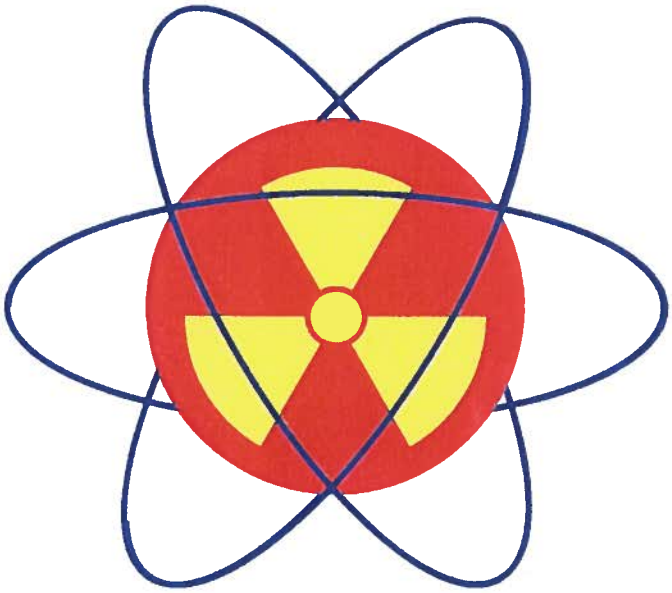
DEEOIC BASIC CE COURSE
Resource Book
May 2004



