You’ve worked for months on your research. You’ve been using the biosafety cabinet, wearing the appropriate PPE, doing what you thought were all the “right” things. But today you discover that your research materials are contaminated. What happened?

Sometimes we forget – we use the wrong type of ventilation equipment for the job, leave too many materials in the cabinet or hood, forget to work clean to dirty. Hopefully, this course will serve as a reminder of things you need to do on a regular basis to prevent contamination, exposure, and accidents while working inside ventilation equipment.

**Specialize Ventilation Equipment**

Biosafety cabinets, fume hoods, and clean air work stations are types of specialized laboratory ventilation equipment. The primary purpose of this equipment is protection. **What** they protect is where they differ greatly.

**Personnel, Product, Environment**

The ventilation equipment covered in this course is designed to protect one or more of the following:

- Personnel – the person using the equipment
- Product – the research material you are using (tissue culture, cell culture, etc.)
- Environment – the air, the other lab personnel, animals, and the equipment located in the area

It is essential that you understand how to identify the equipment as well as how to use it. Pay attention – there will be a test later!

**Fume Hoods**

Fume hoods are different from biosafety cabinets and clear air work stations. A fume hood will protect you (the personnel) from contamination (to some degree) and exposure to toxic and/or volatile chemicals. It does this by a constant inward flow of air. **It will not** protect your research materials (called the product). It should never be used when working with infectious materials.

Please watch the videos on Fume Hoods at this time.

See how the airflow sweeps across the surface inside the fume hood. When objects are placed in front of the material you are working with, it can adversely affect the airflow.

Raising and lowering the sash should be done slowly and carefully to avoid adversely affecting the airflow.

Placing objects toward the rear of the fume hood is generally the best location.
Placing objects toward the front of the fume hood is not desirable because the vapors could sweep into the breathing zone of personnel.

As you can see in these two pictures, someone or several people decided that their fume hood would make a great storage area. In the far right picture, there is a Plexiglas shield, a trash can, and a mixture of chemical containers. The picture on the left looks like they used their hood for storing old chemicals.

![Picture 1](image1.jpg)

![Picture 2](image2.jpg)

**Travis, a Vacuum Pipe, and a Dumpster - True Story**

This story is told by Kyle Boyett the Assistant Director of Biosafety.

What I am about to tell you is a true story. However, we’ll use fictional names to protect the not-so-innocent offenders. One of the worst offenses we have ever seen was from Travis. We had been called to Dr. Paulin’s lab because the fume hood wasn’t working. When we showed up at the lab we couldn’t see anything obvious that would cause a problem there so we took a trip up to the roof.

You’re not going to believe this, but it’s the truth. The exhaust fan was stopped up – with Kimwipes. We went back down to the lab. “Travis, what do you do with your Kimwipes when you’ve used them?”

“I let go of them so that they’ll go up the vacuum pipe to the dumpster on the roof.”

We eventually had to replace the exhaust fan, motor, and housing not to mention the expense associate with proper disposal of the contaminated Kimwipes.

Folks, the fume hood exhaust duct is **not** a vacuum, and there is **no** giant trashcans or dumpsters on the roof.

Dispose of Kimwipes, tissues, and gloves in the proper receptacles – not the fume hood exhaust duct.
Fume hoods are an integral part of the dynamic laboratory ventilation system. A fume hood affects laboratory pressure relationships due to the nature of the hood being exhausted to the outside. Therefore, in order to maintain a negative pressure relationship between the lab and the corridor, care must be exercised to verify the hood is working properly.

Although UAB has a variety of fume hoods, the auxiliary air hoods are becoming more and more obsolete. Most of the hoods at UAB are conventional and bypass hoods.

**Class 100 Clean Air Work Station**

A Class 100 Clean Air Work Station is NOT a biosafety cabinet. It offers protection to the product ONLY. Personnel and the environment are not protected. It should NEVER be used with infectious materials. A Class 100 clean air work station is primarily used in pharmaceutical compounding.

**Class I BSC**

A Class I biosafety cabinet offers protection from contamination from infectious materials to both personnel and the environment. It does NOT offer any protection for the product.
Class II BSC

Class II biosafety cabinets offer protection from contamination and exposure to infectious materials to personnel, the product, and the environment. Biosafety cabinets should always be used when working with infectious materials.

But biosafety cabinets are not designed for chemical use. They may be used for non-volatile toxic chemicals or low-level radioactive materials. Minute amounts of volatile chemicals may be used. However, volatile chemicals are not retained by the HEPA filter. This means that personnel may be exposed if the chemicals not exhausted. Some chemicals may also damage the HEPA filter.

Also, biosafety cabinet fans are not spark proof. Chemical use may result in a fire or explosion so avoid the use of Bunsen burners. Flames can affect airflow and damage HEPA filters. Chemical fire at Medical University in South Carolina

Class III BSC

Although UAB currently does not have any Class III biosafety cabinets, you should know that a Class III is not a standalone system. Often times, a Class II will be part of the system and is custom designed for the experimental protocol.

Purchasing, Obtaining, and Risk Factors

If you are considering the purchase of a new biosafety cabinet or obtaining a used one from another department, contact the OH&S Biosafety Program first.

We can help you determine the risk factors as to which type of biosafety cabinet would best suit your needs. There is a PDF file on the OH&S website that covers risk factors and the appropriate type of ventilation equipment.
To Protect You or the Infectious Materials?

Biosafety cabinets are required when working with infectious materials. Why? We always think that it’s to keep us from catching something. It is, but we also carry organisms that could severely affect the outcome of the product.

