

**HEALTH AND
HEALTH COMPLAINTS:
WHY SCHOOLS ARE
DIFFERENT**

By: Russ Crutcher

Goals




- How Schools are Unlike Offices or Homes
- Particles are Not Just Dirt
- It Matters How and Where You Sample

Schools Are Special

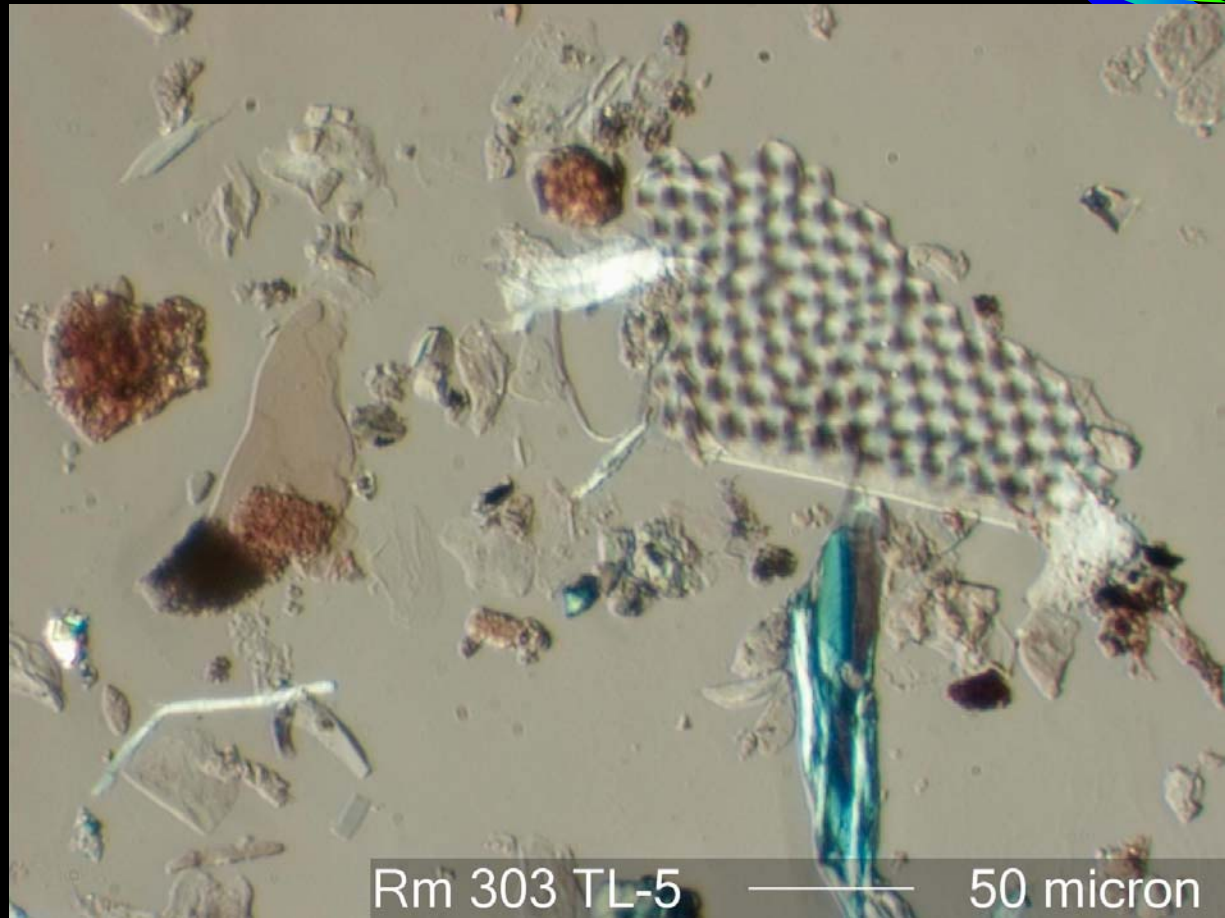
- High Population Density
- High Activity Level
- Utilitarian Construction
- Eclectic Decor and Paraphernalia
- High Surface Area to Volume Ratio

People As Particle Sources

- 
- 3,000,000 Skin Flakes per Minute-Person (MP)
 - Hair
 - Clothing Fiber
 - Track-In, 2,000,000 Particles per MP
 - Shoes
 - Clothing
 - Baggage

People As Particle Sources

- People Generate Particles
 - Skin flakes and clothing fiber
- People Transport Particles
 - Sawdust, insect parts, paper fiber, humus, minerals, dog dander, cat dander, mold, mites, etc.



People As Particle Sources

- Carpet as a Particle Collector
- Classroom Becomes a Particle Repository

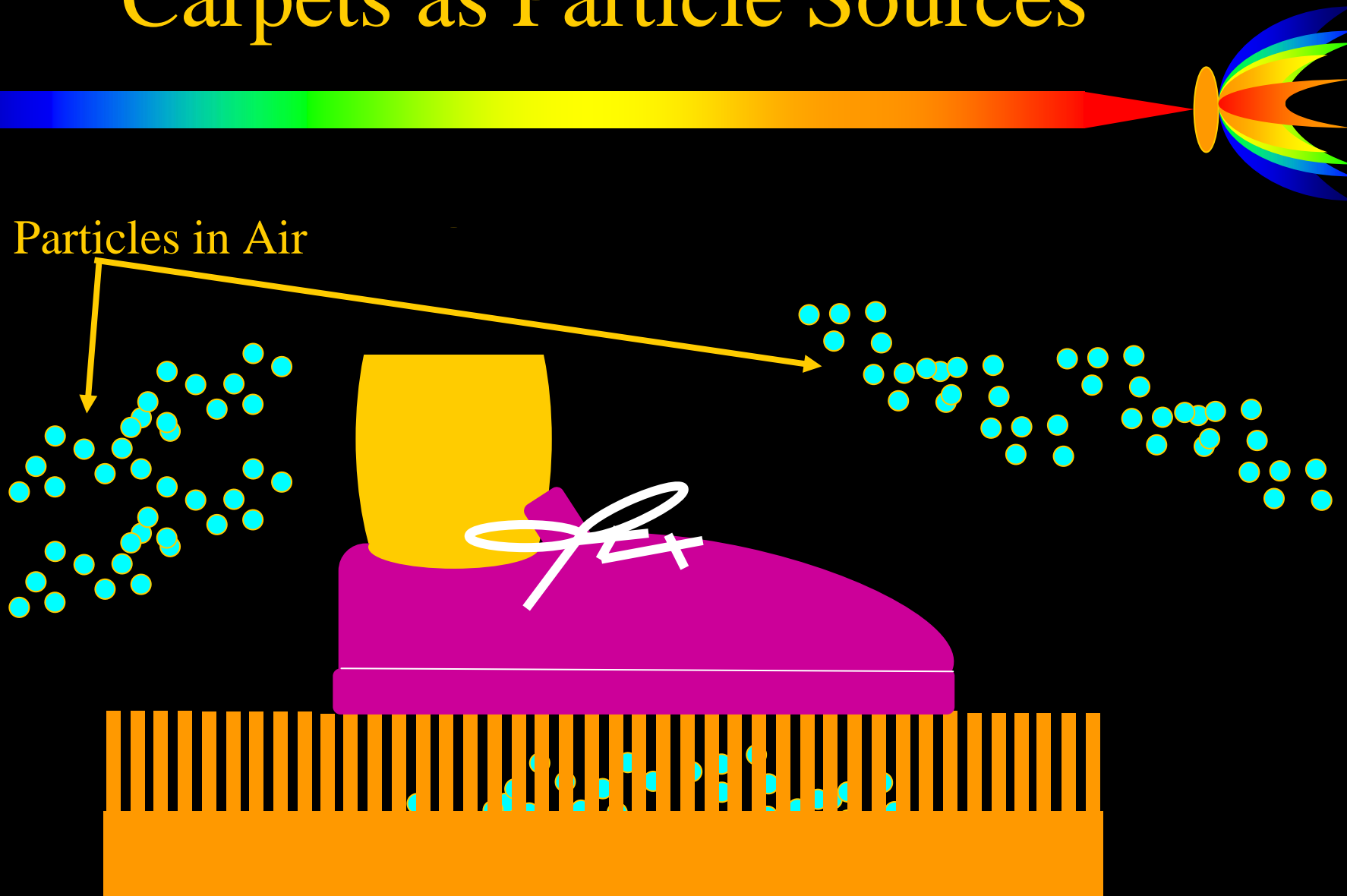


HALLWAYS

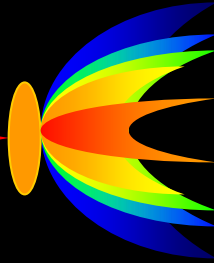


CLASSROOMS

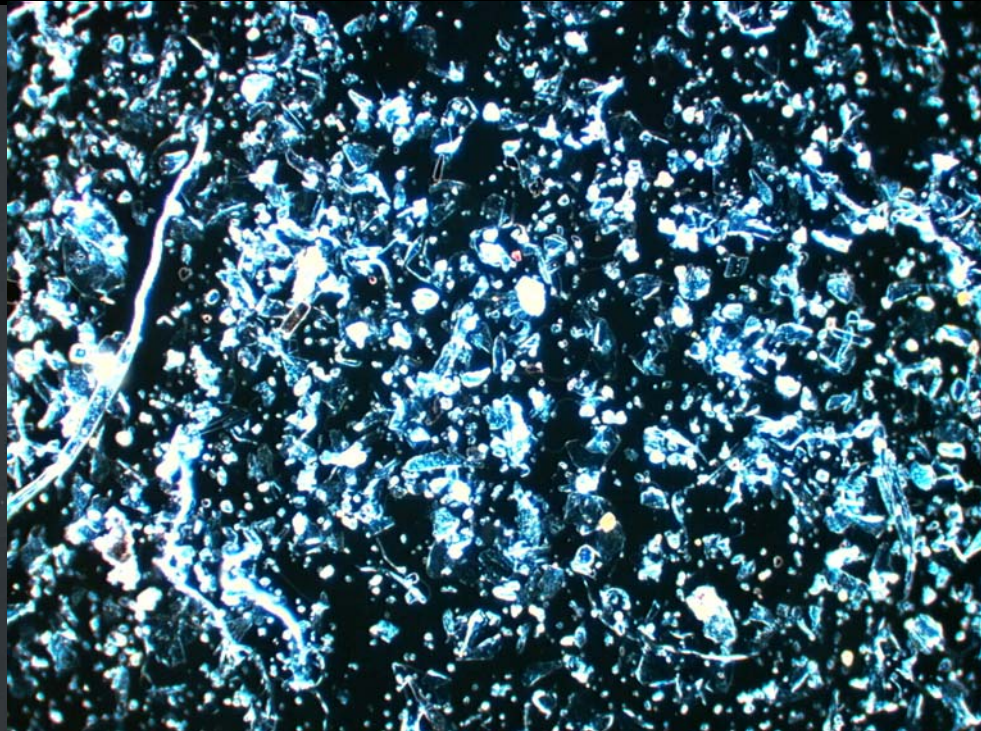
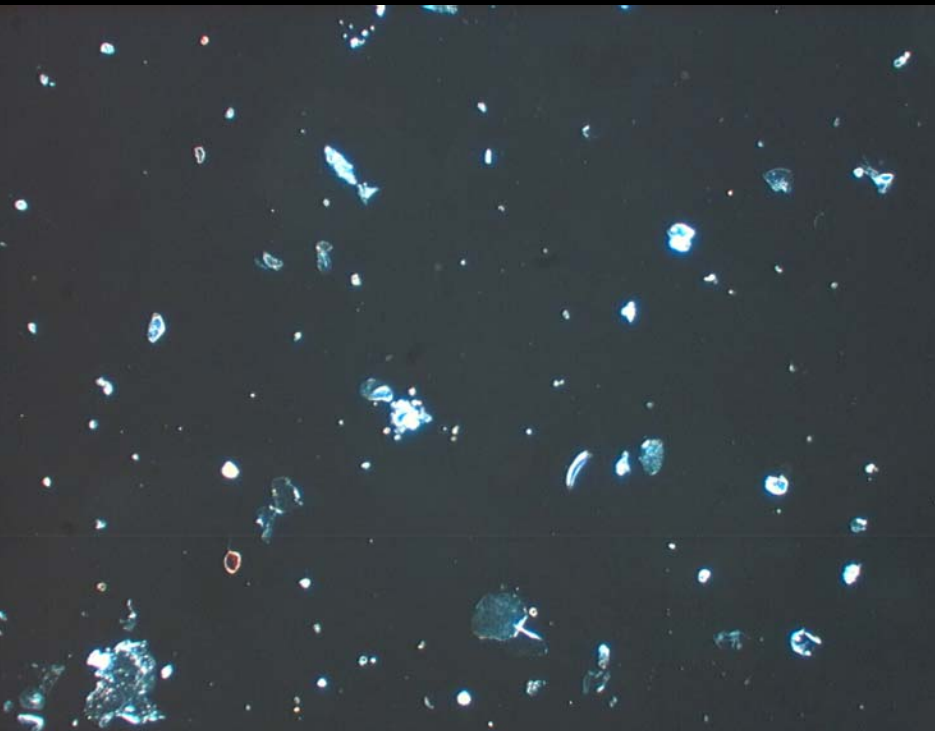
Carpets as Particle Sources



