

Managing Laboratory Wastes

ANY KIND OF TESTING you do in a biotechnology laboratory will cause some material to be left behind. This remaining material is called waste. What you do with the waste is important. Some solid waste is perfectly safe, and you can put it into the garbage. Some liquid waste is perfectly safe, and you can pour it down the drain. However, some wastes are hazardous and should never be put into the garbage or the drain. The reason these materials should not be put into the garbage or the drain is that anything in those two locations will eventually get back to you and everyone else through our food or water.



Objectives:



1. Identify types of laboratory wastes.
2. Explain how to handle and dispose laboratory wastes safely.
3. Describe the flow of wastes after they leave the laboratory.

Key Terms:



autoclave

chemical reaction

disinfectant

disintegrate

landfill

microbes

MSDS

sludge

sterilization

Types of Laboratory Wastes

BIOLOGICAL MATERIAL WASTES

Biological materials, such as plants and animals, are often used for testing in the biotechnology laboratory. After testing, you will have something left, called waste. The waste may be either hazardous or nonhazardous. The main difference is the presence or lack of **microbes**, which are microscopic bacteria, molds, etc.

You can't tell a safe microbe from a hazardous microbe just by looking at it. So, you will have to treat all waste that contains microbes as being hazardous.

CHEMICAL MATERIAL WASTES

Chemical materials are used regularly in biotechnology laboratories for various tests. Some chemical materials are relatively safe, and others are hazardous. You can't tell the difference just by appearance. When chemical materials are used for testing, they undergo a chemical reaction. A **chemical reaction** is a process in which one or more chemical materials change into one or more new and different chemical materials. These new materials may be hazardous.

The safe way to determine whether the new chemical materials are hazardous is to find information about them. The best source of such information is an **MSDS** (material safety data sheet). An MSDS will list any hazard of a given material. Material safety data sheets can be obtained online from a number of sources.

MIXED LABORATORY WASTES

Many biotechnology wastes are a combination of biological materials and chemical materials. If your biotechnology laboratory produces mixed wastes, further consideration is needed. You must analyze the wastes separately for their biological and chemical components. If any one of the biological or chemical components is hazardous, the mixture is hazardous.

Handling and Disposing of Laboratory Wastes

HANDLING BIOLOGICAL WASTES

When biological material waste contains no microbes, it is assumed to be safe. Safe biological waste can be put into the regular garbage can for local collection. A preferable disposal method, if it is available, is to compost the material. This produces good soil additives to help plants grow.

If the biological material waste contains microbes, the microbes must be destroyed before you can dispose of the material. Two methods are available.

If the material is large and bulky, it can be sprayed with a disinfectant. A **disinfectant** is a chemical material designed to destroy microbes. Many disin-



FIGURE 1. Disinfectant sprays are often used on surfaces where microbes may be found.

fectants are now available, especially in spray bottles. You may use a spray disinfectant on the tables in your biotechnology laboratory to eliminate germs.

A second method of eliminating microbes is most often used when the microbes are intentionally grown as a culture. The culture must undergo **sterilization** (the destruction of all microbes) before disposal. To accomplish this, the waste is put into an autoclave. An **autoclave** is an enclosure in which microbes are destroyed by very high temperature and pressure. It is similar to a pressure cooker you may have seen at home.

Regardless of which way microbes are destroyed, the material may be discarded in the garbage once it has been sterilized.

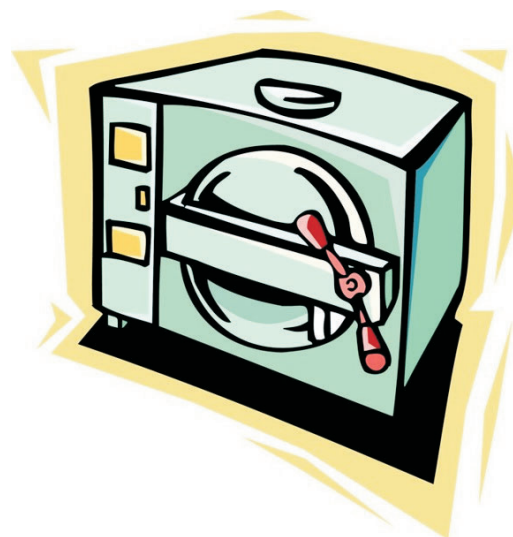


FIGURE 2. An autoclave uses very high temperature and pressure to kill microbes.

