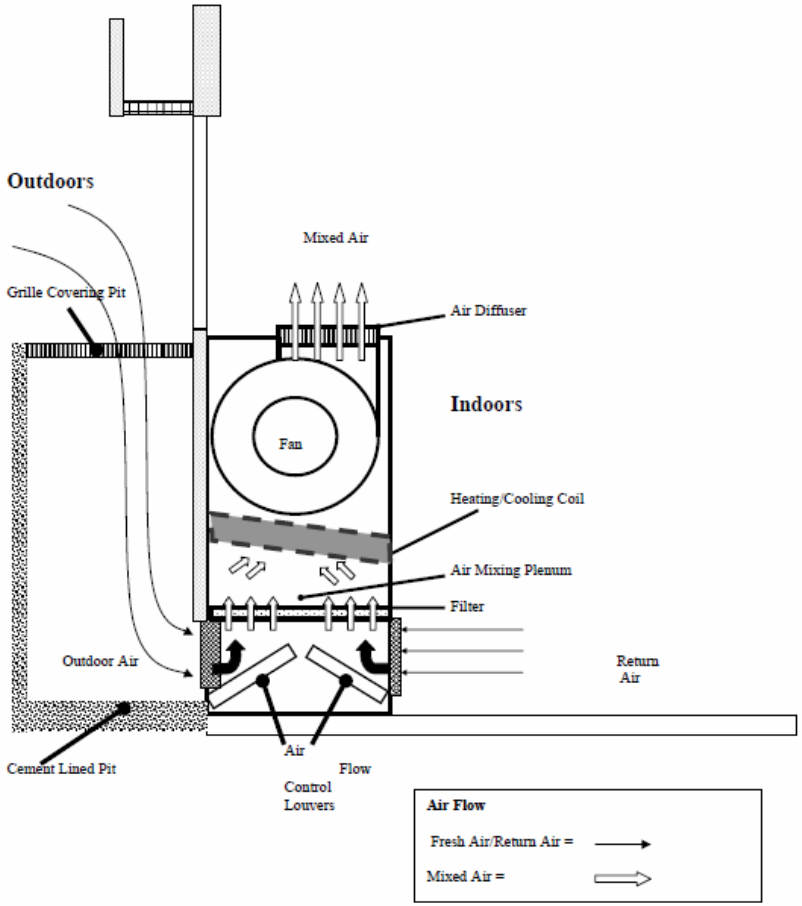
**Typical Unit Ventilator (Univent) Installation**



- General Observations
  - Unit ventilators supply fresh air in A-Block classrooms and outer core of B-Block
  - Univents were deactivated in many areas
  - Obstructions to airflow observed in may areas

# Results – IAQ

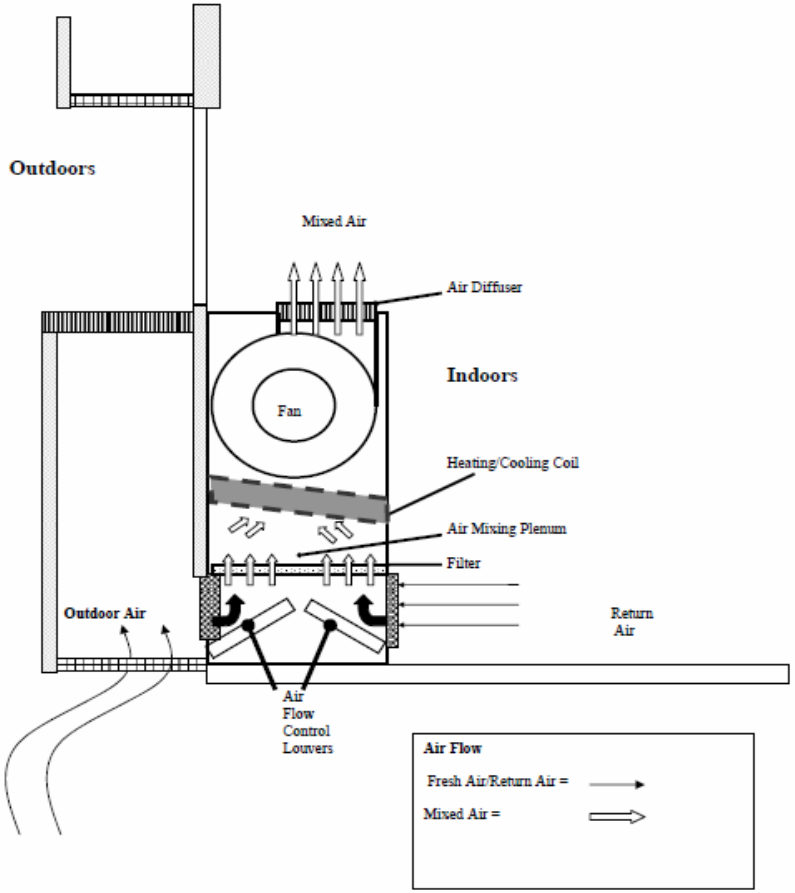
**Ground Floor Unit Univent Configuration**



- Ground floor fresh air intakes in cement-lined pits
- Bird screens covering pits often covered with thick layer of pine needles
- Debris often observed in pits

# Results – IAQ

**2nd and 3rd Floor Unit Univent Configuration**



- Fresh air intakes behind spandrel panel
- Cement windowsill caps space between exterior wall and spandrel
- Metal grate located at bottom of spandrel

# Results – IAQ

- **Air intake grates were damaged and missing**
- **Bird nesting behind the spandrels**
- **Bird Waste**
  - **Diseases associated with exposure**
    - **May affect both healthy and immune compromised people**
    - **Hypersensitivity pneumonitis**
    - **Psittacosis**
- **Grate repair**
- **Cleaning & disinfection**