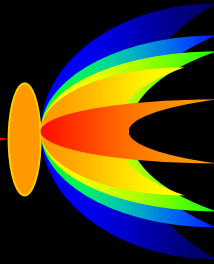
Airborne Particles in Schools



- Room 5 vs Problem School

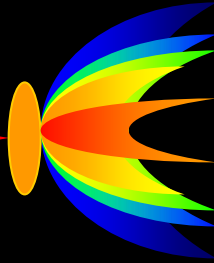


People As Particle Sinks

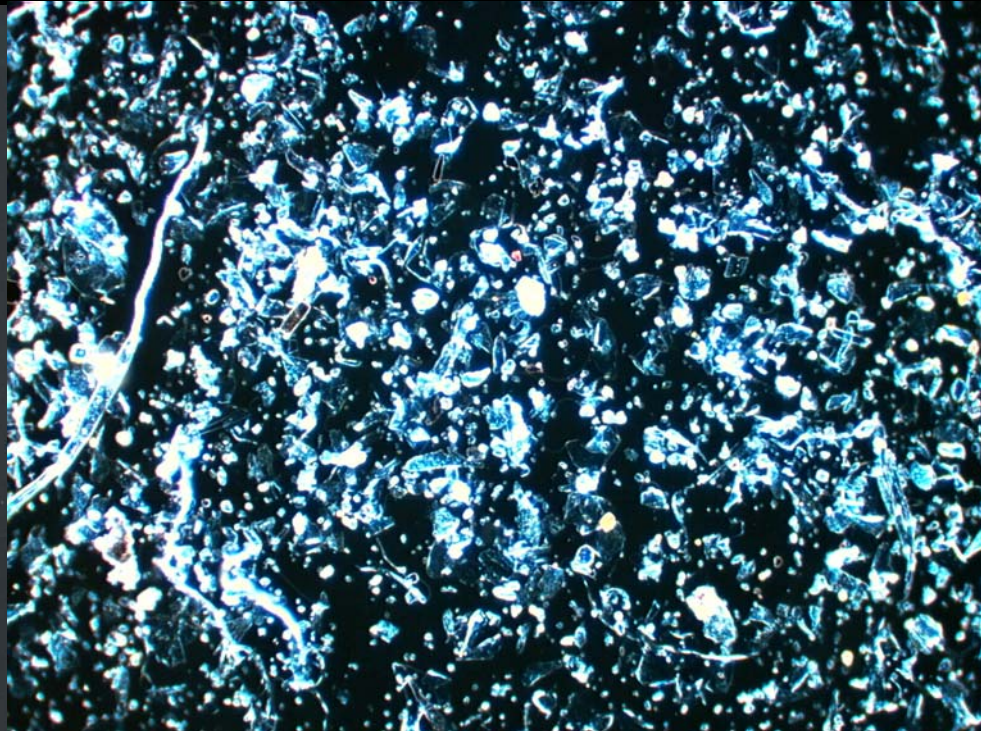
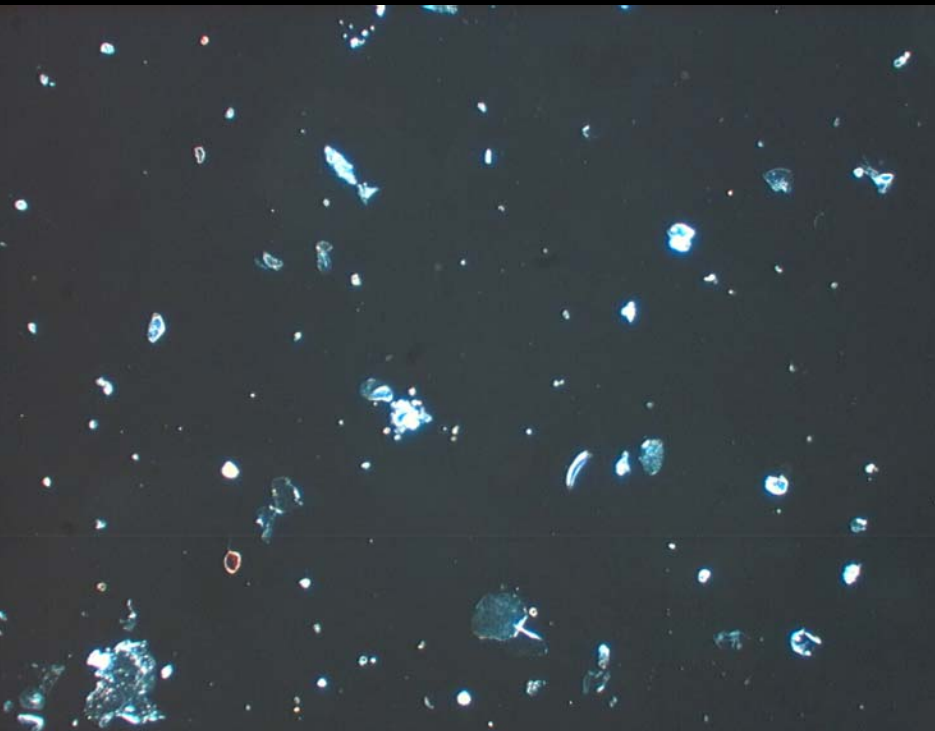


- If 1 Out of 100 is Sensitive
 - In a Class of 33 There is a 28% Chance of Complaint
- If 2 Out of 100 are Sensitive
 - In a Class of 33 There is a 49% Chance of Complaint
- If 3 Out of 100 are Sensitive
 - In a Class of 33 There is a 63% Chance of Complaint
 - In an Office of 6 There is a 16% Chance

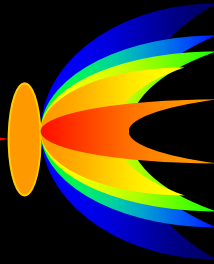
Airborne Particles in Schools



- Room 5 vs Problem School



Activities And Particles

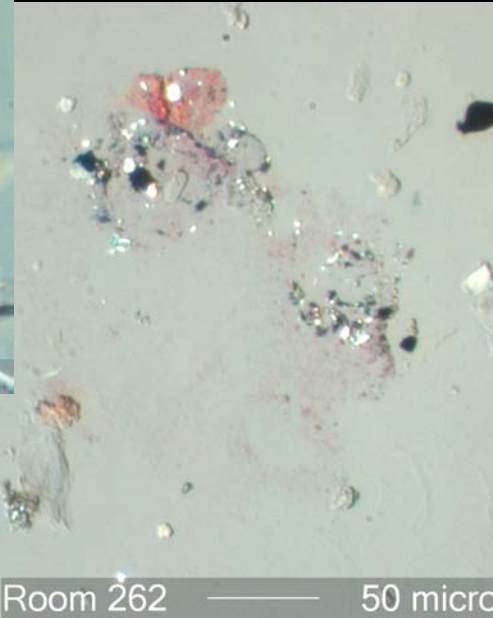


- Paper Shuffling
 - Sizing and Toner
- Pens and Pencils
- Blackboards or Whiteboard
- Projects
- Eating
- Floor Friction
- Cleaning



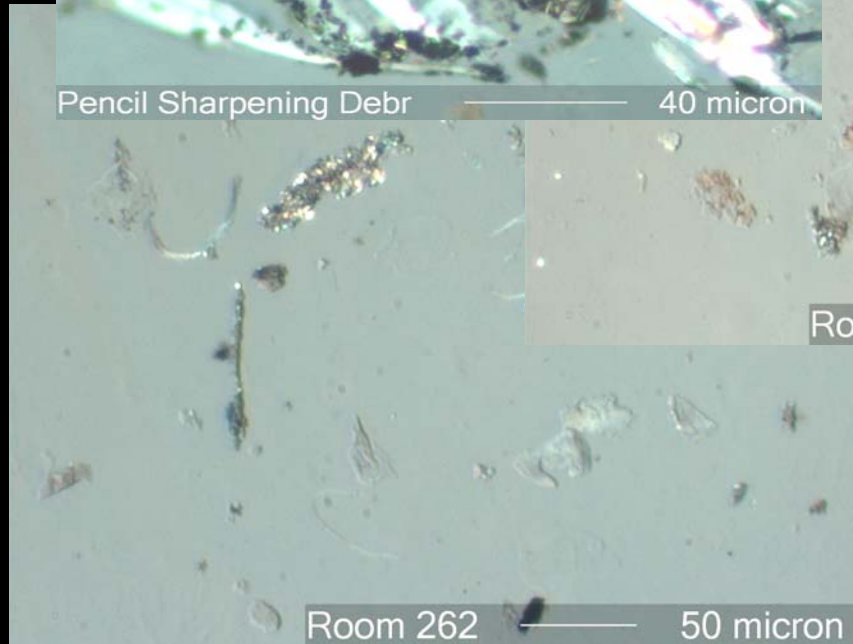
Pencil Sharpening Debr

40 micron



Room 262

50 micron

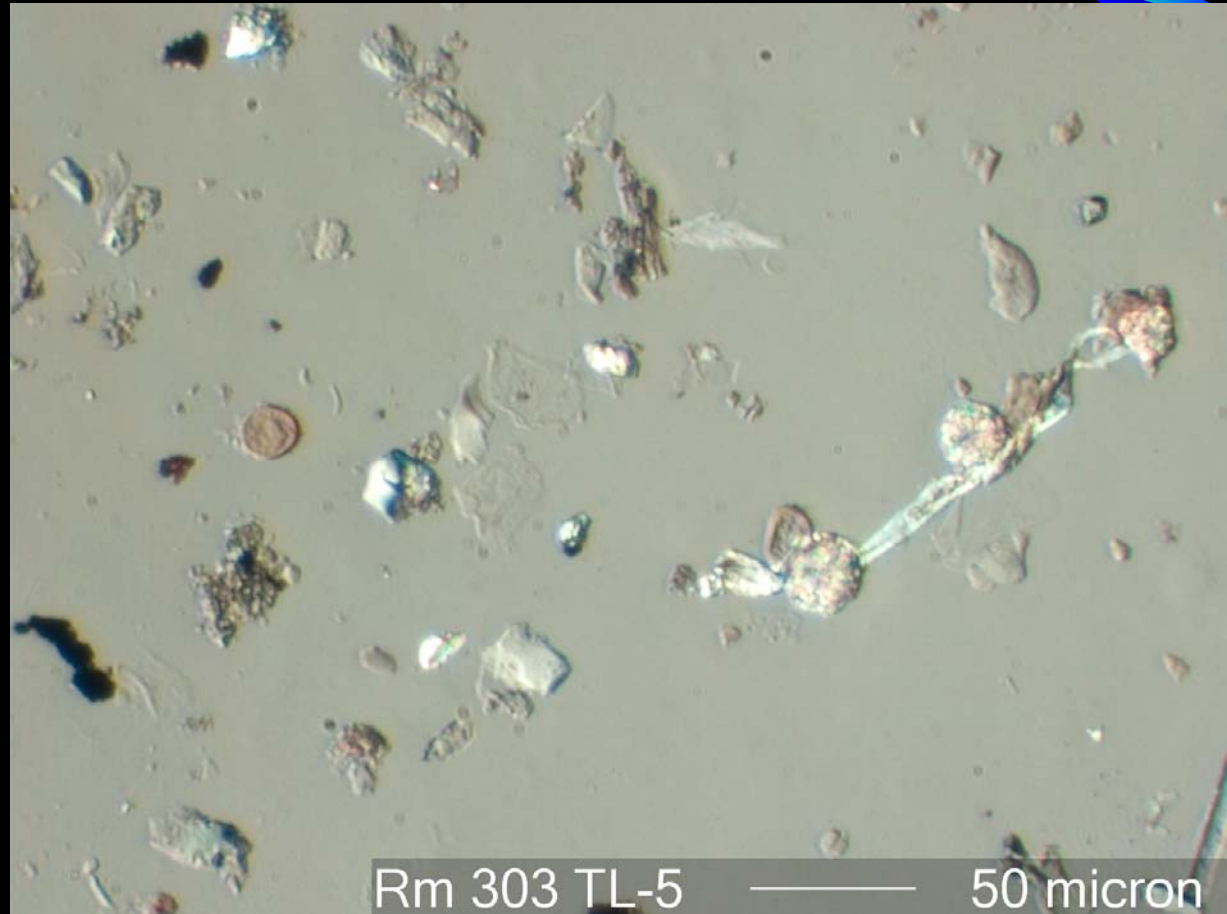


Room 262

50 micron

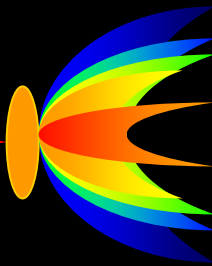
Activities And Particles

- Paper Shuffling
 - Sizing and Toner
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- Blackboards or Whiteboard
- Projects
- Eating
- Floor Friction
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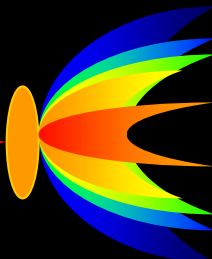


