AHERA
Asbestos Building Inspector

U.S. EPA and Cal-OSHA Accredited

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by The Asbestos Institute

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CHAPTER 2

POTENTIAL HEALTH EFFECTS RELATED TO ASBESTOS EXPOSURE

OBJECTIVES:

1. To understand the difference between passive and occupational exposure, and to understand where the greatest health hazard occurs.
2. To understand the functioning of the respiratory system.
3. To become familiar with the diseases associated with asbestos exposure.
4. To understand the interaction between smoking and asbestos exposure.

EVIDENCE OF HEALTH RISKS

To understand the health risks associated with a substance such as asbestos, scientists evaluate data compiled from clinical, epidemiological, and laboratory studies. Clinical data ordinarily provide the first indication that a substance may have adverse effects on the body. Physicians observe a pattern of symptoms, or the presence of a disease which appears to be linked with a particular activity, or exposure to a particular substance. Such observations lead to a hypothesis that the activity or substance caused the symptoms or the observed disease. Epidemiologists will then undertake an investigation to attempt to confirm the hypothesis. If an association between the symptoms, or disease, and the activity or substance appears to be substantiated, laboratory studies are undertaken. Should animal response to the substance produce effects similar to that observed in humans, the case for an association is strengthened.

Most of the information on the health effects of exposure to asbestos has been derived from studies of workers exposed to asbestos in the course of their occupation. Asbestos fiber concentrations for such workers are many times higher than those encountered by the general public, or by most workers in building with asbestos-containing material (ACM). Because their exposure was much higher, asbestos workers will have a much higher incidence of asbestos-related diseases than people who live or work in buildings with ACM. This is known as the dose-response effect. However, people in buildings with ACM may experience higher risks than the public at large, depending on condition and disturbance of the ACM. Unfortunately, the available data does not allow us to reliably estimate the actual risk.

Because asbestos fibers appear to be ubiquitous, virtually everyone is exposed to some extent. During autopsy, asbestos fibers have been detected in the lungs of most urban residents. Exposure of the general public is troublesome because we are talking about a large population which includes unhealthy as well as healthy persons. Moreover, exposure may begin during childhood, leaving a long period for the manifestation of asbestos related disease. Furthermore, asbestos may enhance the carcinogenic effects of other materials. Any additional exposure to asbestos should thus be avoided.

Despite epidemiological studies of workers and laboratory studies of animals, questions remain about which properties of asbestos are responsible for the adverse health effects. It is not known whether the particular properties which produce one disease, for example, lung cancer, are the same as those which produce another disease, such as asbestosis. Which conditions of exposure are most likely to lead to adverse health effects have not been positively identified. Some characteristics that appear to be important are: the physical size of fibers and their durability. The variation in chemical composition among different types of asbestos does not appear to be

as important as difference in physical properties. However, the Environmental Protection Agency (EPA) believes that current evidence is not sufficient to say that one type is any more toxic than another.

Exposure to man-made mineral fibers, such as fibrous glass and ceramic materials is relatively recent. Occupational exposure levels have not been as high as asbestos exposure. However, some epidemiological data do suggest that diseases of the respiratory tract, such as pulmonary fibrosis and lung cancer, may result from long-term exposure to these fibers if the fibers are thin. Fibrous glass used for thermal insulation does not appear to be a problem.

THE RESPIRATORY SYSTEM

To be a significant health concern, asbestos fibers must be inhaled. An understanding of the mechanics of the respiratory system will aid in appreciating the potential for exposure and the resulting health effects.

Every cell in the body needs a constant supply of oxygen. The respiratory system meets this need by bringing oxygen to the bloodstream, which delivers it to each cell and carries away carbon dioxide. The lungs are the focal point of the respiratory system, which also includes the respiratory tract, the channel by which air flows into and out of the lungs. Exhibit 2-1, on the following page, is an illustration of the respiratory system.