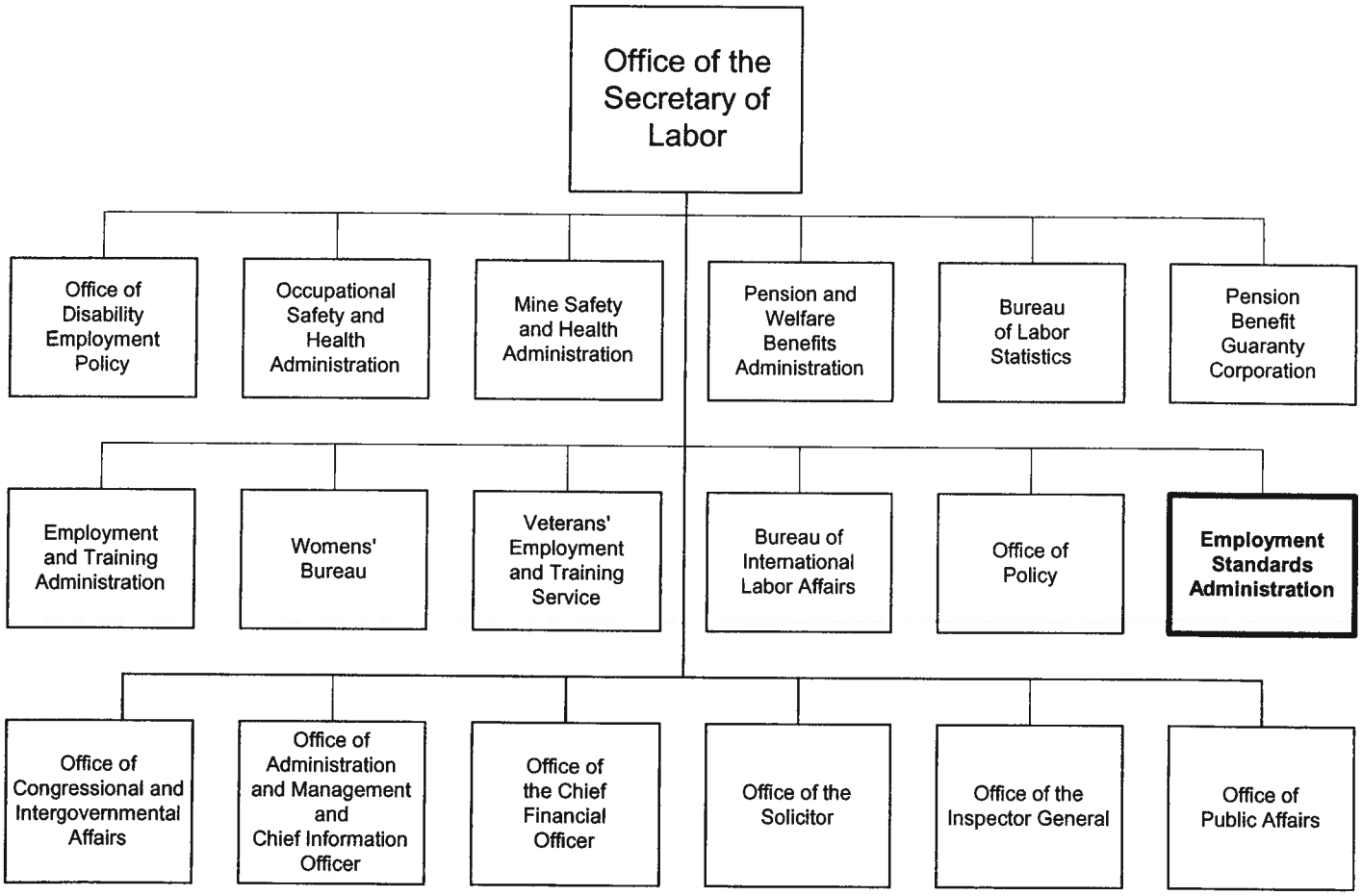
READINGS

TABLE OF CONTENTS

The following readings are contained in this section:

U. S. DEPARTMENT OF LABOR ORGANIZATION CHART

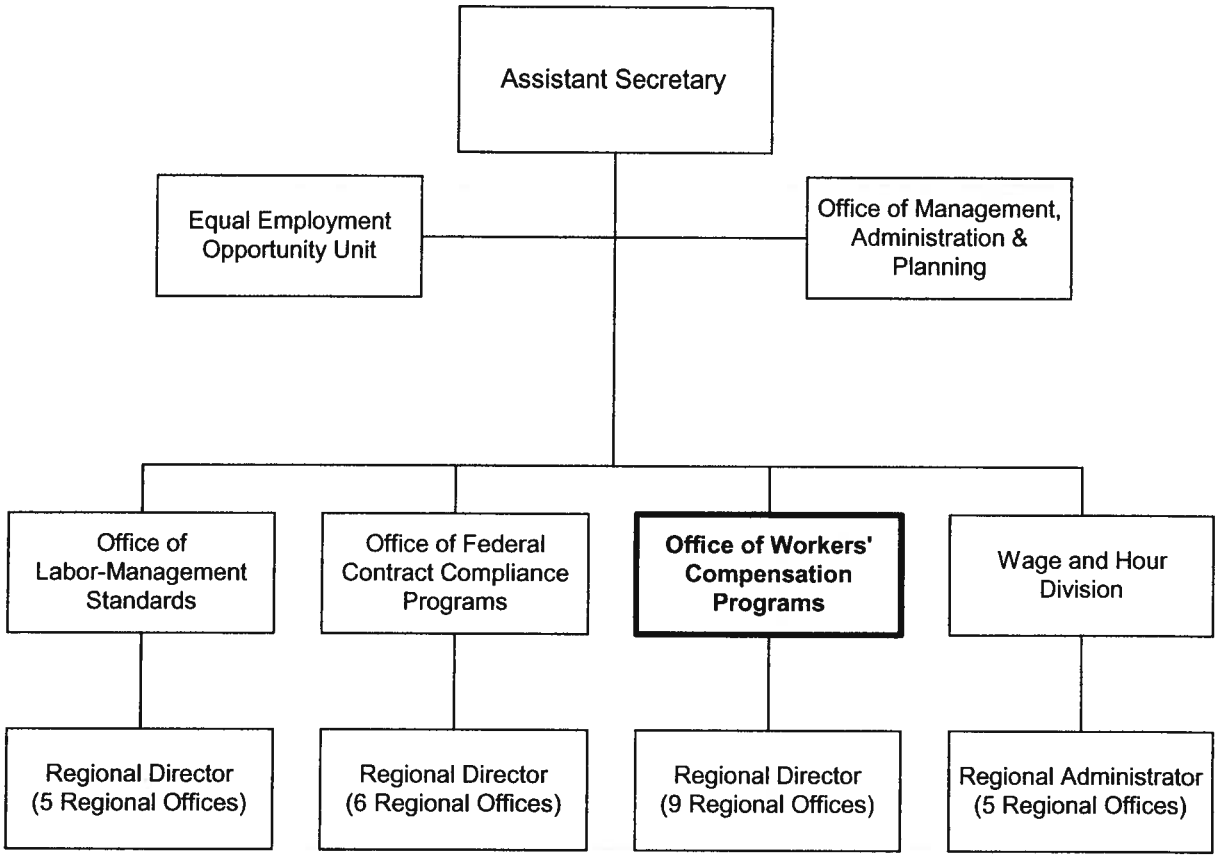
The **Department of Labor** is one of 14 major departments in the executive branch. The main mission of the Department of Labor is to protect the interests of America's workers. This and the next few pages show how DEEOIC fits within the Department.