Particles By Design

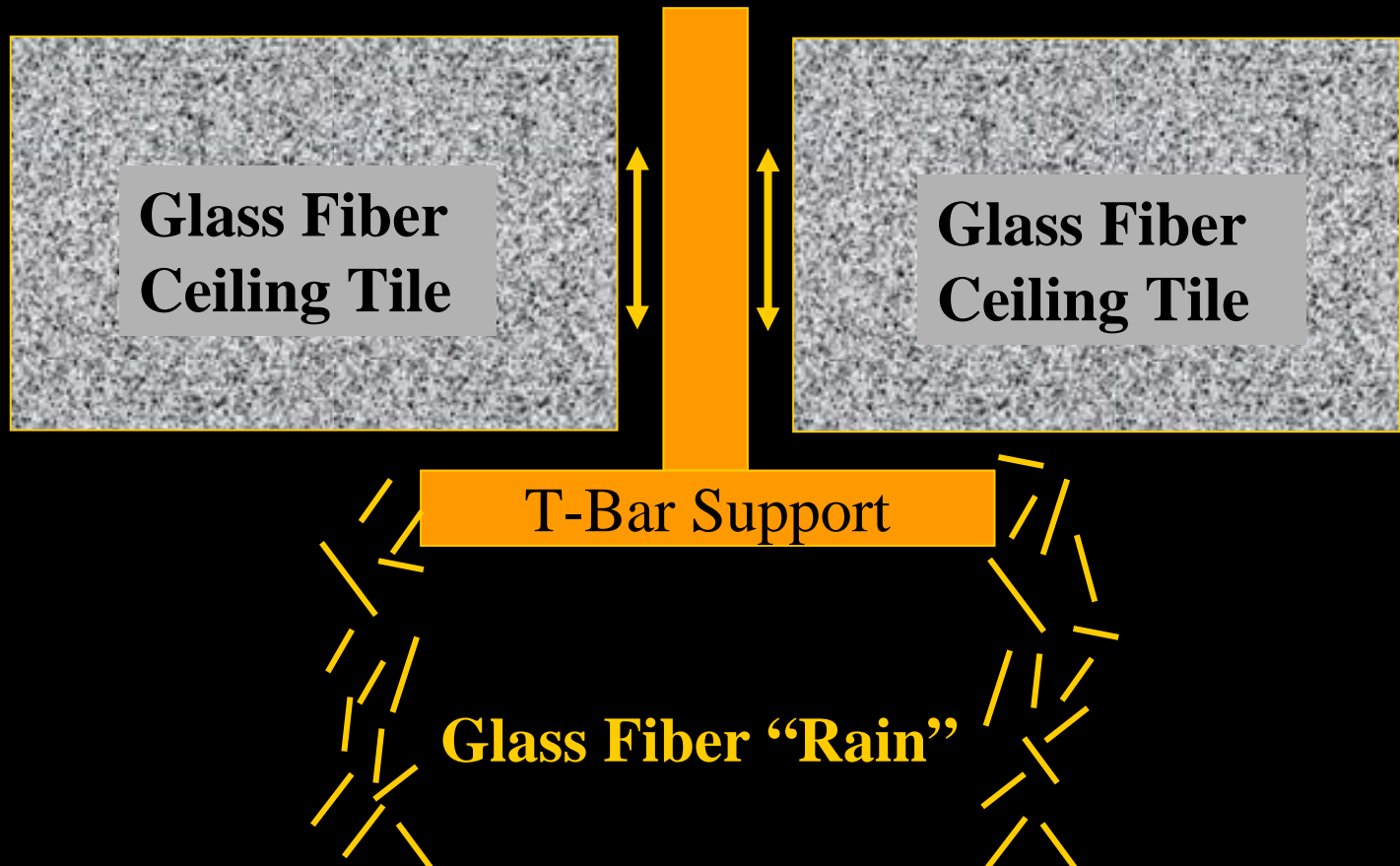
- Acoustic Ceiling Tile
- Glass Fiber Lined Ventilation System
- Glass Fiber Soundboard
- Univent Air Supply
- Shelves and Cabinet Tops



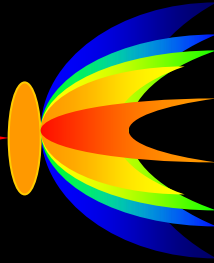
Particles By Design



- Major Glass Fiber Source in Schools

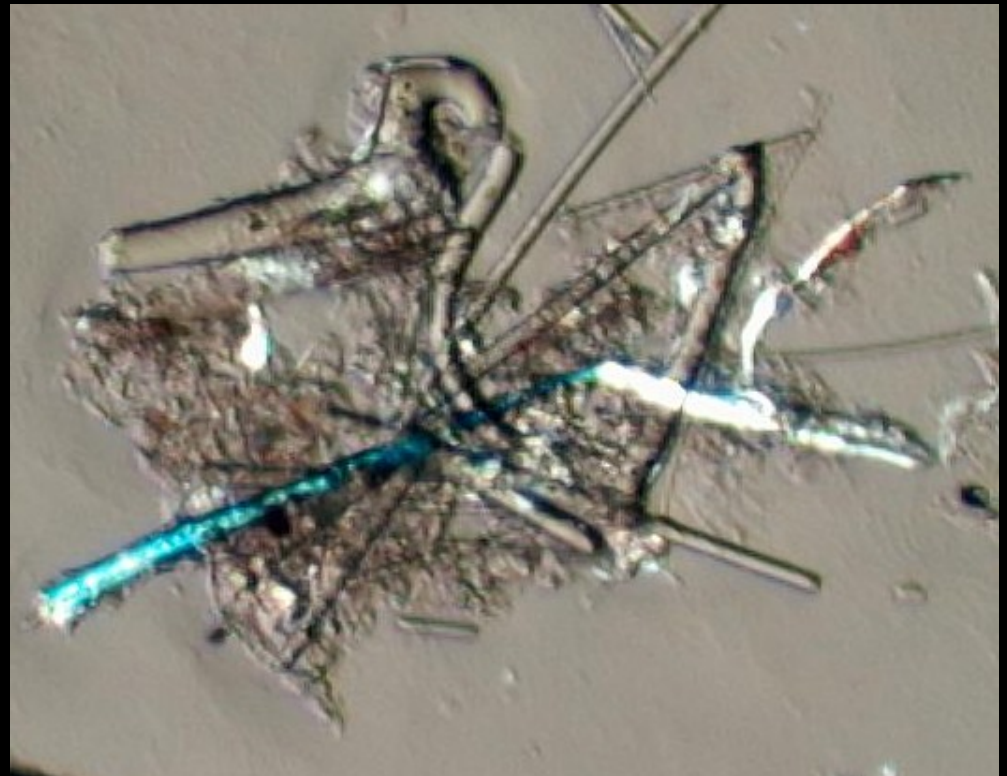


Particles By Design

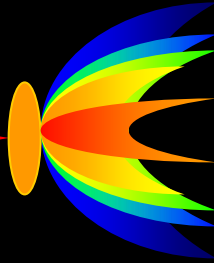


Acoustic Ceiling Tile

- Glass Fiber
- Epoxy
- Calcite
- Paper Fiber



Particles By Design

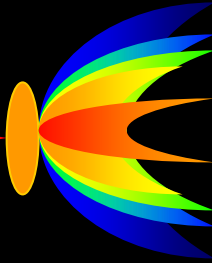


- Univent Air Supply
- Shelves and Cabinet Tops



Special Sources

- Experiments
 - Chemical
 - Biological
 - Physics
- Boxes From Storage
- Exotic Animals
- Art Projects



Special Sources

- Boxes From Storage



Full of Critters
and Irritants




Surfaces And Cleanliness

- The Less Surface to Volume the Cleaner

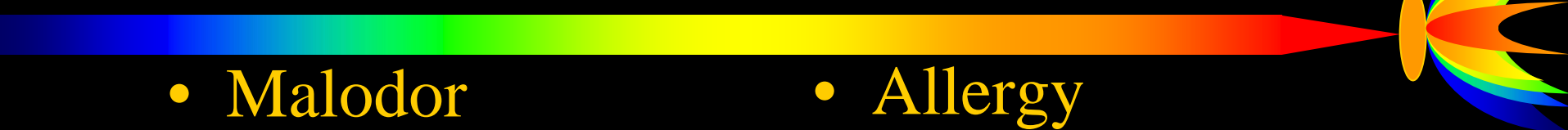
Typical
Classroom?




Health and Health Complaints

- 
- Health and Health Complaints are Not the Same
 - Health is a Condition--May be Unnoticed for Years
 - Health Complaints are a Response to Perception
 - 95% of Health Complaints are Caused by Particles
 - Success is Based on Disappearance of Complaints


Complaints

- 
- Malodor
 - Stuffy Air
 - Rashes
 - Sinus Congestion
 - Dry Itchy Eyes
 - Fatigue
 - Headache
 - Nausea
 - Chest Tightness
 - Allergy
 - Asthma
 - Flu
 - Frequent Illness
 - “Foggy-Headedness”
 - Metallic Taste
 - Soiling
 - Anxiety
 - Other

Source of Complaints

- 
- Carbon Dioxide Above 500ppm
 - Allergens
 - Irritants
 - Toxins
 - Infectious Agents
 - Infestious Agents
 - Mental Anguish (Fears)

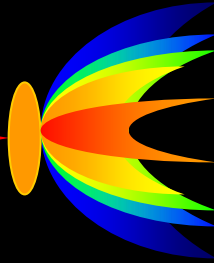
Source of Complaints in Schools

- 
- 15-30%: Glass Fiber, Total Airborne Loading
 - 5-14%: Cleaning Residues, Mold, Vehicle Emissions, Dry Erase Pens, Dust Mites (Der p+f), Ventilation System
 - 1-4%: Copy Machine, Cat, Insect Debris, Other Mites, Plant Parts, Fleas, Lice, Rodent, Bird, Pollen, Industrial Emissions, Fireplace, Human Skin Flakes, Dog
 - 95% of Complaints Attributable to These
 - 5% Other or False Claim

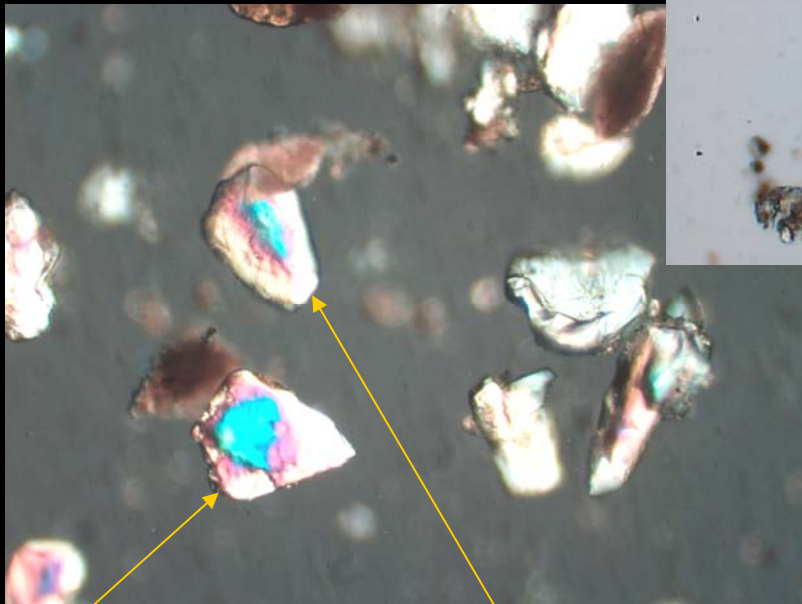
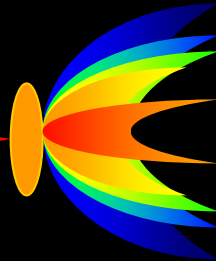
Indoor Particles

- How Many Different Types?

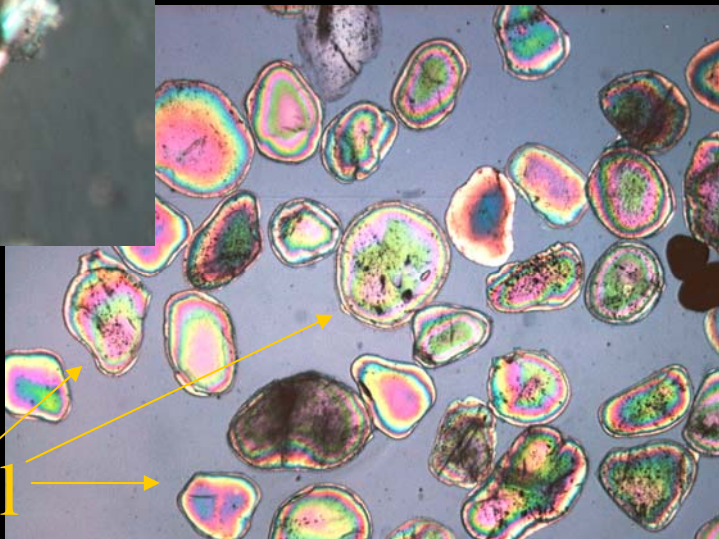
- Glass Fibers: 20 Types, 100's of Sub-Types
- Insect Parts: 10,000+Types, 10s of Features
- Natural Minerals: 10,000+Types, 10's of Varieties
- Fungal Spores: 100,000+Types, Many Look Similar



Mineral Grains



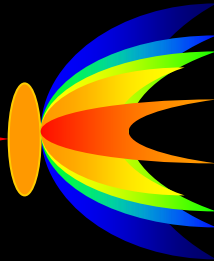
Weathered Mineral



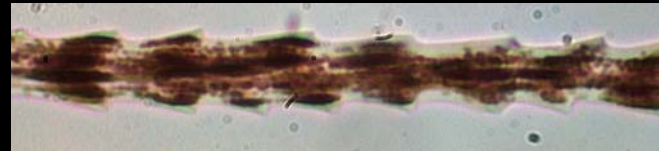
Rounded Mineral

Freshly Formed Mineral

Mammalian Hair



- Hair
 - Intruder?
 - Clothing?
 - Pet?
 - Allergen?



