Using 3D Printers Safely

Washington State Department of
Health

Three dimensional (3D) printers are a great education tool. They provide rapid prototyping and the ability to create small-scale manufacturing for various lessons in science, technology, engineering, math, and art. Although a great educational tool, 3D printers produce hazardous byproducts including fine and ultra-fine particulates, volatile organic compounds, and heavy metals.

When using 3D printers, required safety precautions protect students from inhaling hazardous particles and chemical vapors and avoid physical hazards such as burns, cuts, and pinches. The State Board of Health Rule for Primary and Secondary Schools, WAC 246-366-080, requires 3D printers to have local mechanical exhaust ventilation.

A recent National Institute of Safety and Health (NIOSH) study evaluated the hazards associated with using different 3D printers and recommended ways to minimize exposure to these hazards. This document focuses on the safe use of fused filament fabrication (FFF) 3D printers (functionally similar to fused deposition modeling, or FDM printers), which are most common in K–12 schools.
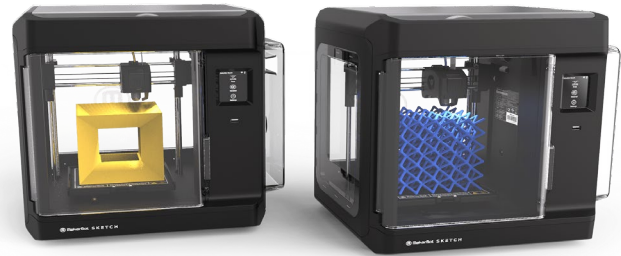
Two examples of FFF 3D printers.

NIOSH Recommendations

3D Printer and Filament Selection

- Select a fully enclosed printer to best protect from particulate, chemical, and physical hazards.
- Select a printer that can be used with polylactic acid filament (PLA). PLA is a biodegradable plastic made from natural substances including sugar, corn starch, or sugar cane. PLA filaments:
  - Typically have the lowest emission rate of all filaments.
  - Can print at a low temperature and don't require a heated bed, which is a burn hazard.

3D Printer Setup

Printer setup includes selecting the proper location, establishing appropriate ventilation, and placing appropriate signage to provide visual reminders of safety practices.

Printer Location
- Set up the 3D printer in an area away from student desks or main workstations. This limits the time students spend near running 3D printers.
- Set up the 3D printer near a fire extinguisher.
- The printer must connect to an appropriately grounded outlet.

Printer Ventilation
Before using the printer, verify the effectiveness of the exhaust system. Here are ventilation options listed in order of preference:
- Place the 3D printer inside an enclosure or fume hood that captures emissions and exhausts them outside of the building.
- Place the 3D printer inside an enclosure or fume hood that captures emissions and filters them through charcoal and HEPA filters before discharging them within the building.

Printer Signage

Appropriate signage and other visual cues provide important safety reminders to users. Post signs in a location directly visible to a person approaching the printer, on the front of the enclosure if possible. Signs should include:

- Bulleted rules and procedures for safe use.
- Signs that identify and warn of hot surfaces.

3D Printer Operation

Safe printer operation includes:

- Safety training before using the printer. It must include safe operating procedures and a discussion of potential hazards, including a review of the safety data sheet(s) for all products associated with printer use.
- A pre-use printer safety inspection by the classroom instructor.
- Students should not stand near or hover over the 3D printer when it is running.
- A removable print surface set with painter's tape or a glue stick is recommended for easy removal of completed objects. This can eliminate the need to use a sharp tool or blade for project removal.
- Only a classroom instructor or maintenance person should do routine maintenance or cleaning because it may involve other chemical exposure.
- Only a certified professional should service the 3D printer.
- Select the lowest temperature appropriate to filament materials being used to prevent unwanted emissions.

Post a Warning Sign

- Be cautious of burn risk when the 3D printer is preheating or powered on. The heater block, nozzle, heated print bed, and motors become hot and can cause burns if touched.
- Do not open the 3D printer cover once a project starts.
- Before removing a project, ensure the 3D printer has cooled to avoid touching hot surfaces.
- If using a scraper blade or another sharp removal tool, always scrape away from your body and hands.
- Do not eat, drink, chew gum, or touch eyes, nose, or mouth when near or using a 3D printer.
- Wash hands thoroughly after use.
- Use a wet towel to clean work surfaces. Sweeping or brushing will cause particles to go into the air and be inhaled.

Contact the School Environmental Health and Safety Program at www.doh.wa.gov/schoolenvironmentcontact.

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