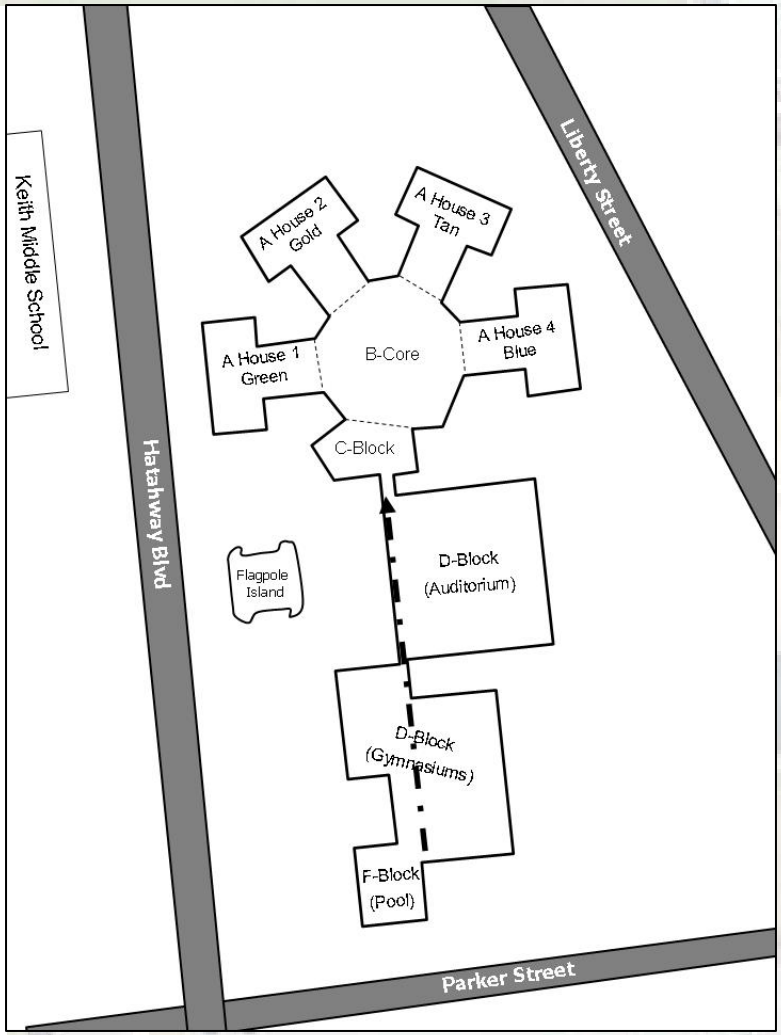
# Results – IAQ

## Other HVAC Mechanical Systems

- Air-handling units (AHUs) provide ventilation in large areas and some offices and classrooms
- No airflow detected in many areas at time of assessment
- Specialized Exhaust Ventilation
  - Restroom exhaust fans were off at the time of assessment
  - Auto shop exhaust ventilation not operating during assessment

# Results – IAQ

- Pool odors
  - **HVAC in pool area not exhausting air**
  - **Pool odors observed ~500 ft from pool**
  - **Relative humidity**
    - **In pool = 60%**
    - **In hall = 70% (10% > than pool)**
  - **Evidence of water damage observed on wall above doorway to pool stairwell and ceiling in hallway**
  - **Efflorescence observed on both the interior and exterior walls of the pool**



# Results – IAQ

- Pool Odors

# Results – IAQ

Condensation in lower level of NBHS

- **Staff reported water on floors in ground level throughout building**
- **Univent intakes covered with pine needles from trees adjacent to the A Houses, holding moisture inside air intake pit**
- **Floor temperatures in 42 of 51 rooms at or below dew point**
- **Observed swollen floor glue**
- **Evidence of chronic condensation problem near freezer in kitchen, cold air leaking from freezer door**

# Results – IAQ

Building-wide Issues

- Leaks
  - Roof
  - Windows
  - Observed area of visible mold
- Breaches exterior walls
- Plants

# Results – IAQ

Building-wide Issues (continued)

- Plant and moss growth
- Shrubs/trees close to building
- Breaches in exterior of building

# Results – IAQ

Other IAQ Concerns

- No measurable levels of carbon monoxide detected
- PM 2.5 below NAAQS, except for in restrooms due to smoking and deactivated exhaust ventilation

# Results – IAQ

## Other IAQ Concerns

- Observed sources of VOCs in some classrooms
  - Air fresheners and reed diffusers
  - Cleaning products
  - Dry erase boards and markers
- Accumulated dust
  - On air diffusers and exhaust vents
  - On personal fans
  - On items stored in classrooms
  - Chalk dust and pencil shavings

# Results - IAQ

- Recommendations will be made in several areas:
  - Pool area
  - HVAC system
  - Mold and moisture issues

# Environmental Toxicology Program

## Evaluation of Indoor Air Data

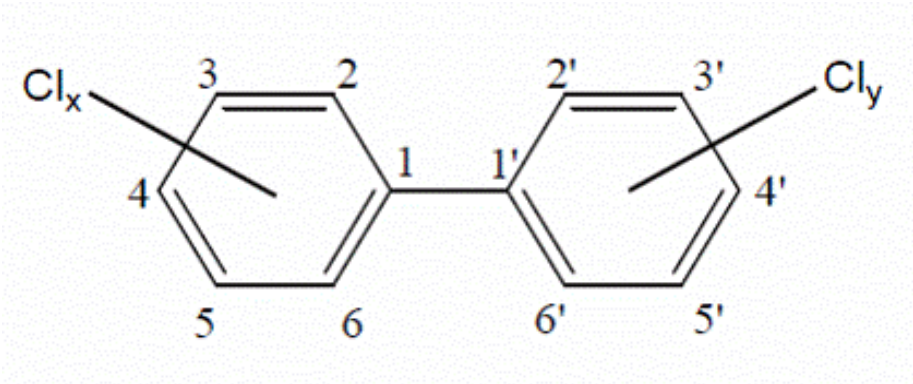
## &

## PCB Exposure Assessment

# Introduction – Exposure Assessment

## What are PCBs?

- Polychlorinated biphenyls (PCBs) refer to a class of chemical compounds with 209 possible congeners in which chlorine atoms have replaced some or all of the hydrogen atoms in the biphenyl molecule.
- Were historically used in electrical components (e.g. capacitors) and in building materials (e.g. caulking), among other uses
- PCBs were sold in the U.S. commercially as mixtures known by the trade name Aroclor (e.g. Aroclor 1254)



# Introduction – Exposure Assessment

## PCB exposure and cancer

- Although the epidemiological evidence is sometimes conflicting, most health agencies have concluded that PCBs may reasonably be anticipated to cause cancer.

# Methods – Exposure Assessment

- Environmental Toxicology Program (ETP) staff evaluated indoor PCBs testing data from 2006 through Feb 2011
  - Air, wipe, and bulk samples
    - Air samples most relevant for potential health impacts
  - Developed quantitative estimates of health risks associated with opportunities for PCB exposure
  - Reviewed indoor air results by floor/wing
  - Evaluated across sample types in areas where multi-media samples collected
  - Compared PCB levels to results of the IAQ evaluation (e.g., rooms with poor ventilation may have higher levels of PCBs)

# Methods – Exposure Assessment

Health-Based Screening Values

- Used to determine whether chemicals found at a location need further evaluation
- Specific to each chemical and each environmental medium (i.e., air)
- Generated by U.S. ATSDR, U.S. EPA, etc
- Based on scientifically peer-reviewed values
- Available for PCBs in air: ATSDR Cancer Risk Evaluation Guide (CREG) = 0.01 $\mu g/m^3$