• Bat



• Rat



• Mink



• Mouse

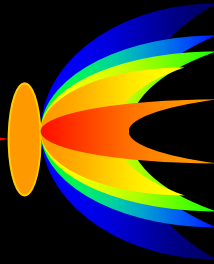


• Cat



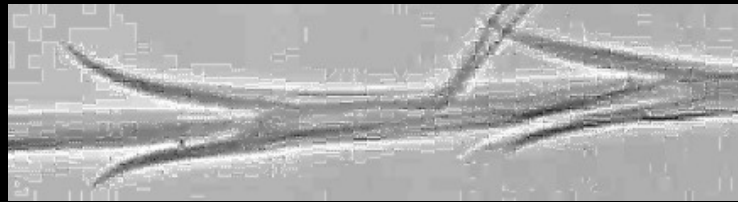
• Dog

Feather Barbules



- Feather Barbules

- Intruder?
- Clothing?
- Pet?
- Allergen?



- Chicken



- Parakeet



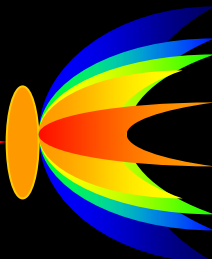
- Finch



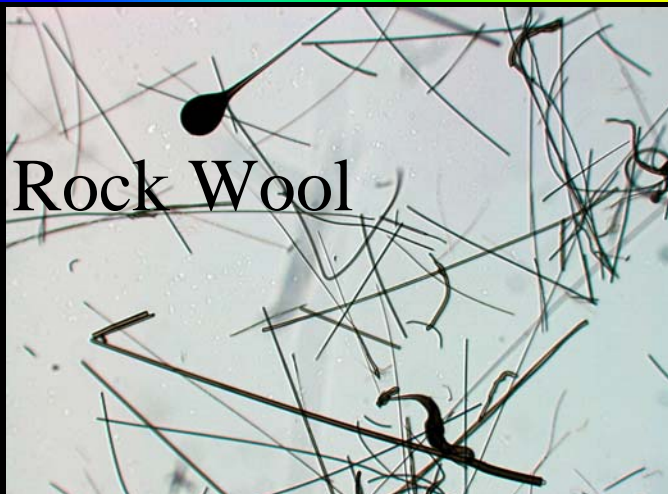
- Pheasant

Spores

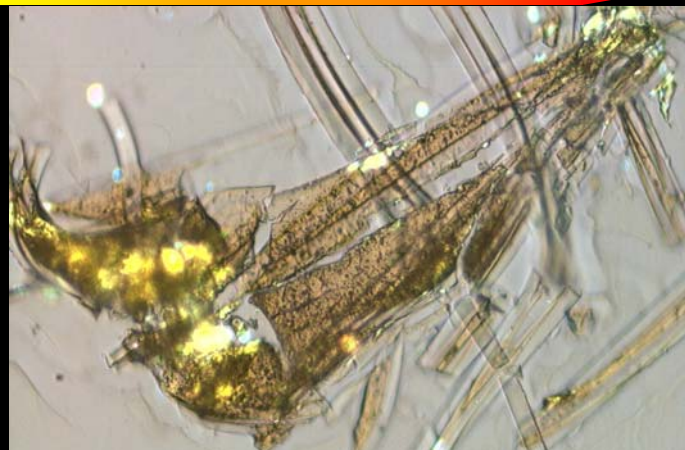
- *Stachybotrys*
 - Toxic Mold!!
- *Aspergillus*
 - Hospital Problem
- *Acrodictys*
 - Cute?



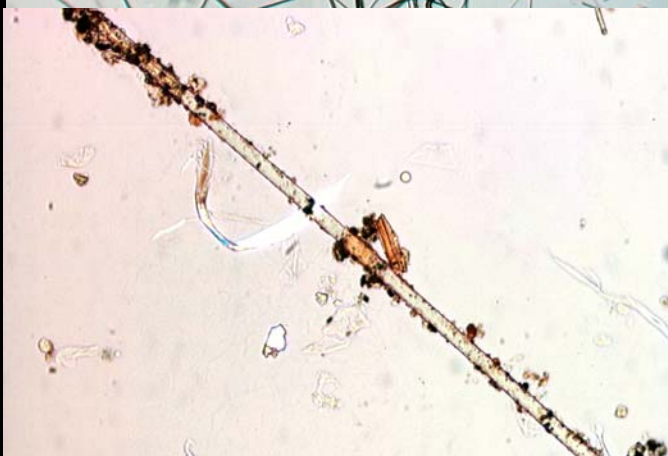
Glass Fiber



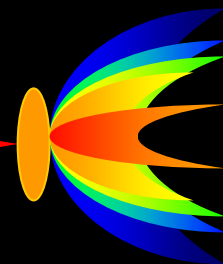
Rock Wool



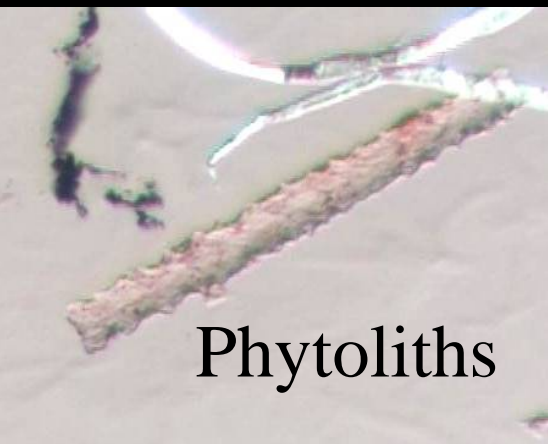
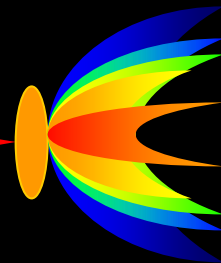
Acoustic Ceiling Tile



Glass Fiber From Ventilation



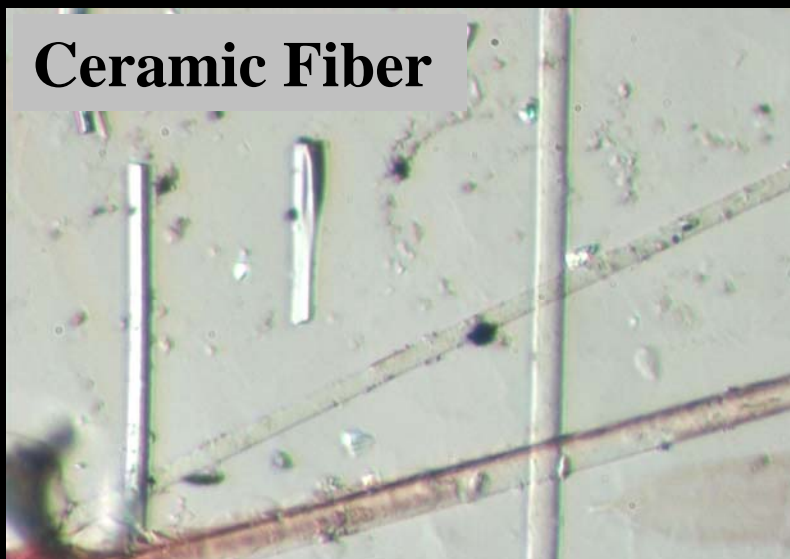
Glass Fiber



Phytoliths

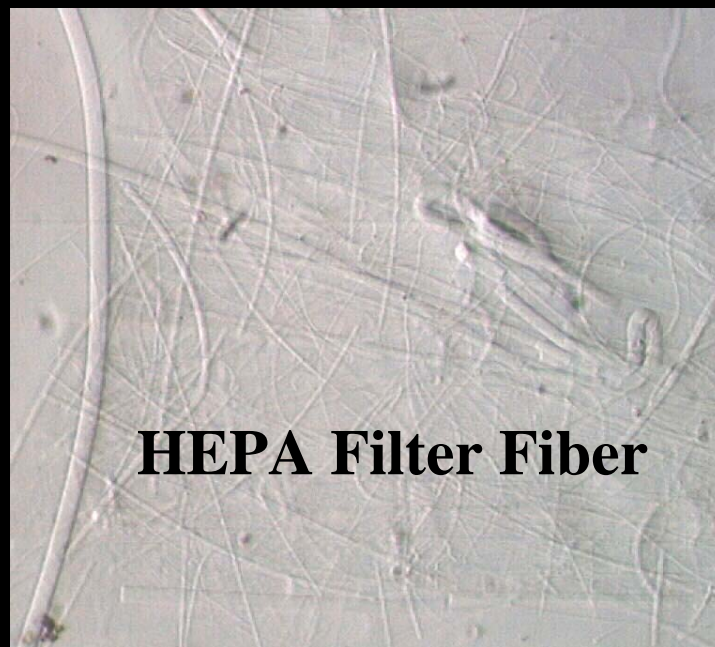


Woven Glass from Cloth



Ceramic Fiber

Glass and Plastic Foam F ————— 40 micron



HEPA Filter Fiber

Starch

Variety of Starch Grains



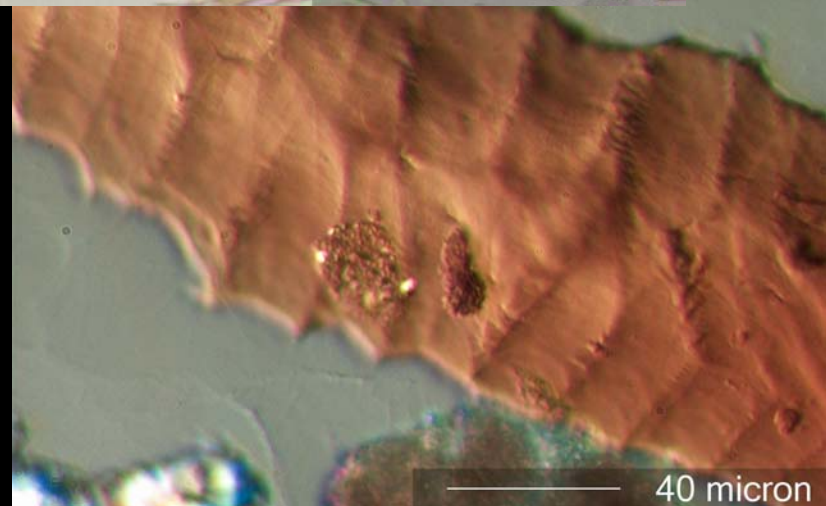
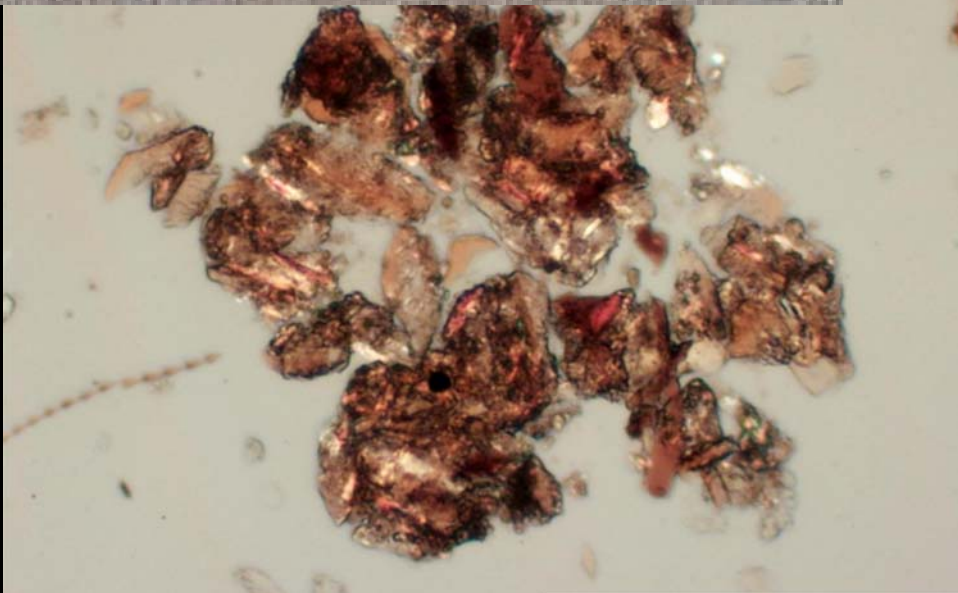
Starch Grain



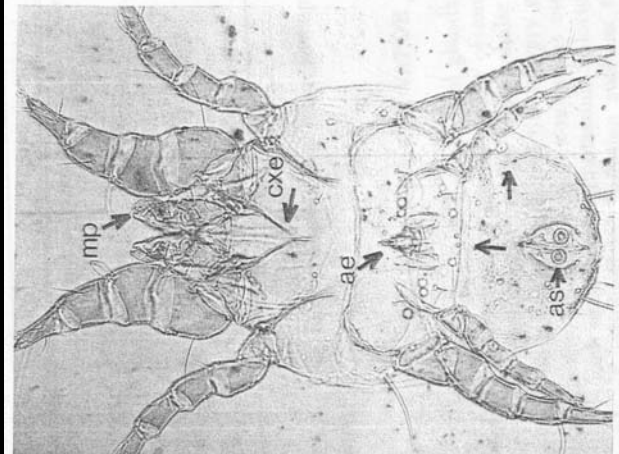
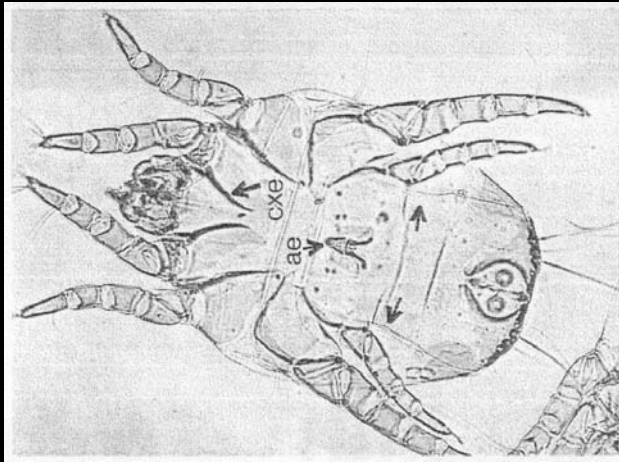
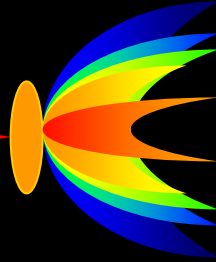
Insect