HANDLING CHEMICAL WASTES

Chemical wastes are often more difficult to handle than biological wastes. Many chemical materials can be hazardous. Some are hazardous by their very nature, and some are hazardous in certain quantities. Since you will usually have a chemical reaction involved, it is necessary to know what new chemical materials have been formed. You may need a professional chemist to determine this. Once you know what the materials are, you need to know whether they are hazardous.

The way you can determine any hazard of a chemical material is to refer to the MSDS for that material. The MSDS will tell how you can dispose of the material. Just a few chemical materials can be diluted with much water and washed down the drain. Most chemical materials have sufficient hazard that they cannot be put into the drain. They will need special handling.

For some very common chemical materials, there are procedures for making them nonhazardous. These are listed in many sources and are very much like recipes you would have to follow. Finally, some chemical materials cannot be made nonhazardous by any means. These must be stored until they are professionally removed. All states have some professional hazardous materials (HazMat) removal procedures.

The Flow of Wastes from the Laboratory

SOLID WASTE DISPOSAL

Solid materials in the garbage are usually taken to a landfill. A **landfill** is a remote location where solid wastes are placed for long-term containment. A landfill is usually either a natural or human-made depression in the surface of the earth. The landfill continues to receive garbage until it is “full.” Then a layer of soil is placed over all the garbage, and it is left.



ON THE JOB...

CAREER CONNECTION: Wastewater Treatment Plant Operator

An operator in a wastewater treatment plant performs many technical processes. Directed by the supervisor, the operator could control additions to the wastewater to be sure it is properly treated. The operator could perform analyses of the treated wastewater to be sure it is safe. Such an operator frequently needs some postsecondary training and a state license.

Two things happen over time. The garbage itself will disintegrate. To **disintegrate** is to form smaller and simpler materials from original material. Also, whenever it rains, the rainwater will fall on the landfill area. Water will sink into the ground and keep moving downward until it reaches a rock layer. In the process of trickling down through the landfill area, it will also dissolve some of the materials from the landfill. A danger arises if the contaminated water seeps into the groundwater.

LIQUID WASTE DISPOSAL

Materials poured into the drain run through a pipe. This pipe may end in the yard if a septic system is used. The liquid from the septic system will then sink into the ground to get to the rock layer. If there is a municipal wastewater system, the materials go to a wastewater treatment plant. At this point, chemical materials are added to the wastewater to remove some of its contents. The solid matter separated out by a wastewater treatment plant is called **sludge**. The sludge is sometimes used as a fertilizer. The liquid from the wastewater treatment plant flows into a stream or river, and eventually ends in a lake or large river.

Our drinking water comes from one of two sources. It can come either from a well drilled into the ground to the water layer or from a river or lake. In either case, our drinking water could contain anything hazardous that passed into the water source. This is why it is so important that no hazardous materials are allowed to leave the biotechnology laboratory.



FIGURE 3. A treatment plant is responsible for removing contaminants from wastewater.

Summary:



All waste from a biotechnology laboratory, whether solid or liquid, should be considered potentially dangerous. It is essential to determine whether it is hazardous. If

it is, the proper means must be used to make it nonhazardous. Any waste that cannot be made nonhazardous must be removed by professional hazardous materials handlers. This care must be exercised to prevent hazardous waste from entering our drinking water supply.

Checking Your Knowledge:



1. How could you dispose of nonhazardous biological material wastes?
2. What usually makes biological material wastes hazardous, and how can the wastes be made nonhazardous?
3. Why is waste from chemical materials so difficult to handle?
4. How would you determine if chemical material wastes are hazardous?
5. Why must all wastes be analyzed to determine whether they are hazardous or nonhazardous?

Expanding Your Knowledge:



1. Could there be hazardous materials that are gases mixed in the air? How could you handle this problem?
2. Devise a plan to determine the hazards involved with all chemical materials used throughout a semester in the biotechnology laboratory.
3. Since the arrival of the H1N1 flu, numerous hand sanitizers have appeared. Research what is in the hand sanitizers.

Web Links:



Earth's Water: Groundwater

<http://ga.water.usgs.gov/edu/earthgw.html>

Groundwater and Drinking Water

<http://www.epa.gov/OGWDW/>

Wastewater Treatment Water Use

<http://ga.water.usgs.gov/edu/wuww.html>

Hazardous Materials

<http://www.ready.illinois.gov/during/hazmat.htm>

Household Hazardous Waste Collections

<http://www.epa.state.il.us/land/hazardous-waste/household-haz-waste/>

Agricultural Career Profiles

<http://www.mycart.com/career-profiles>