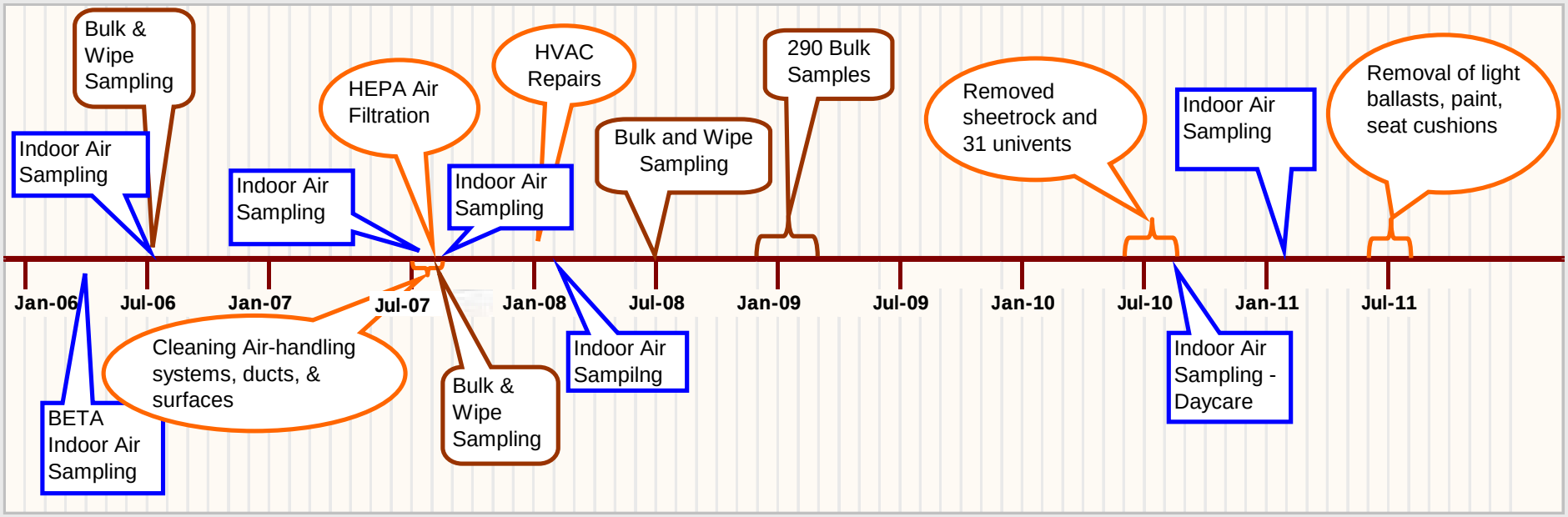
# Methods – Exposure Assessment

Clean-up Standards and Guidelines

- Used to determine whether chemicals need to be cleaned/removed
- Available for PCBs in surface wipes
  - CA clean up guidance (0.1 µg/100cm$^2$)
  - EPA regulatory clean up standard (10 µg/100cm$^2$ ) for residential settings

# Results – Exposure Assessment

## Timeline of Indoor Sampling for PCBs



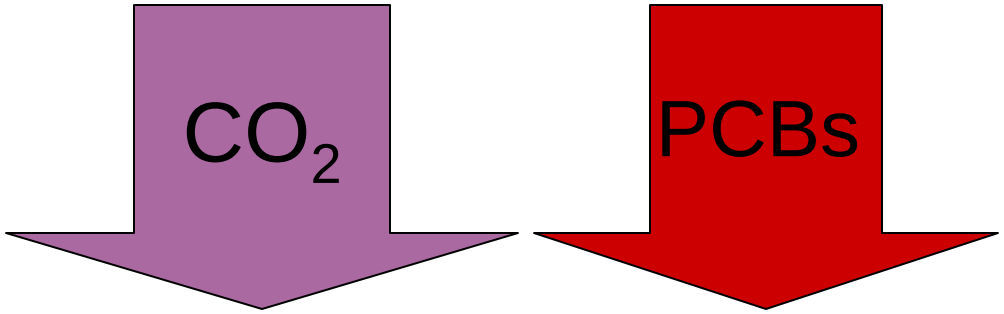
# Results – Exposure Assessment

- Overview of Indoor Air Sampling 2006-2008
  - 89 samples collected from 30 locations inside NBHS
    - 75 of 89 samples > CREG
    - 24 of 30 locations had $CO_2$ measurements
      - 20 of the 24 with $CO_2$ measurements > CREG
        - 9 locations > CREG had $CO_2$ levels > 800 ppm
        - 11 locations > CREG had $CO_2$ levels < 800 ppm <u>but had low to no occupancy</u>
        - 4 locations < CREG had $CO_2$ levels < 800 ppm
- Inadequate ventilation likely contributed to higher PCB levels in indoor air

# Results – Exposure Assessment

## Environmental Testing

- A comparison of PCB and CO2 levels suggests that when ventilation is adequate, PCB levels are lower



# Results – Exposure Assessment

- Overview of Indoor Air Sampling (continued)
  - Daycare sampled in Aug 2010 and Feb 2011
    - < CREG and ND
  - Feb 2011 48 samples collected
    - 25 of 48 samples had detectable levels of PCBs
    - 17 of 25 detects > CREG
    - 3 classrooms closed, PCB residue leaking from fluorescent light ballasts in these rooms
      - Residue removed and air retested (results pending)

# Results – Exposure Assessment

- Overview of Indoor Air Sampling (continued)
  - 20 of the 48 locations sampled in 2011 had been sampled previously in 2008
  - 15 new locations sampled
    - 2 classrooms had highest levels detected at school to date
      - These 2 were among the 3 classrooms closed and PCB residue on light fixtures removed
      - High CO2 levels in these rooms and IAQ inspection noted sub-optimal ventilation

# Results – Exposure Assessment

## Cancer Risk Evaluation – Worst Case Scenario

- MDPH/BEH cancer risk estimates assume worst case scenario
  - Adults exposed to max concentration for 8 hours per day, 180 days per year, for 37 years
  - Students exposed to max concentration for 8 hours per day, 180 days per year for 4 years
- Adults: 5-6 excess cancers in a population of 100,000
- Students: 6-7 excess cancers in a population 1,000,000
- Based on federal health agency guidance, the exposure opportunities that resulted in these risk estimates are not expected to result in unusual cancer risk.