Inhaled air passes through the nose, where moisture and tiny hairs filter dust. It then passes down the throat where air is also humidified. Air continues into the trachea, a tube supported by rings of cartilage. Just above the heart, the trachea divides into two bronchi. Each bronchus leads into a lung where it subdivides into bronchioles and smaller air tubes—giving the appearance of an upside down tree. The tiniest tubes end in globular air sacs,
or alveoli.

The actual exchange of gases—respiration—takes place in the alveoli. There, blood vessels only one cell thick allows oxygen and carbon dioxide to trade places. The carbon dioxide is exhaled back up the respiratory tract. The blood picks up fresh oxygen and transports it throughout the body.

The lungs, cone-shaped, balloon-like, elasticized tissue are located on either side of the chest. Each lung is encased by a double layer of membrane, or pleura. One layer is attached to the lung, the other to the rib cage. Space and fluid between the two layers enable the lungs to expand and contract in the chest cavity without friction. To visualize this association, think of two panes of glass with a drop of water between them. The pieces of glass, like the linings, slide easily across

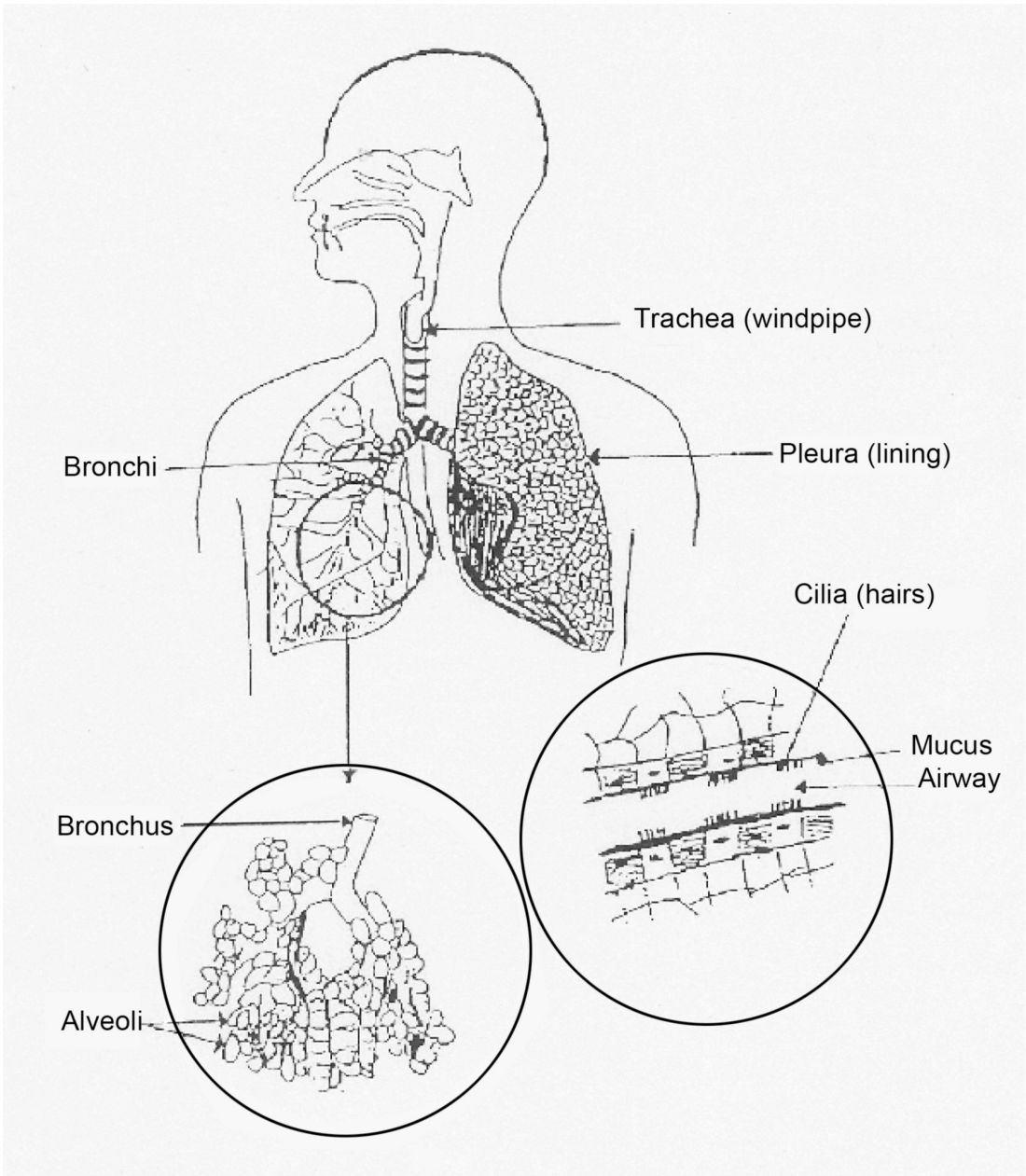

EXHIBIT 2-1: ILLUSTRATION OF RESPIRATORY TRACT

each other, but are difficult to pull apart. When we breathe in, the diaphragm stretches out flat and muscles between the ribs contract with it, pulling the ribs up and out. This expands the chest cavity, creating a vacuum between the linings that expands the lungs and sucks in air. When breathing out, the diaphragm and rib cage muscles relax, the ribs fall in and down, and the lungs contract and push out the carbon dioxide and unused oxygen.

The respiratory system is sensitive to bacteria, viruses, and many airborne particles that can be inhaled. Reactions to these irritants can disrupt the functioning of the system, resulting in many ailments including the following: the common cold, hay fever, sinusitis, sore throat, acute or chronic bronchitis, emphysema, and lung cancer.