**Carpet
Beetle**

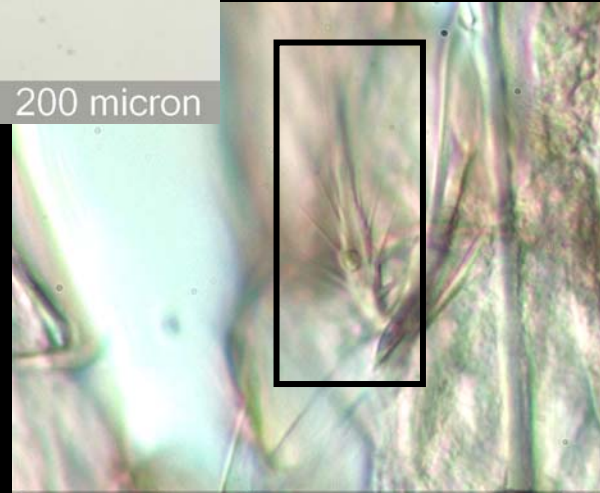


Mites



Tyrophagus putrescenti ————— 200 micron

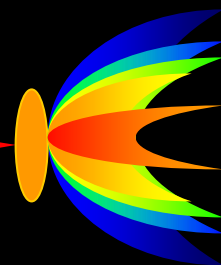
House Mites



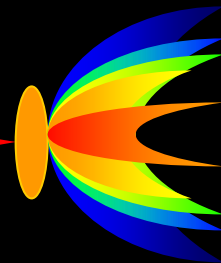
Supracoxal seta T putre

Air Samples Incomplete

**2 Air Samples and a
Sample Collected by a
Nose Impactor Sampler**



Particles From Nose



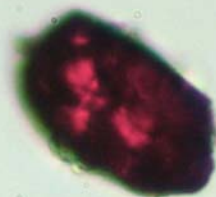
Skin
Protein, harmless



Insect Hair
Protein, Allergen, Irritant

Inhalix, Office 3/14/05 20 micron

Hematite
 Fe_2O_3 ,
harmless

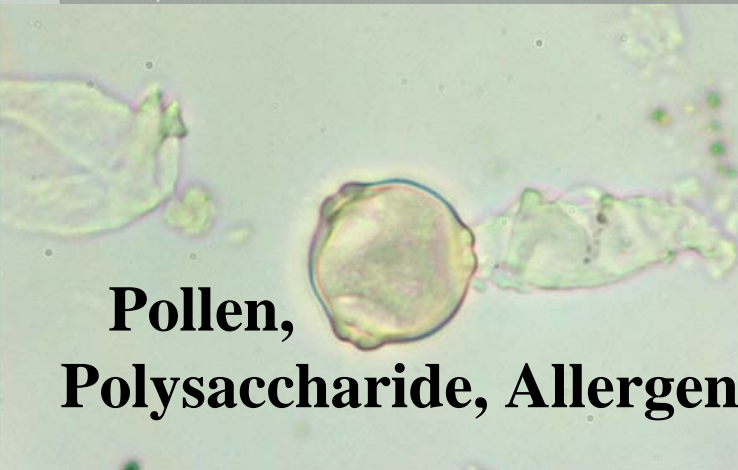


Phytolith,
 SiO_2 , Irritant



Inhalix, Office 3/14/05 20 micron

Pollen,
Polysaccharide, Allergen



Inhalix, Office 3/14/05 20 micron

**Aerodynamic Diameter
of Particles From
Nose > 11 to >> 11 μm**

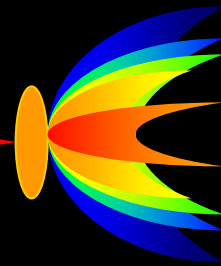
How and Where to Sample

- Typical Elementary School Classroom



How and Where to Sample

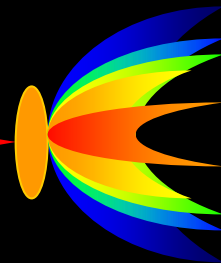
Air-O-Cell or Samplair Sequential Air Sampler



- Air Sample
 - Away from Door
 - 3-4 Feet High
 - Occupied Room
 - 10 Minutes @ 15Liters/Minute
 - Multiple Samples



How and Where to Sample



Forensic Tapelifts

- Surface Samples

- Reservoir (Top of Door)
- Reservoir (Base of Globe)
- More Current (Shelf)
- More Current (Desk Away from Hands)
- Topical (Mold)



Micro-Environment



- Localized Set of Condition
 - Specific Set of Airflow Patterns
 - Specific Particle Sources
 - Specific Particle Sinks

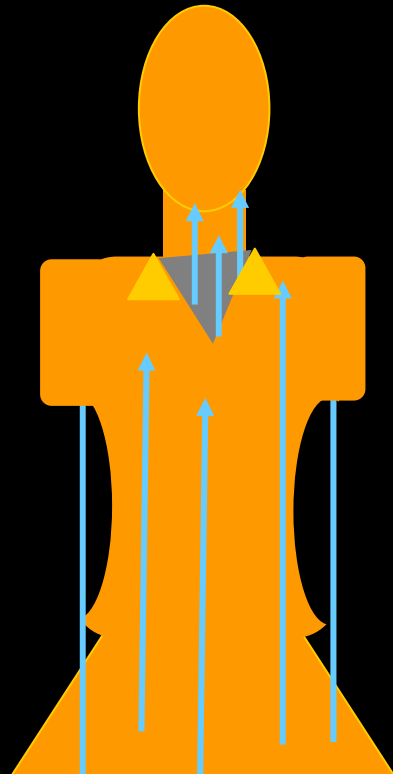
From Floor To Nose



98.6° F

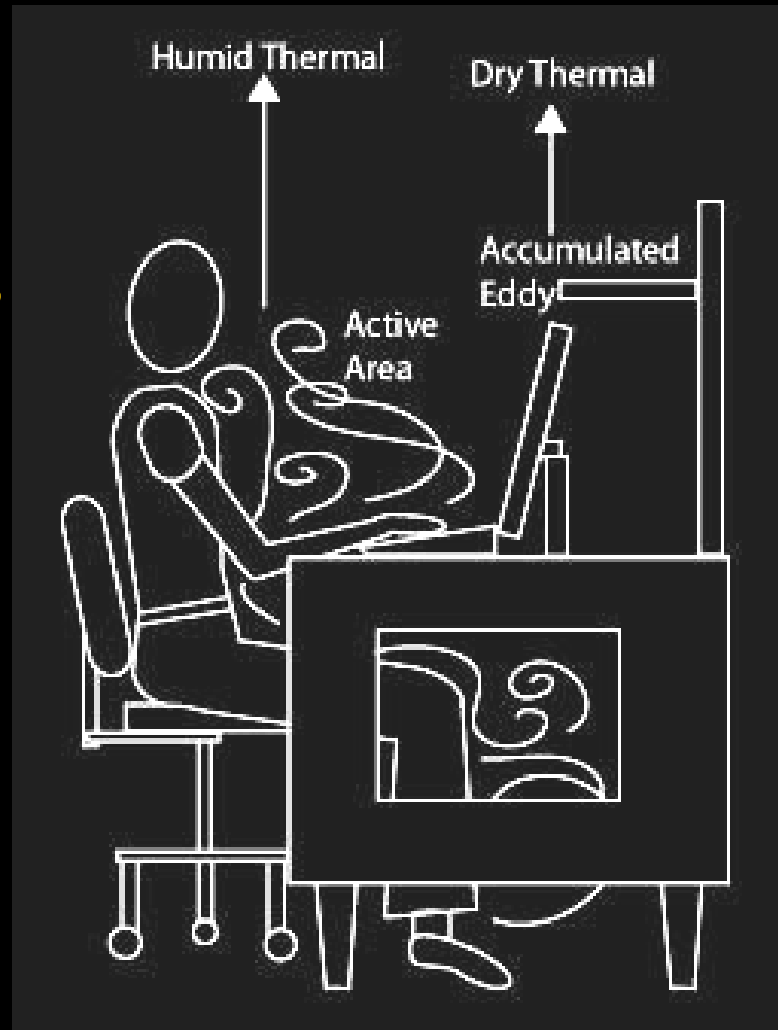
Warm Air Around the
Body is Less Dense,
It Rises Due to
Convective Flow

70° F

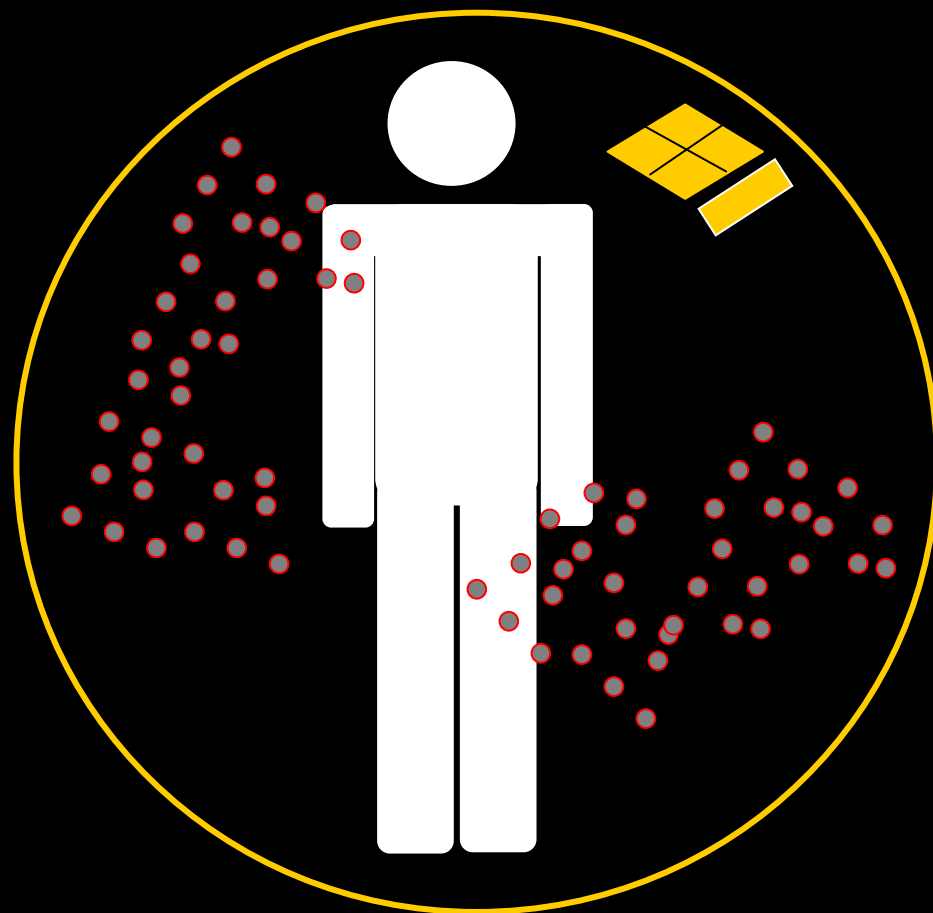


Personal Envelope

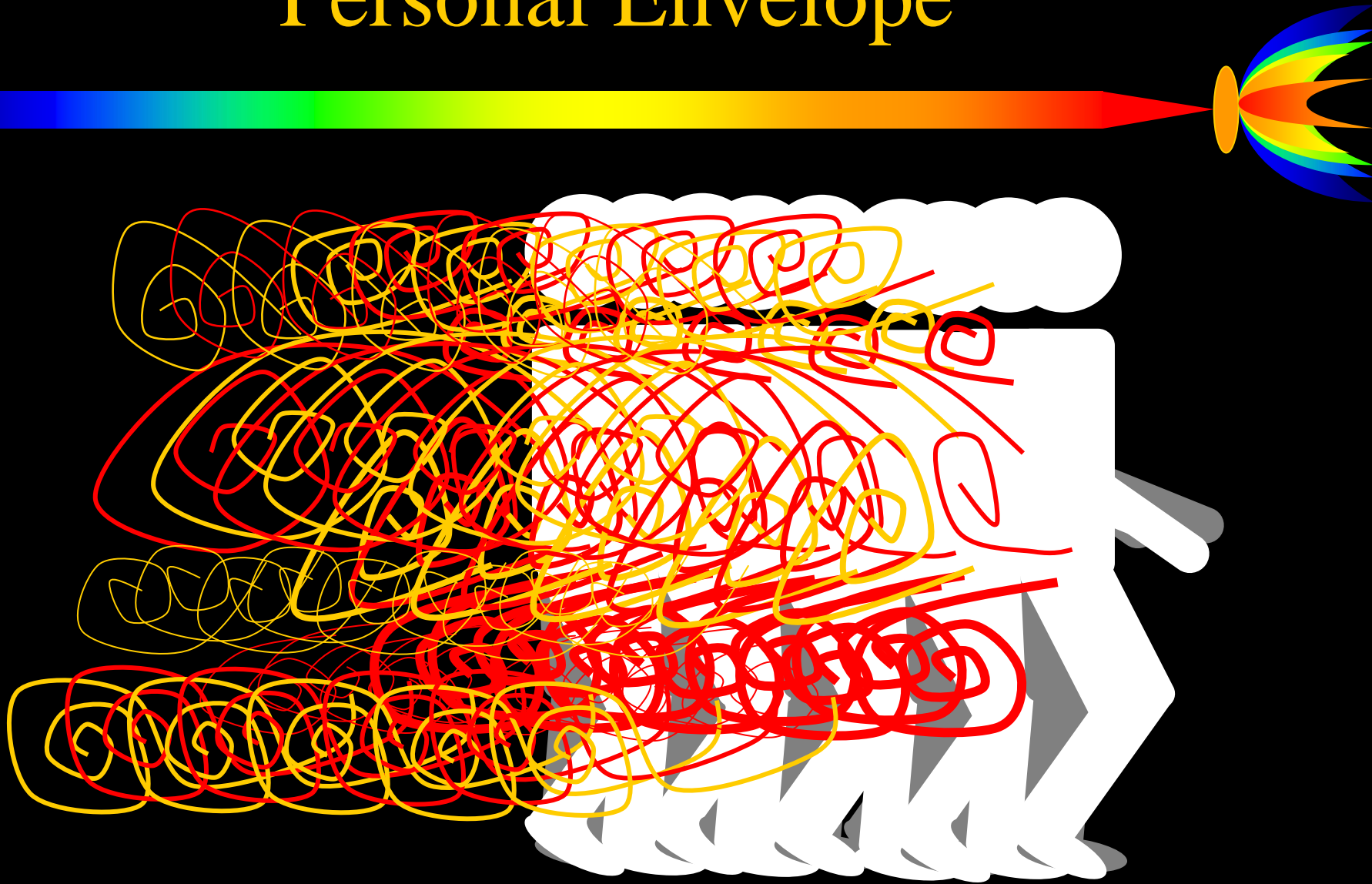
Multiple Local
Sources Of Particles
At a Typical
Work Station