# Community Assessment Program

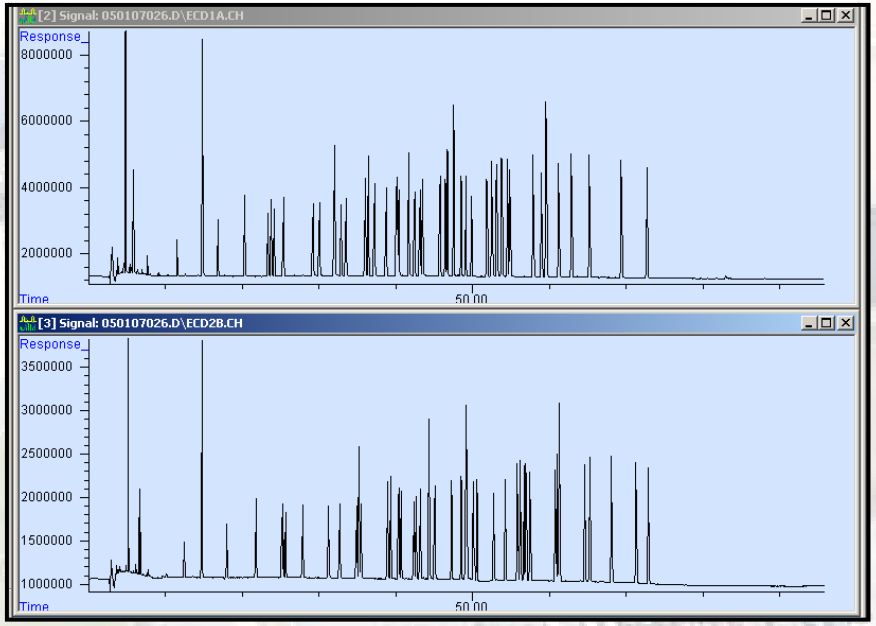
## PCB Blood Serum Testing

# Methods – Serum PCBs Testing

- Phase I
  - Outreach activities
  - Exposure assessment questionnaire
- Phase II
  - Blood testing offer letters sent
  - Blood sample collection
  - Sample analysis

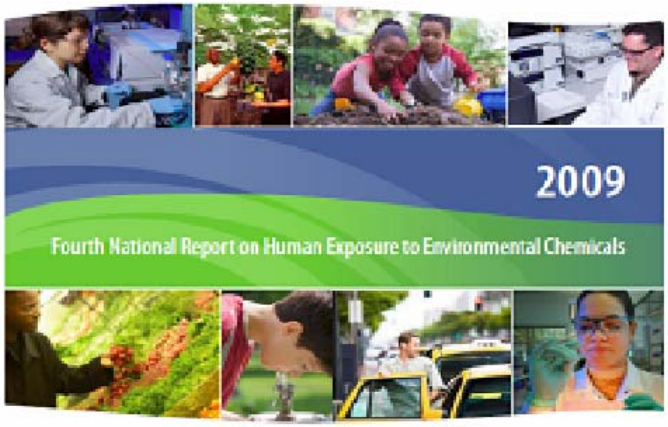
# Methods – Serum PCBs Testing

- Analyzed by MDPH's William A. Hinton State Laboratory Institute
- Results reported as whole weight and lipid-adjusted (adjusted for fat content of serum)



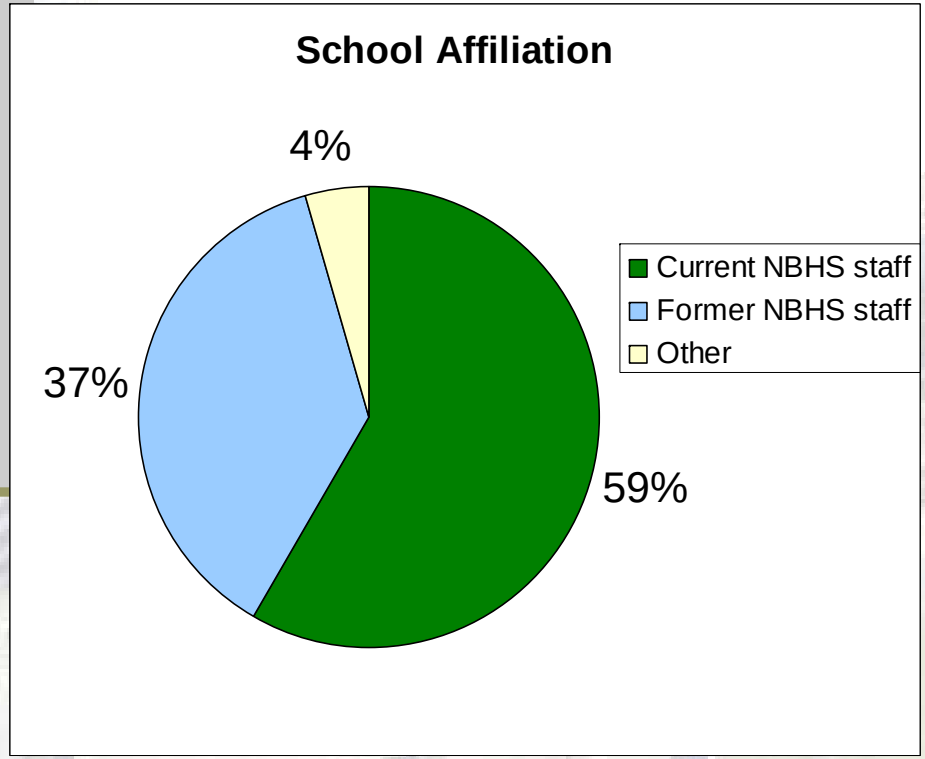
# Methods – Serum PCB Testing

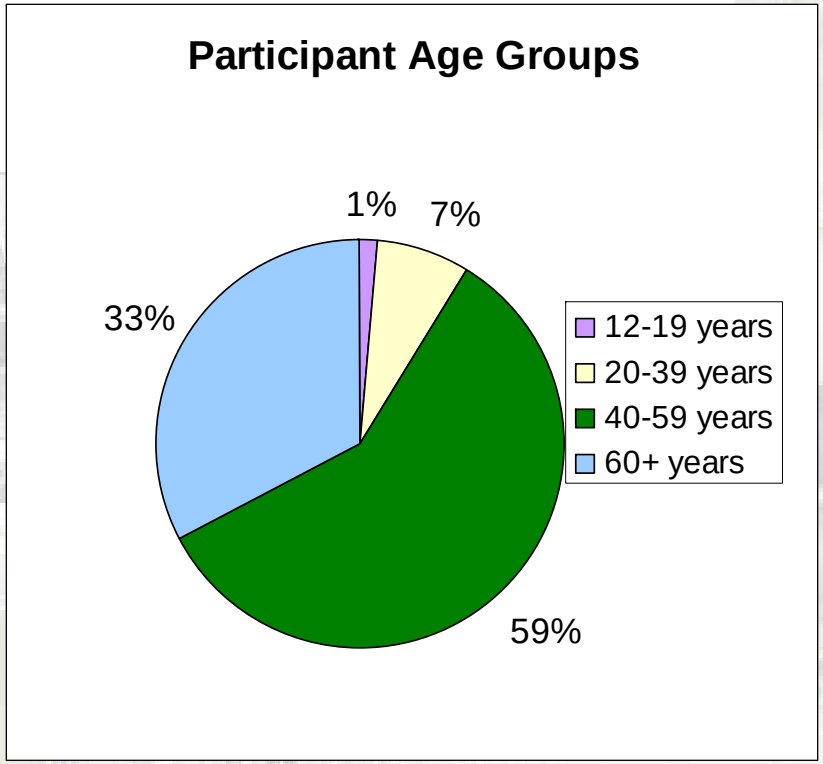
- Results compared with U.S. Centers for Disease Control's National Health and Nutrition Examination Survey
- Comparisons based on age group: 12-19 years, 20-39 years, 40-59 years, and 60+ years
- According to the CDC, the 95th percentile is useful for determining whether serum PCB levels are unusual