The body has several mechanisms by which it filters the air it breathes. The tiny hairs in the nose filter out dust and airborne particles. Like the nose, the trachea and the bronchi are lined with small fine "hairs" called cilia. Together with mucous secreted by cells lining the airways, cilia trap particles and help prevent respiratory infections. The cilia beat in an upward direction sweeping foreign particles up to the back of the mouth from where they are expelled or swallowed. Viruses and bacteria are also attacked by enzymes called lysozymes in the mucous cells. Microbes that slip through are usually handled by white blood cells called phagocytes that envelope and eat these invaders in the lung.

Cigarette smoking temporarily paralyzes the cilia. If smoking continues long enough, the cilia wither and die. They are never replaced. The efficiency of the cilia is replaced by the smoker's inefficient cough which attempts to rid the respiratory tract of foreign particles and excess mucus.

Dirty, contaminated air presents the greatest challenge to the respiratory system. Some of the particles entering the airways reach the alveoli. When this occurs, white blood cells called macrophages attempt to engulf and digest the particles. In the case of asbestos, we are dealing with a mineral fiber, a substance which macrophages can often not successfully attack. As a means of secondary defense, the macrophages deposit a coating on the fibers which are then deposited in the smaller passages. Here they clog and actually scar the tissues. The walls of the alveoli lose their elasticity and useful function in respiration. Coated asbestos fibers (asbestos bodies) are often seen at an autopsy.

DISEASES ASSOCIATED WITH ASBESTOS EXPOSURE

The adverse health effects of asbestos were observed in the first century by the Greeks and Romans. They noted a breathing problem in slaves weaving asbestos cloth. Modern knowledge linking asbestos and a lung disease called asbestosis dates to 1900. Autopsy reports from 1938-1949 indicated that a large number of persons who died with asbestosis also had lung cancer. In the 1960's the link between asbestos and a rare form of cancer called mesothelioma was established. These diseases are discussed below.

Asbestosis is a scarring (fibrosis) of the lung. The scarring impairs the elasticity of the lung tissue and hampers its ability to exchange gases. This leads to inadequate oxygen intake to the blood. The disease restricts breathing leading to decreased lung volume and it increases resistance in