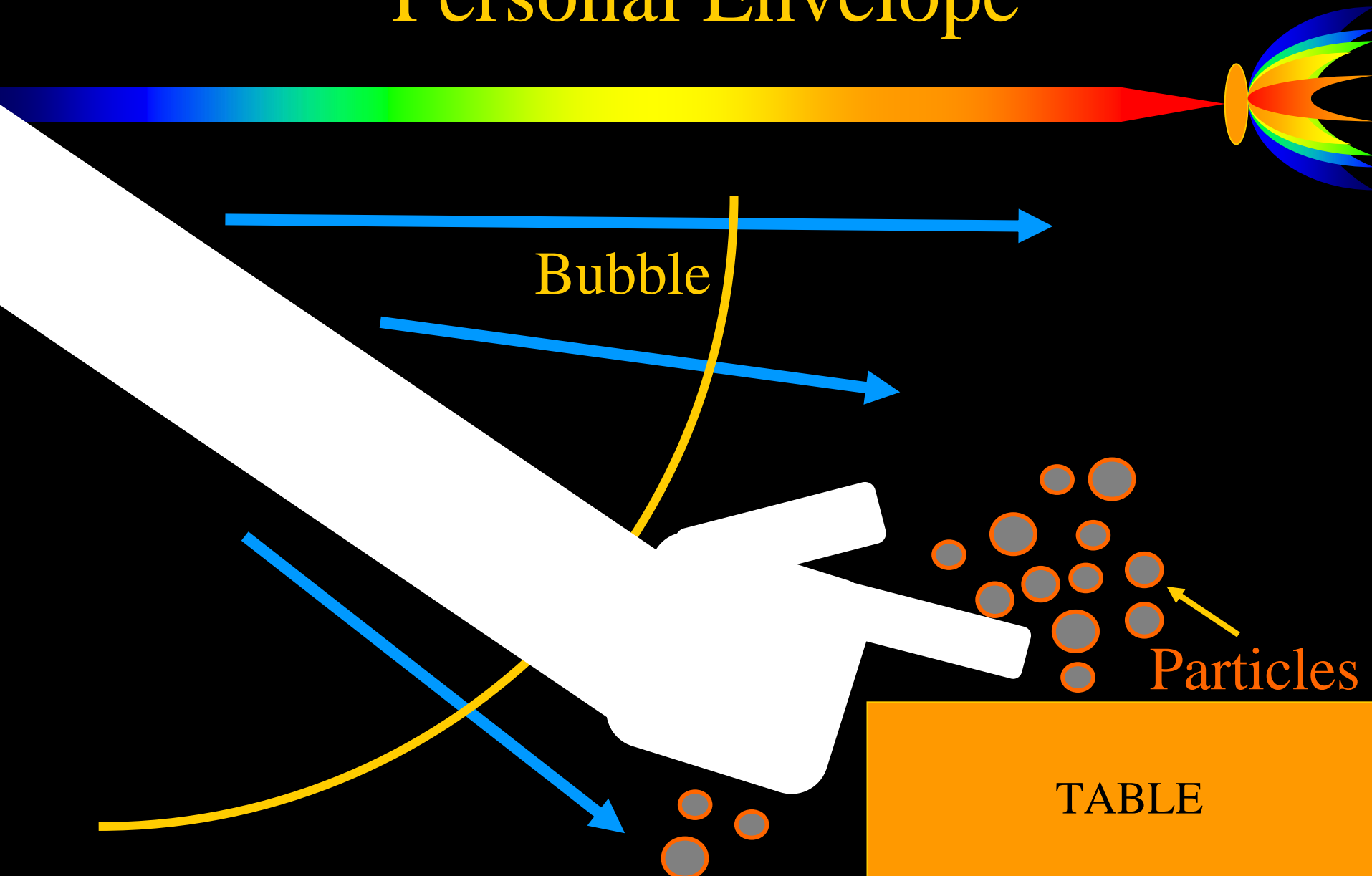
Personal Envelope



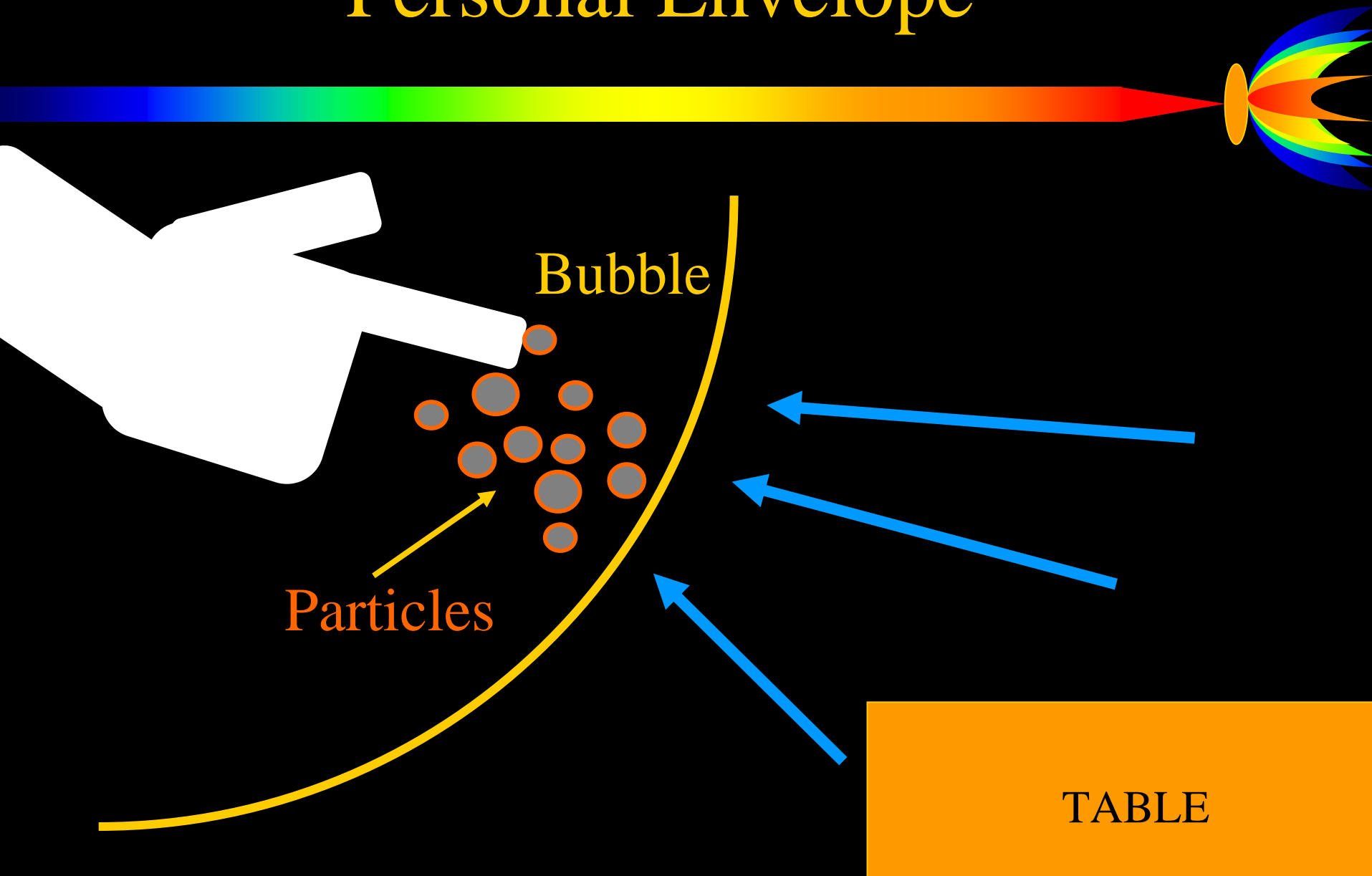
Personal Envelope



Personal Envelope

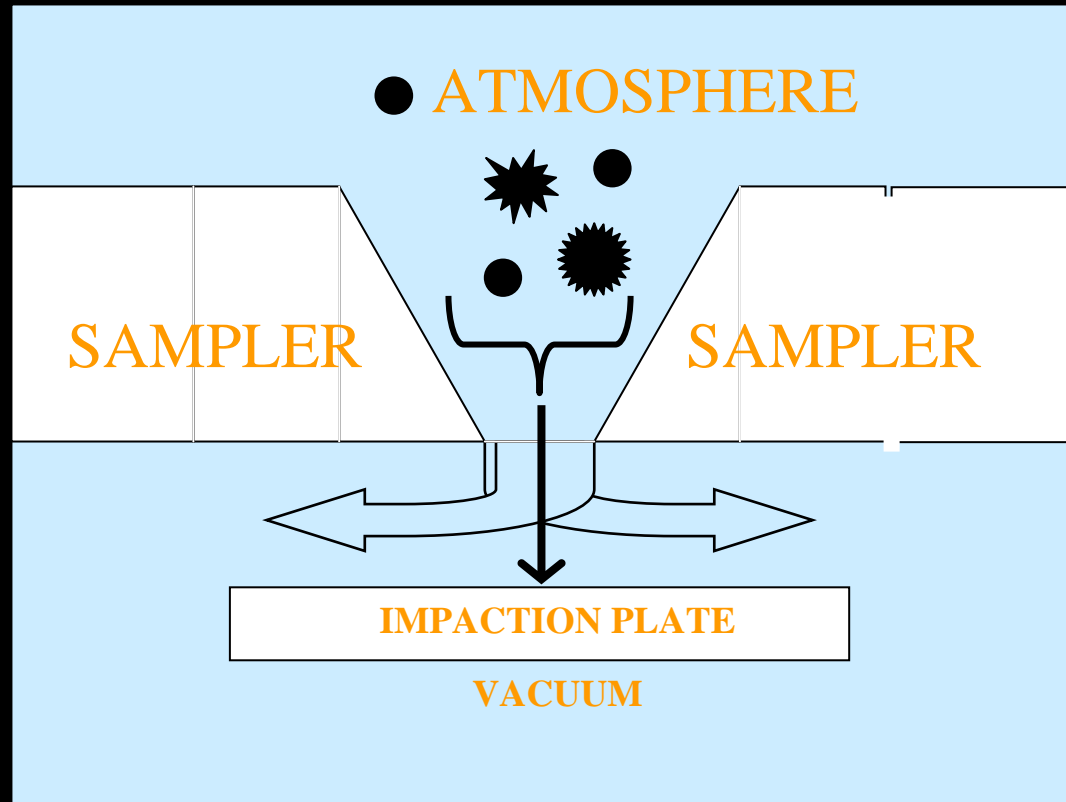


Personal Envelope

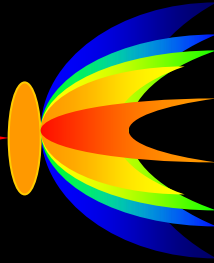


Airborne Particle Sampling

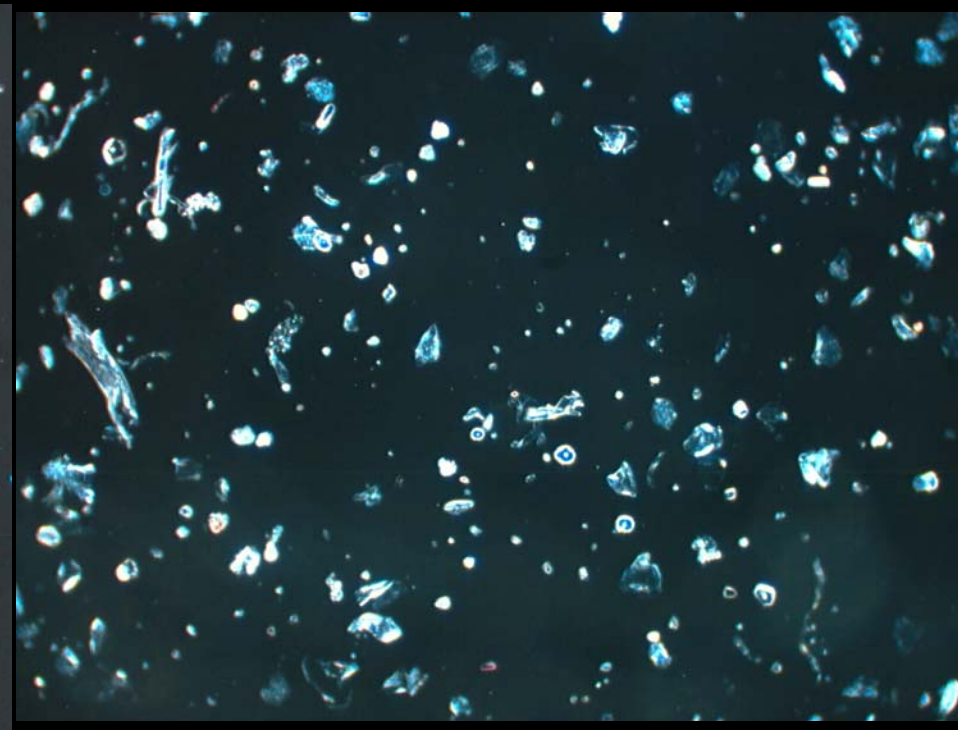
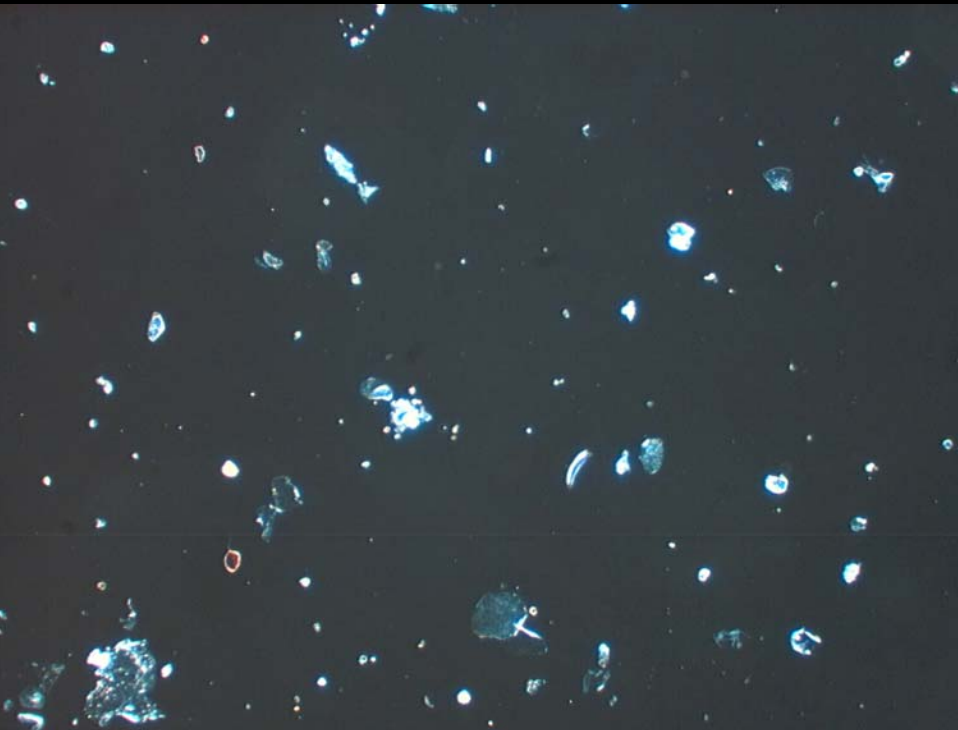
- Impactor



Airborne Particles in Schools