By using the proper equipment, the appropriate PPE, and following the correct procedures, you’ll protect the personnel, the product, and the environment.

Protection Factors

Personnel is protected by the inward flow of air. Product protection is afforded by HEPA filtered laminar flow filtered air inside the biosafety cabinet. Environmental protection is created by a HEPA filter exhaust.

Two Basic Types of Class II BSCs

An A1 biosafety cabinet has positive pressure plenums relative to laboratory. What does this mean? It means that if a breach were to occur in the gasketing system, the laboratory could become contaminated.

In an A2 biosafety cabinet, all positive pressure plenums are surrounded by a negative pressure zone and are therefore the preferred biosafety cabinet used today.
HEPA Filters

The Frame - A rigid frame contains a sealing gasket which, when properly installed, forces the air to flow through the filter media.

The Aluminum Baffle - The aluminum baffle provides separation between the folds of the borosilicate filter media and allows air to properly flow through the filter.

Filter Material - Most HEPA filters are 99.97 to 99.99% efficient at 0.3 micrometers. Mycobacterium tuberculosis is about 2.0 to 4.0 micrometers in length and .2 to .5 micrometers in width.

This graphic demonstrates the three methods by which particulate material is filtered by a HEPA filter. *As you can see, the greatest efficiency occurs in the area above 99.97% and .3 μm (micrometers).*

Pre-checklist for BSC Work

Before you begin your work inside the biosafety cabinet, you should

- Always wash your hands.
- Next don (or put on) the appropriate PPE. The PPE you’ll need will be determined by your protocol.
- Airflow and possible contamination will be lower if you don’t have to move in and out. Therefore, load the supplies you’ll need first.
- Turn the biosafety cabinet on and allow it to run for 10 to 15 minutes.
• Check the inward airflow by securely attaching a piece of tissue to the face hood. As you can see in this picture, the lab coat appears to be pulled in toward the cabinet.

• Adjust seat height so that the bottom edge of the sash is level with your underarms.

Work Clean to Dirty and On the Centerline

Always designate a clean side and a dirty side. Work from clean to dirty, and work on centerline of work surface. Note the location of discard trays and how other items are positioned to avoid compromising the airflow.

Please watch the videos on Clean to Dirty and Airflow with Slow Movements.

Working on the approximate center line is the recommended best location to maintain the integrity of proper airflow.

Slow and deliberate movements into and out of the biosafety cabinet has very little affect on the airflow whereas rapid and sudden movements can disrupt the airflow dramatically.

Airflow is disrupted if the front grill is blocked while working in the biosafety cabinet as well as the room air when entering the biosafety cabinet.

When placing lab supplies and materials inside the biosafety cabinet, make sure they are placed in a location where the airflow is not disrupted.
Post-checklist for BSC Work

When you have completed your work,
- disinfect all of the items to be removed from the cabinet,
- remove all waste products and place in appropriate receptacles,
- wipe down the interior of biosafety cabinet with an appropriate disinfectant, and
- allow cabinet to run for 10 - 15 minutes before shutting off.

If you are using a UV light, make sure you still follow proper procedures. A UV light will not destroy all microbes so an appropriate disinfectant must be used. UV lights should be wiped down at least once per week when the light is off.

Decontaminating a BSC

Decontaminating a biosafety cabinet is not performed on a regular basis. Paraformaldehyde gas or vaporized hydrogen peroxide (VHP) is used when decontaminating. There are three reasons for decontamination:

- If the biosafety cabinet is to be moved; or
- For repairs that would involve entering a potentially contaminated space; or
- If cabinet is suspected of contaminating work. However, all other sources that could cause contamination must be eliminated first.

Certification of a BSC

The certification procedures assure the user that the protection factors of personnel, product, and environment are maintained by verifying that the down flow velocities, in-flow velocities, and HEPA filters are within specification.

In addition, several other tests are performed that assure the user that general safety is maintained.

Class II biosafety cabinets are regulated by the National Sanitation Foundation (or NSF). The certification procedures listed here have been mandated by them.

OH&S recommends that certification should be performed initially after receiving any type of new and/or used ventilation equipment. It should also be certified:

- After the unit has had repairs that necessitate re-certification,
- After the unit has been relocated, and
- At least annually thereafter.
Helpful Tips!

The following are tips to use when working with fume hoods or biosafety cabinets. These tips have been complied into a job aid located on the OH&S website under Biosafety Cabinets and Fume Hoods, Job Aids.

When working inside a fume hood:
- Make sure that your materials do not adversely affect the airflow. Raise all of the equipment two inches off the counter with blocks to allow the proper airflow.
- Never allow the experiment to expand to a point where the sash cannot be closed.
- Always keep the sash clean and clear.
- Place only the necessary equipment or materials related to the experiment in the hood.
- Wear the appropriate PPE when working inside the fume hood.
- Remove all trash and materials specific to that experiment from the hood chamber once the experiment is complete.
- Keep sash fully closed when hood is unattended.

When working inside a biosafety cabinet:
- Make sure that your materials do not adversely affect the airflow.
- Always keep the sash clean and clear.
- Place only the necessary equipment or materials related to the experiment in the cabinet.
- Wear the appropriate PPE when working inside the biosafety cabinet.
- Remove all trash and materials specific to that experiment from the biosafety cabinet once the experiment is complete.

This concludes the OH&S Biosafety Cabinets and Fume Hoods course. Complete the quiz to receive credit. 80% or higher is required to pass. Job aids and other resources are located on the OH&S website.