Each of the organizations has an Assistant Secretary who reports to the Secretary of Labor.

Responsibility for the Energy Program belongs to the Employment Standards Administration (ESA)—it's the second box from the bottom on the right side of the chart. Let's look at ESA's organization chart.

EMPLOYMENT STANDARDS ADMINISTRATION ORGANIZATION CHART



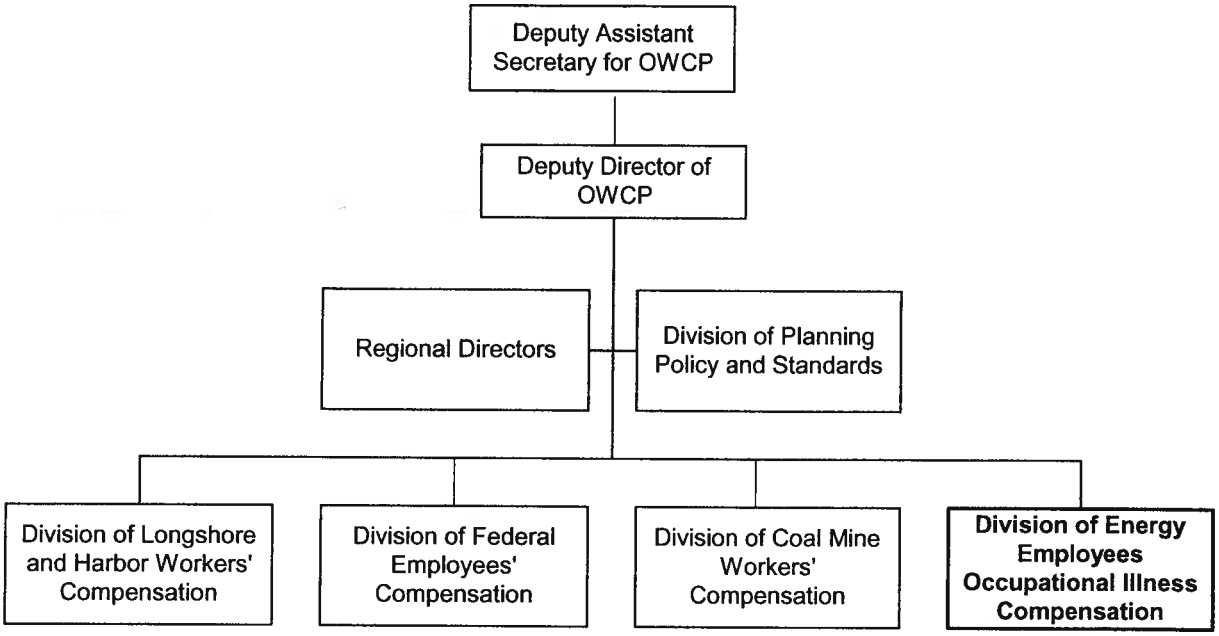
Notice that the Assistant Secretary (mentioned on the previous page) is the head of ESA.

Responsibility for the Energy Program has been assigned to the Office of Workers' Compensation Programs (OWCP) within ESA.

Note that the head of OWCP reports to the Assistant Secretary for ESA.

Let's look at OWCP's organization chart.

OFFICE OF WORKERS' COMPENSATION PROGRAMS ORGANIZATION CHART



The head of OWCP is the Deputy Assistant Secretary who reports to the Assistant Secretary for ESA.

The Directors of the compensation programs report to the Deputy Director of OWCP.