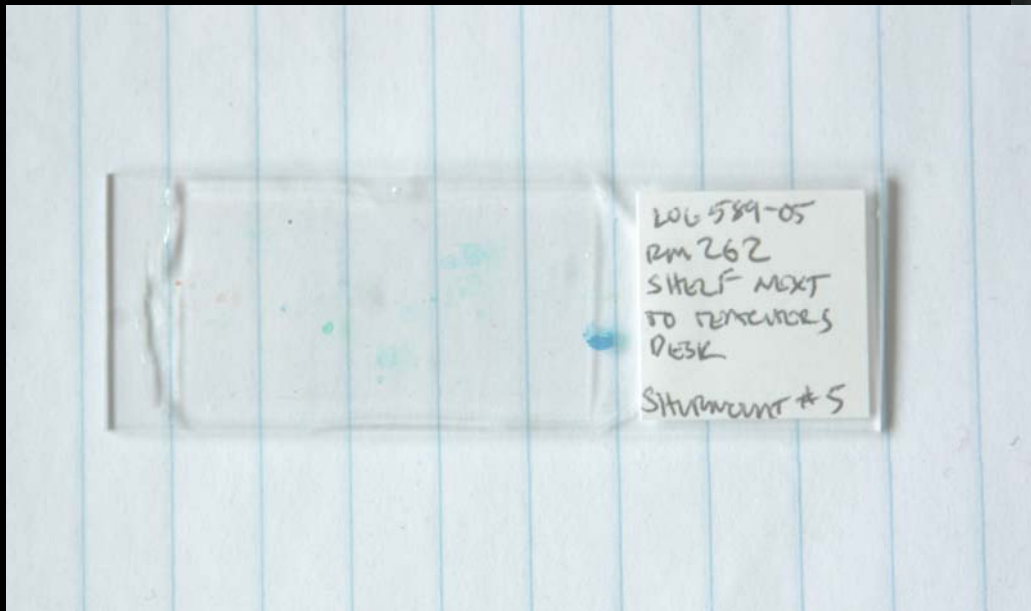


- Room 5 vs Conference Room



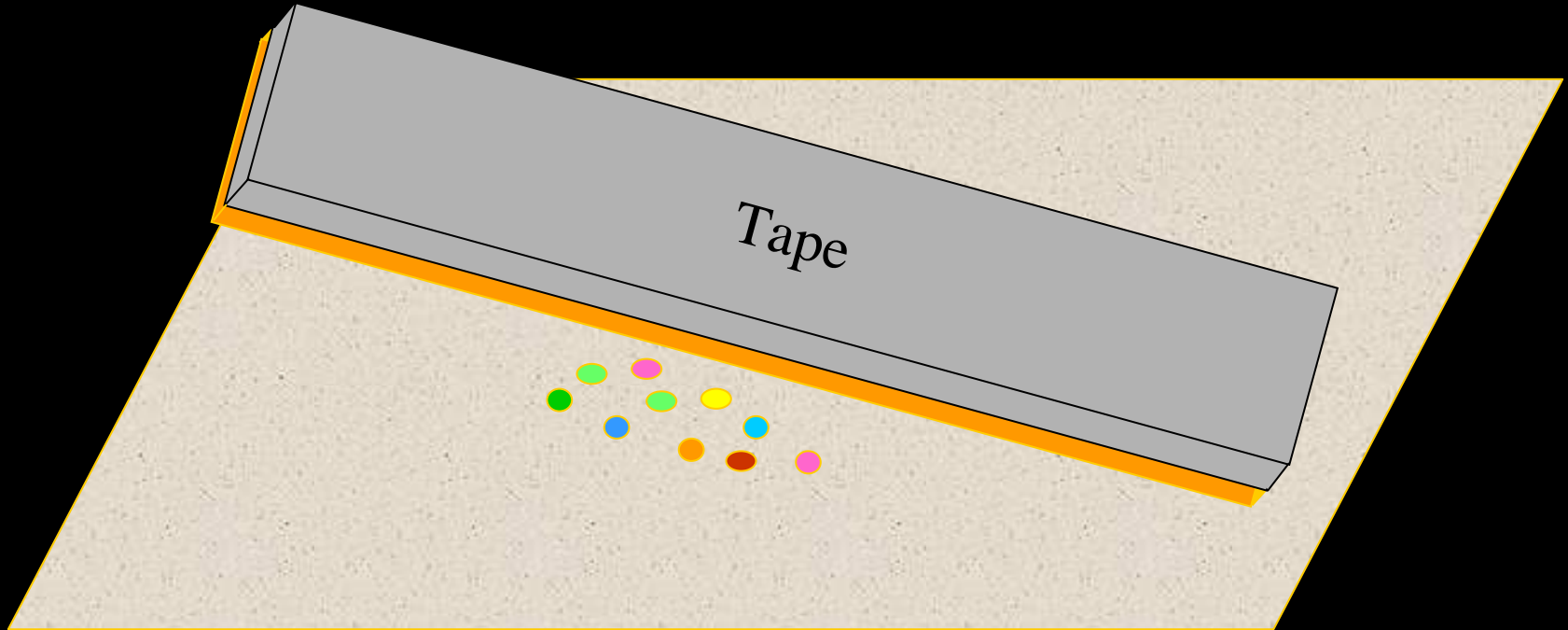
Forensic Tapelift

- “Magic Frosted Tape”, 3M Scotch Brand
 - Cellulose Ester Plastic Film (Acetone Soluble)
 - Acrylic Adhesive (Acetone Stable)



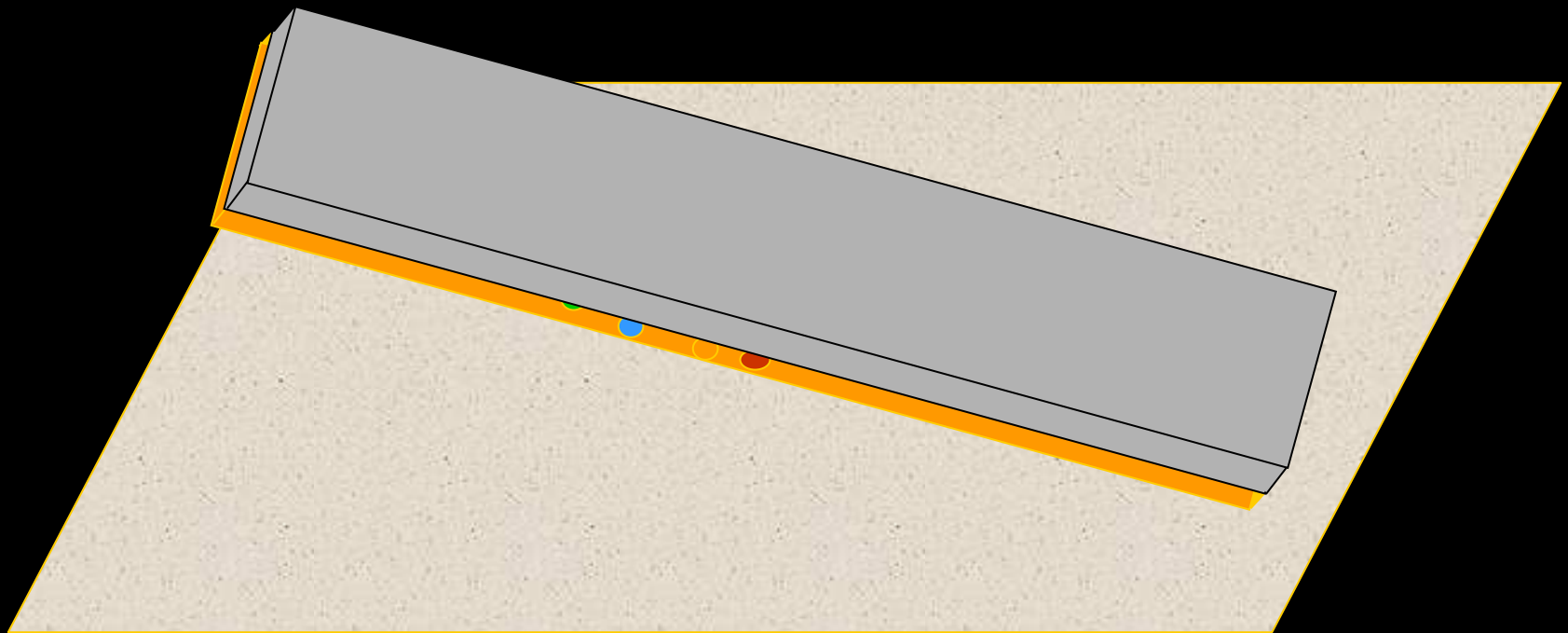
Forensic Tapelift

- Particles on Surface to be Lifted
 - 3M Scotch Brand “Frosted Magic Tape”