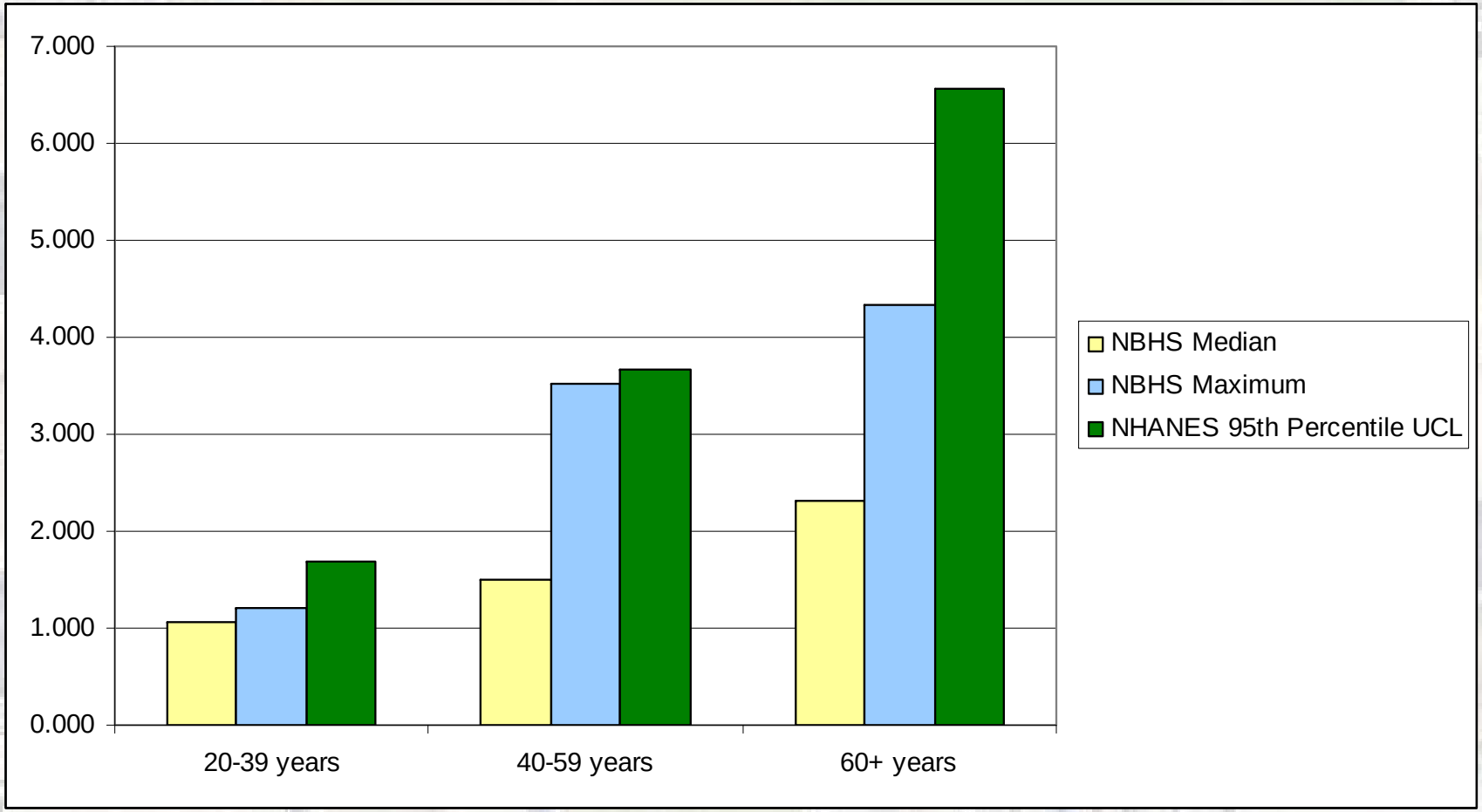
# Results – Serum PCB Testing

- This report summarizes the results for 67 people

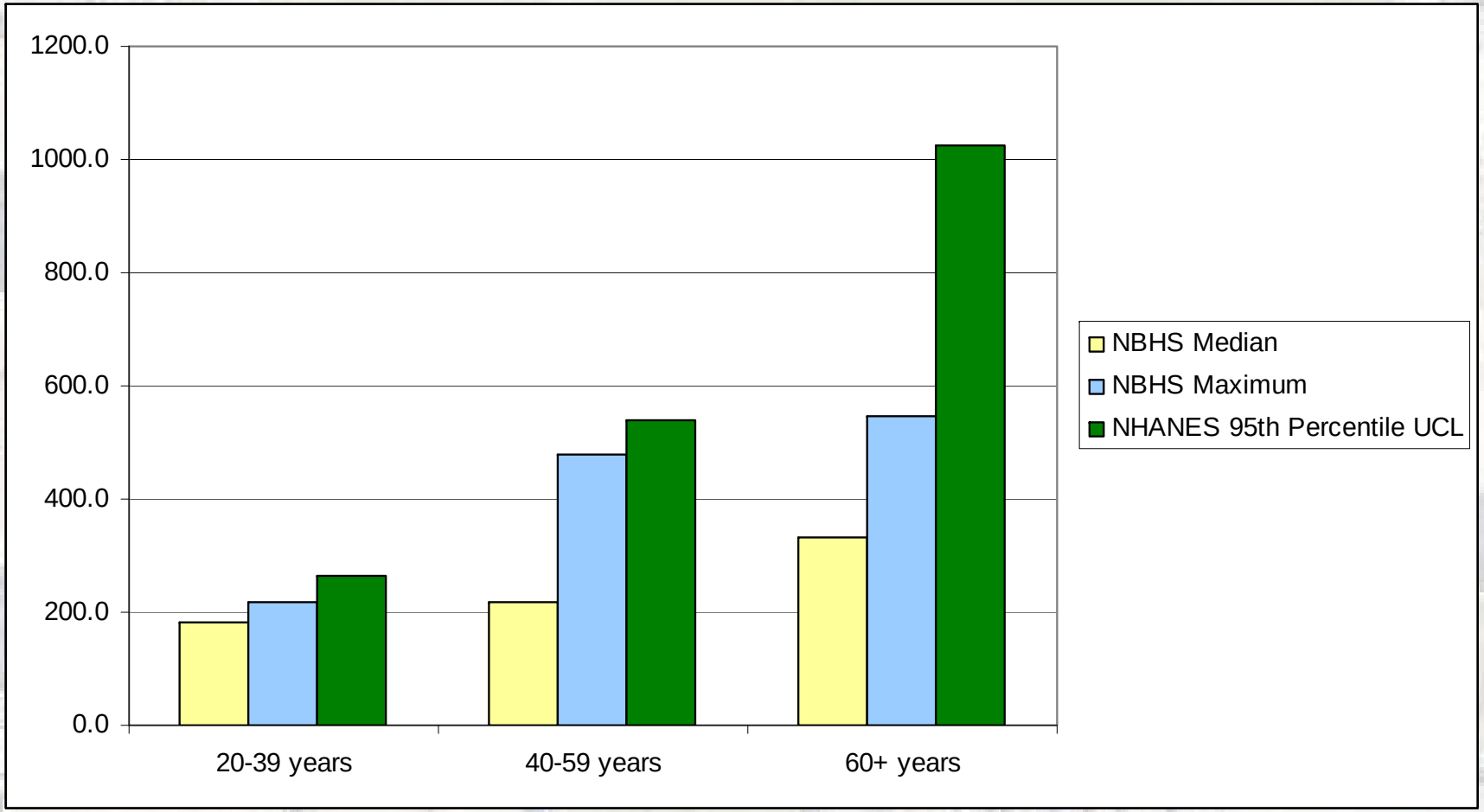


# Results - Serum PCB Concentrations (Whole Weight)



# Results - Serum PCB Concentrations (Lipid-Adjusted)

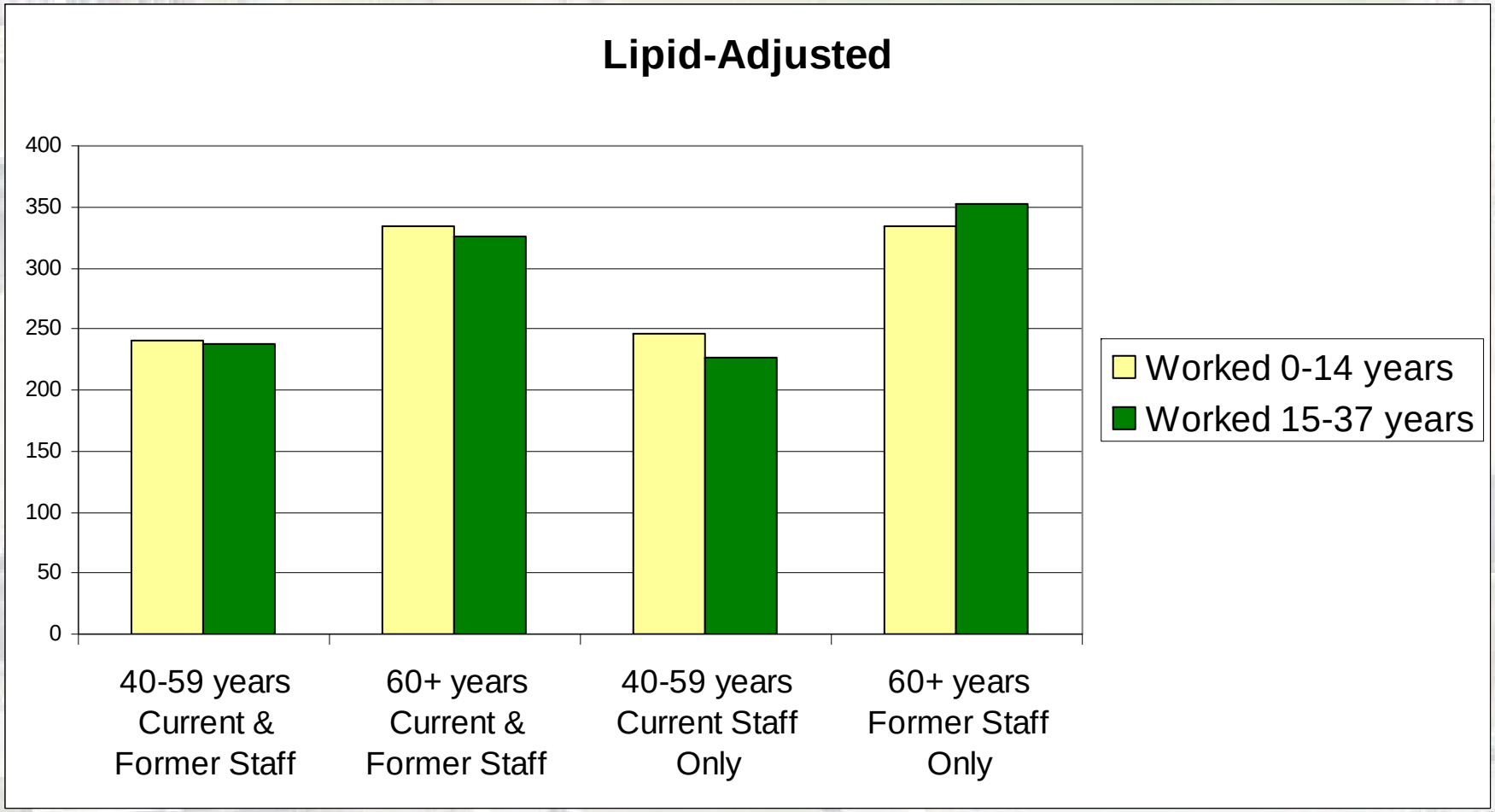


# Results –

## Geometric Mean Whole Weight Serum PCB Levels (ppb) by Years Worked at NBHS

# Results –

## Geometric Mean Lipid-Adjusted Serum PCB Levels (ppb) by Years Worked at NBHS



# Results – Serum PCB Levels Compared with Building Location

- Asked where staff spent the majority of their time inside NBHS
- Most participants indicated that they work or worked in various locations throughout NBHS
- 10 participants identified specific rooms
- 21 reported spending most of their time in one block or house
- No consistent pattern of higher serum PCB levels with higher indoor air levels

# Results – Serum PCB Level in Participants Diagnosed with Cancer

- 6 participants diagnosed with cancer in the last 20 years
- 1 of these 6 reported  working in one of the rooms where indoor air samples were collected for PCB analysis
- Detected indoor air concentrations were among the lowest detected in the school
- The serum PCB concentrations for all six participants are within the range of levels measured in the NHANES 2003-2004 survey

