



Breathe Easy

Designing and Testing Air Filters for Ships



Dahlgren, VA (Naval Surface Warfare Center) -- Engineers design and test air filters for Navy ships. They create filter technologies to keep people safe and to protect sailors from toxins and poisons—harmful chemicals, biological pathogens, and other pollution that may be in the air. Multilayer air filters (two mechanical and one chemical) are designed and tested before they are installed. They will filter the outside air as it is pumped into the ship and recirculated.

"We have filters to purify and clean out contaminants so that we don't ingest them or inhale them—so we can remain healthy and active." **Carlos Murillo, chemical engineer**

Framework

Middle School

Standards

- NSES - B.i.2 ➤ Substances react chemically in characteristic ways.
- NSES - F.iv.2 ➤ Risks are associated with occupational hazards.
- STL - 2.N ➤ Systems thinking involves how parts relate.
- STL - 4.D ➤ Technology affects safety and comfort.
- STL - 5.E ➤ Technologies break down waste.

Content Illustrated

- Animated air circulation through a house.



Content



Physical Science

- Air filters capture germs, pollen, dust, dirt, and chemicals (from tobacco smoke, for example).
- Activated carbon has been processed so that the carbon granules have a large surface area.

Technology

- Houses have air filter systems. Usually these are circular systems which pull air from inside the home through a mechanical filter, heat or cool it, and then send it back into the home.
- A mechanical filter is a replaceable, thin, fibrous mat that removes dust and dirt.
- Navy ship air filters pull air in from outside the ship. The air goes through three filters: a pre-filter, a HEPA filter, and a carbon filter. Pre-filters and HEPA filters are mechanical filters.
- High-efficiency HEPA filters look a lot like paper, but they are made from microscopic glass fibers which capture nanosize particles.
- The carbon filter is a chemical filter that works by adsorption. When a material adsorbs something it attaches by chemical attraction. Chemicals bind with the activated carbon and are removed from the air.
- Activated carbon has been processed to give it a porous, large surface area, much like a sponge.
- Filters are often made similarly to paper and felt.
- Home water filters use activated carbon.

Engineering

- Engineers design and test air filters that will remove dust, aerosols, and chemicals but will allow nitrogen and oxygen to pass through.
- Special air filters must be tested before they are installed on Navy ships.

Guiding Questions

To think about as you watch:

- What does it take to clean the air we breathe?

Suggested Activities

- Try filtering chalk dust that's suspended in the air through mechanical filters made of different materials.

Keywords

activated carbon
adsorption, aerosol,
carbon filter,
contaminants, felt,
fibrous, filter, HEPA,
intake, mechanical
filter, nitrogen,
oxygen, particles,
pre-filter

- *Breathe Easy* can be found online at www.ndep.us/Breathe-Easy. Visit www.ndep.us/LabTV for a list of process skills modeled in webisodes.