Forensic Tapelift

- Particles Lifted with Tape

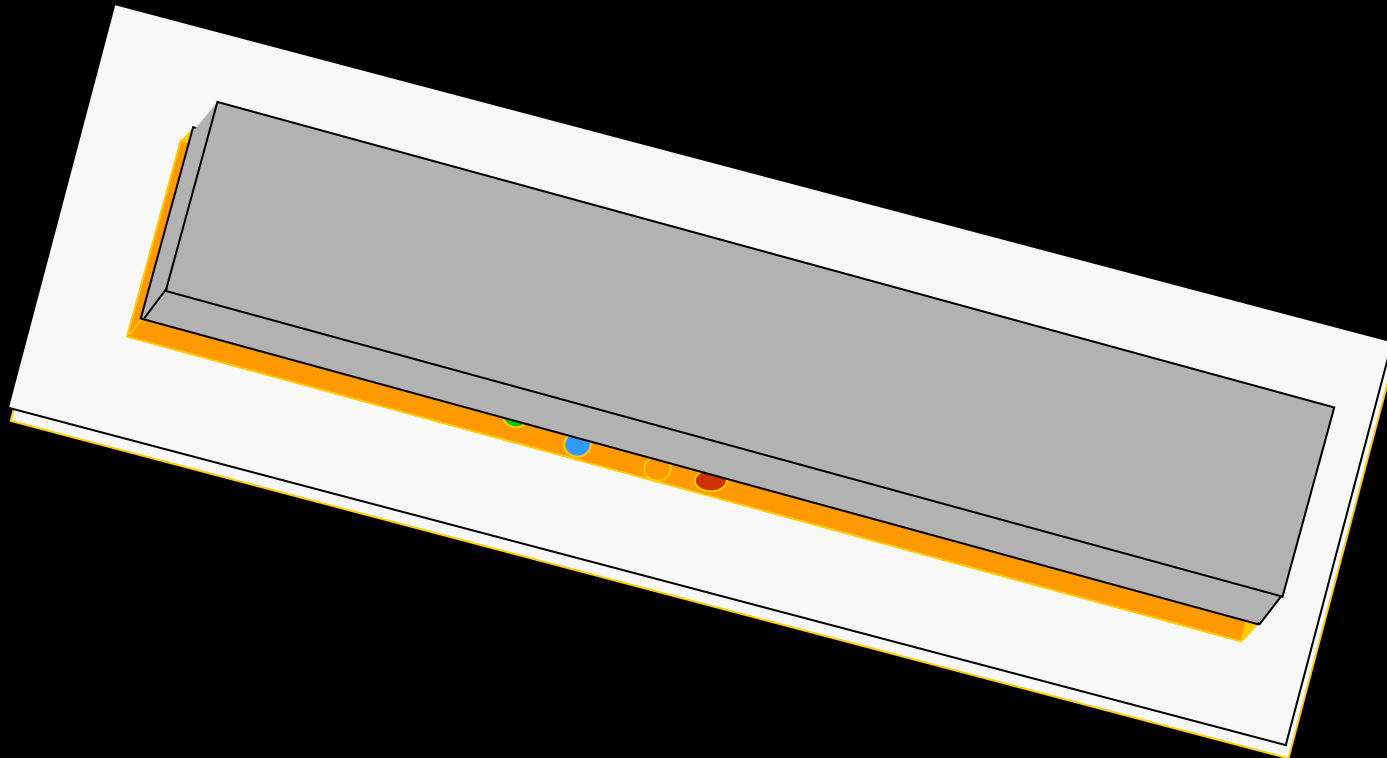


Relative Position Retained

Concentration Per Unit Area Retained

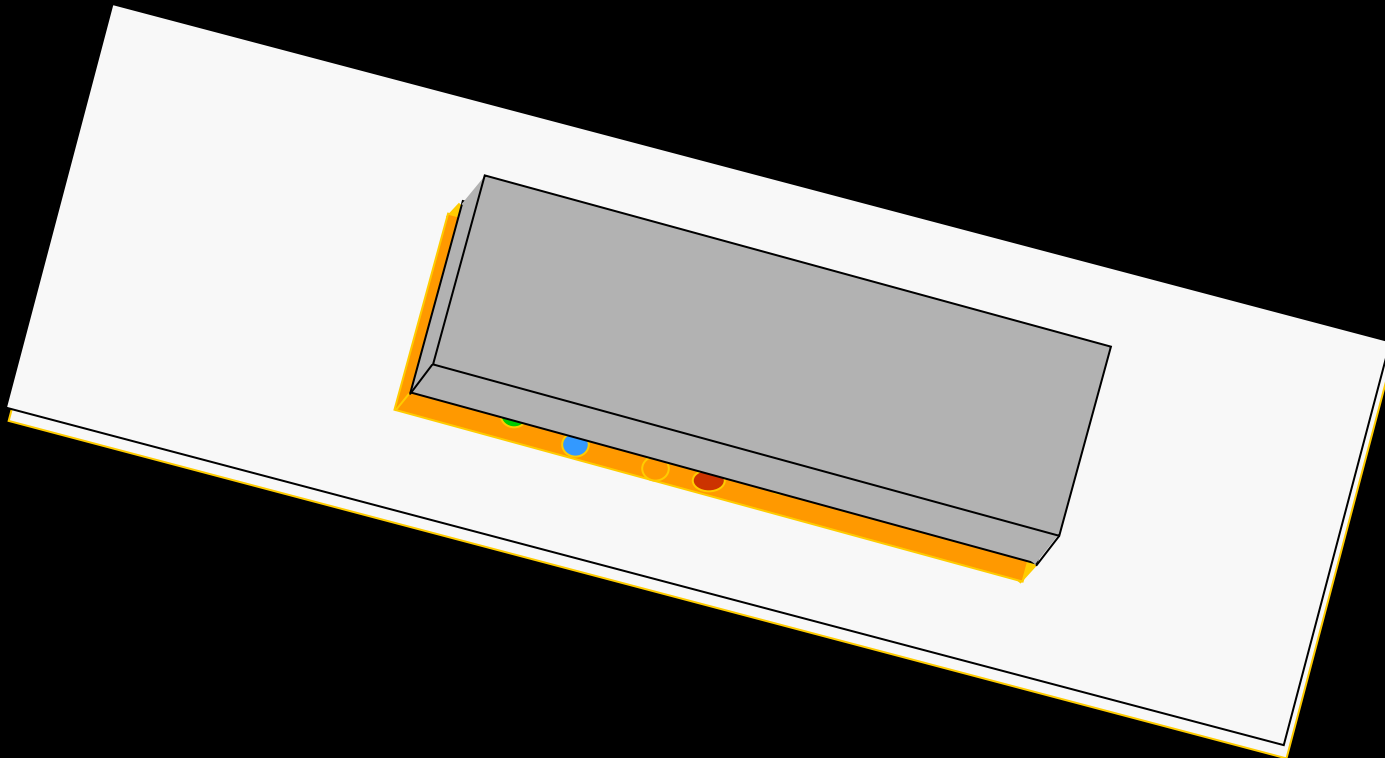
Forensic Tapelift

- Tapelift Placed on Clean Slide
 - Ready for Trimming



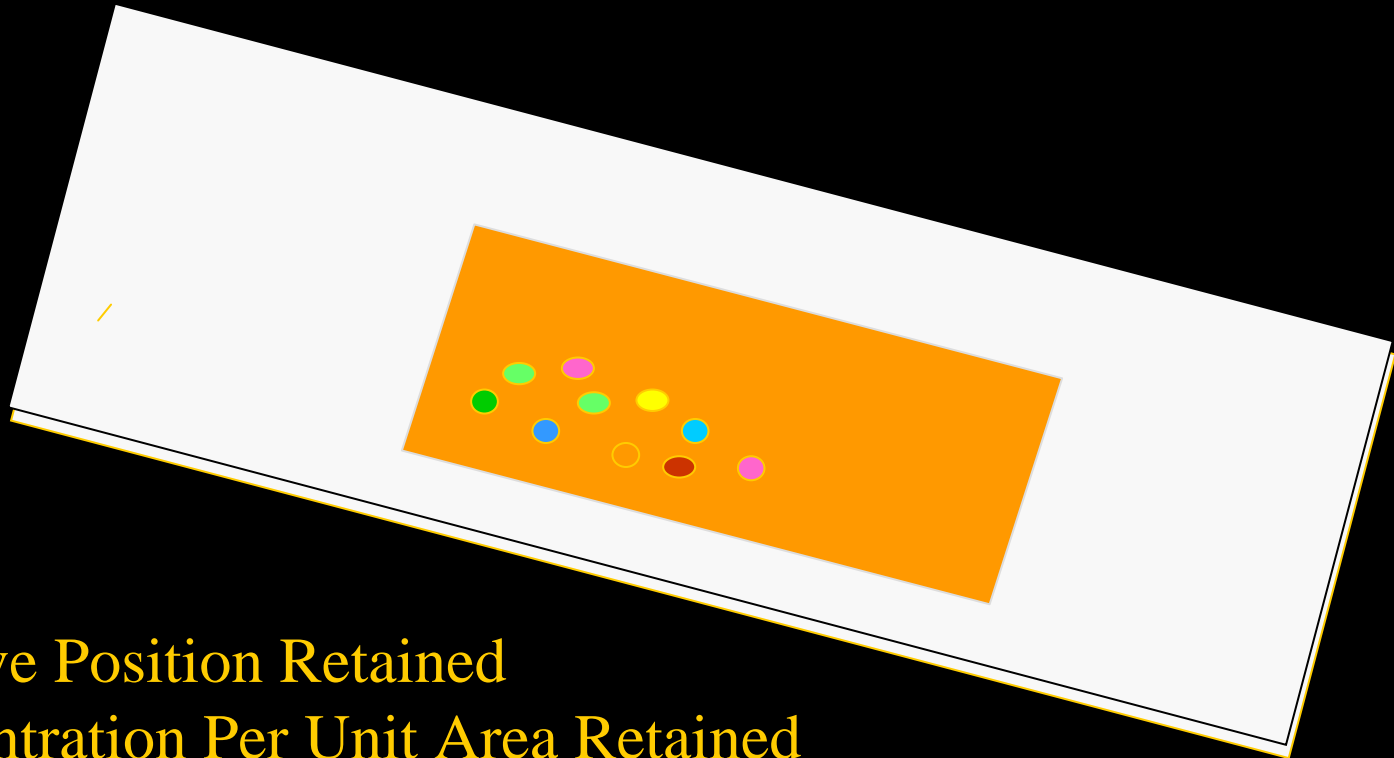
Forensic Tapelift

- Tapelift Placed on Clean Slide and Trimmed
 - Ready for Removal of Cellulose Ester Film



Forensic Tapelift

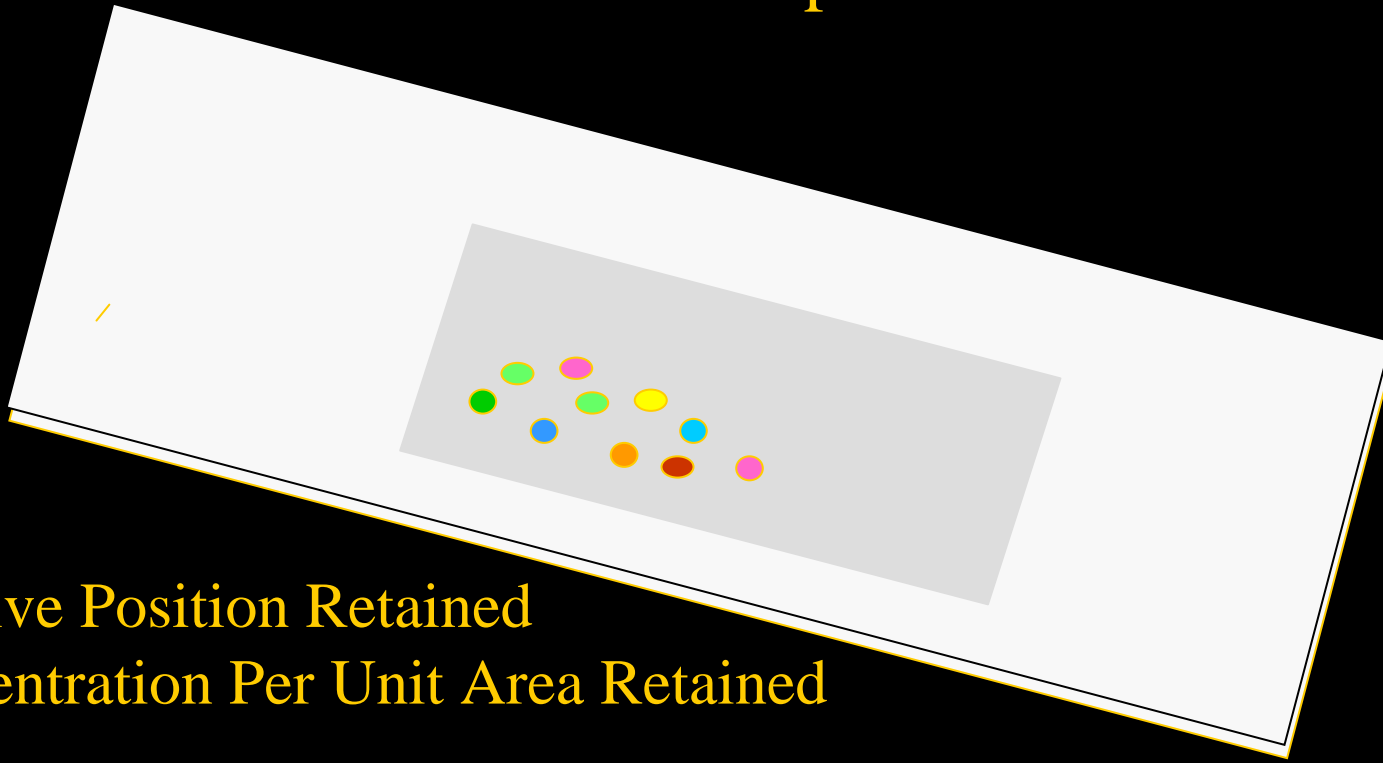
- Film Dissolved with Acetone
 - Particles Fixed in Acrylic Adhesive



Relative Position Retained
Concentration Per Unit Area Retained


Forensic Tapelift

- Final Mount
 - Adhesive Cleared with Mounting Medium
 - Covered with a Coverslip



Relative Position Retained
Concentration Per Unit Area Retained

Conclusion

- 
- Schools Are a Unique Environment
 - High Density, Special Construction, Unique Activities.
 - Dust is a Complex Mixture of Chemical Agents
 - Allergens, Irritants, Pests, Toxins
 - Documentation of Problem, Sample Location, and Quantity Critical
 - Why, Micro-Environment, Volume, Touches