# Results – Serum PCB Levels Compared with Years Worked at KMS

- 14 of the 67 participants work or worked at KMS for 1 to 3 years
- PCB concentrations in air consistently below health-based comparison values
- Remedial work prior to construction has eliminated the potential for contact with contaminated soil on the KMS property
- Qualitative review found no clear pattern of higher serum PCB levels with more years worked at KMS

# Results – Serum PCB Levels Compared with Years Worked at the Former Keith Middle School

- 26 of the 67 participants work or worked at KMS for 1 to 20 years
- Serum PCB levels (by age group) versus the number of years they reported working at the Former Keith Middle School were examined
- Qualitative review found no clear pattern of high serum PCB levels with more years worked at KMS

# Community Assessment Program

Health Concerns and Cancer Incidence

# Methods – IAQ Health Concern Evaluation

Information regarding NBHS employee health concerns were gathered from the following sources:

- BEH conducted interviews with NBHS staff at the time of the IAQ inspections at the school (April 29 and 30, 2008);
- An MDPH contractor conducted exposure assessment interviews with some current and former NBHS staff as part of the PCB blood serum testing program;
- A petition, signed by NBHS staff, requesting a health assessment and medical testing was sent to the former Director of the NBHD, and forwarded to MDPH;
- Supplemental information collected and distributed by a local advocacy group obtained via an email; the email distribution list included BEH.

# Methods – IAQ Health Concern Evaluation

- All information was reviewed to identify:
  - the types of symptoms reported,
  - their frequency of occurrence,
  - any unusual patterns
- Analysis Response Classification
  - Asthma
  - Other Respiratory Symptoms
  - Allergy Symptoms
  - Central Nervous System Effects

# Results – IAQ Health Concern Evaluation

## IAQ Interview Results (n=42)

- Respiratory effects (n=33)
  - Sinus congestion
  - Upper respiratory infection
  - Colds
- Allergy symptoms (n=14)
- CNS symptom (n=23)
  - Headaches

# Results – IAQ Health Concern Evaluation

## Exposure Assessment Interview Results (n=67)

- Respiratory effects (n=9)
  - Sinus congestion
  - Runny nose
  - Sore throat
- Allergy symptoms (n=8)
- Asthma (n=3)
- CNS effects (n=6)
  - Fatigue and/or tiredness

# Results – IAQ Health Concern Evaluation

## Symptomology and building location

- 36 individuals reported working predominantly in one location during the work day
  - $CO_2$ levels were above the recommended 800 ppm in about half of these rooms

# Results – IAQ Health Concern Evaluation

## General Indoor Air Quality (n=109)

- 24 reported problems with the ventilation
- 13 reported concerns regarding the presence of mold/water damage in the school
- 13 reported the presence of excessive dust
- Indoor temperatures and concerns regarding pests were also mentioned

# Results – Cancer Pattern Evaluation

## Evaluating Cancer Patterns

- What types of cancer are involved?
- Do the cancer types share similar etiologies (i.e., causes/characteristics)?
- How does the relative frequency of the various types of cancer reported compare to what is known about the occurrence of cancers in the population of Massachusetts as a whole?
- Are there an unusual number of rare cancers?

# Results – Cancer Pattern Evaluation

## Facts About Cancer

- Cancer is not one disease but a group of different diseases
- There are more than 100 types of cancer, each with different risk factors
- One or several factors acting over time can cause cancer

# Results – Cancer Pattern Evaluation

## Facts About Cancer

- American Cancer Society estimates
  - 1 out of every 2 men
  - 1 out of every 3 women
  - 3 out of every 4 families

  → Will develop cancer in their lifetime
- Cancer has a long development period (can range from 15 to 40 years)

# Results – Cancer Pattern Evaluation

## Cancers in the Community

- Calculate an expected rate, SIR and 95% CI
- Review individual diagnosis information
  - Age at diagnosis
  - Cancer sub-type
  - Tobacco use
- Review spatial pattern of address at diagnosis

# Results – Cancer Pattern Evaluation

## Cancers in the Workplace

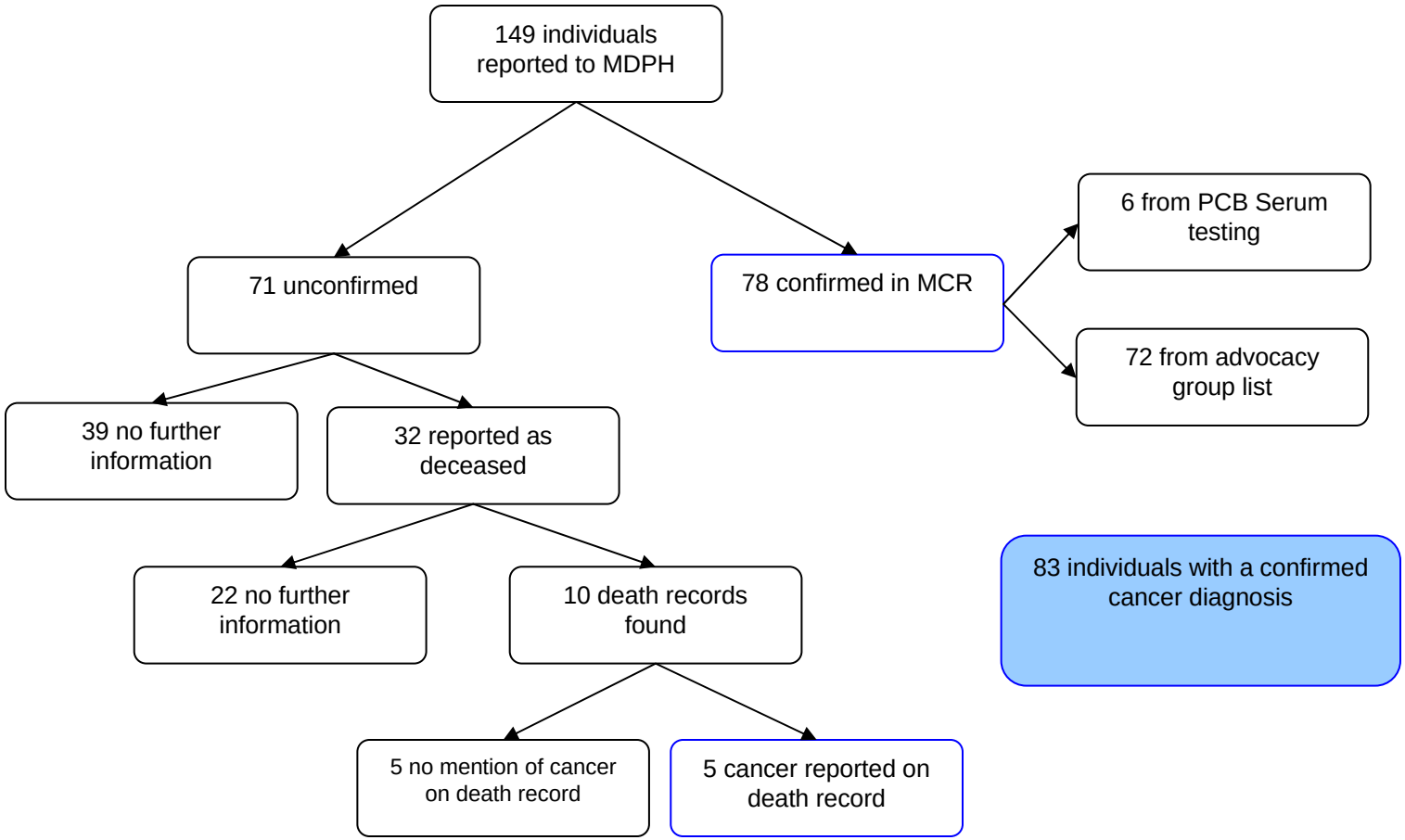
- Types of cancer among staff
- Age and gender of staff in relation to cancer types
- Possible workplace exposure(s)
- Length of employment and work space within workplace
- Development (Latency) period
- Biological plausibility between exposure and disease

# Results – Cancer Pattern Evaluation

## The Massachusetts Cancer Registry (MCR)

- The MCR began collecting cancer incidence data in 1982
- The MCR collects data on all newly diagnosed cancer cases in the state by city or town
- Hospitals have 6 months to report a newly diagnosed cancer case to the MCR
- After receiving the data, the MCR performs extensive quality control, checking each case for errors and removing duplicates

# Results – Cancer Pattern Evaluation



# Results – Cancer Pattern Evaluation

## Cancer Concerns

- 83 individuals identified as having a cancer diagnosis
  - 26 different cancer types
    - breast cancer (n=24),
    - colorectal cancer (n=7),
    - prostate cancer (n=6),
    - lung cancer (n=5)
  - Diagnoses occurred over a 29-year period (1982-2010)

# Results – Cancer Pattern Evaluation

- MDPH received reports of 24 women diagnosed with breast cancer over about 30 years
  - Most common cancer among women
  - Women have a 1 in 8 chance of developing invasive breast cancer during their lifetime
  - Age is the strongest risk factor for breast cancer
    - About 1 in 8 invasive breast cancers in women younger than 45
    - 2 out of 3 invasive breast cancers are in women over 55 years of age
    - Average age at diagnosis for breast cancer diagnoses reported to MDPH is about 55 years of age

# Results – Cancer Pattern Evaluation

- Risk factors
  - Age
  - Genetics and family history
  - Other breast conditions (e.g., dense breast tissue)
  - Alcohol consumption
  - Women who work in professional jobs, including teachers, tend to have an increased risk of developing breast cancer
    - Maternal age at first birth and low parity
    - Likely to have regular mammograms – increases chances of early detection
- Research into possible environmental factors ongoing
  - Compounds found to have estrogen-like properties are of special interest
  - To date, no clear link between breast cancer risk and exposure to these substances

# Conclusions – Cancer and Other Related Health Concerns

- Breast cancer was the most common type of cancer reported among NBHS staff
  - Most commonly diagnosed cancer in Massachusetts
  - Affects 1 out of 8 women nationally
  - Schools' staff often made up predominantly of women – so not unusual for breast cancer to be the most frequently diagnosed
  - Pattern is likely to be consistent with other schools of similar size in Massachusetts and the population in general
    - If the 24 diagnoses represent all of the breast cancer diagnoses
    - Without more information, difficult to draw firm conclusions

# Conclusions – Cancer and Other Related Health Concerns

- In general, the symptoms reported among staff are most commonly experienced in buildings with less than optimal indoor air quality
- Overall there does not appear to be an unusual pattern of cancer
  - Many different types of cancer diagnosed over more than 29 years,
  - Most frequent diagnoses among NBHS employees are the most common types of cancer diagnosed in the general population.

# Conclusions – Serum PCB Testing

- All individuals who were tested and are associated with the NBHS had serum PCB levels within typical range seen in the U.S. population
- No consistent pattern of higher serum PCB levels with increasing years of employment or with building location

# Conclusions – Exposure Assessment

- Based on federal health agency guidance, the exposure opportunities that resulted in these risk estimates are not expected to result in unusual cancer risk.
- However, MDPH recommends taking steps to reduce/eliminate opportunities for exposure to PCBs
  - Cleaning
  - Enhanced monitoring protocols (e.g. deteriorated caulking materials)
  - Regular maintenance

# Conclusions – IAQ

- Deactivation of univents prevents adequate supply of fresh air to classrooms
- Deactivation of exhaust vents
  - Prevents removal of normally-occurring indoor pollutants
  - Prevents removal of other pollutants (pool odors, VOCs, shop pollutants)
- Source of moisture in ground floor areas is condensation resulting from humidification problems in pool area

# Recommendations

- Additional bulk sampling not recommended because indoor levels of PCBs seem to be higher during bulk sampling
- Burned out bulbs should be replaced immediately in light fixtures that may contain PCBs
- MDPH understands that PCB containing light ballasts were removed this summer
- MDPH can work with NBHS to develop O&M plans to address cleaning and bulb replacement

# Recommendations

- Operate all ventilation equipment when the building is occupied.

- Remove all blockages from univents, univent air intakes, and exhaust vents to ensure adequate airflow.
  - Inspect periodically
  - Consider installing wire mesh bird screens over air intakes to prevent further roosting
  - Clean intake vents with an appropriate antimicrobial or use a professional cleaning company.

# Recommendations

- Consult a ventilation engineer
  - to ascertain the best method for increasing fresh air supply in classrooms
  - to plan for the repair and operation of the pool exhaust system

# Recommendations

- Clean expanding mastic between tiles in below grade areas.  Monitor for humidity, condensation and further expansion of tile mastic.

- Ensure roof/window leaks are repaired and replace water-damaged ceiling tiles.  Examine the area above and around these areas for mold growth

# Recommendations

- Additional information required to estimate the actual rate of breast cancer
- Information would be needed for all staff employed at NBHS starting at the first year of diagnosis through current year (i.e. 1982 -2011)
  - This is necessary because in order to calculate an accurate rate of breast cancer, an accurate population number is needed
  - Name, DOB, address, employment history, etc.
  - If this is something that people would want, follow-up meeting recommended with City (including the Health Department and School Dept.) and New Bedford Educator's Association

# Q&A

…Questions?

# Contact Information

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Community Assessment Program: Jan Sullivan

www.mass.gov/dph/environmental_health