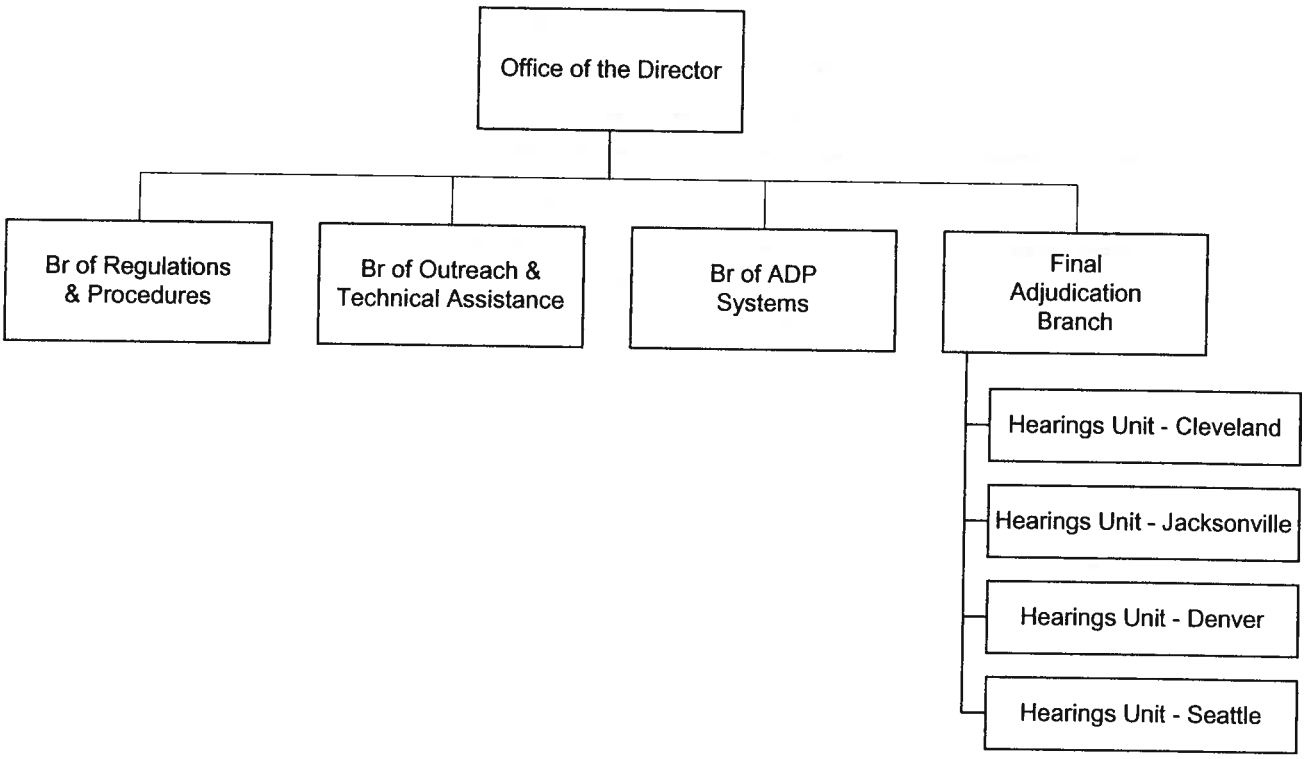
In addition to EEOICPA, the Office of Workers' Compensation Programs (OWCP) also administers:

- the Federal Employees' Compensation Program
- the Coal Mine Workers' Compensation Program (also called "The Black Lung Program"), and
- the Longshore and Harborworkers' Compensation Program

These programs are all workers' compensation programs. They provide benefits for workers who are injured in or become ill as a result of their job.

Let's look at the EEOICPA organization chart next.

EEOICPA
ORGANIZATION CHART
National Office



This is an expansion of the EEOICPA box on the previous page.

- The Branch of Regulations and Procedures writes the regulations and procedures.
- The Branch of Outreach & Technical Assistance provides technical guidance and assistance to District Offices and other interested parties.
- Branch of ADP Systems designs and develops the program's statistical reporting system.
- The Final Adjudication Branch reviews and takes final action on claims and handles requests for reconsideration.

This is the National Office structure. The District Offices established their own structures, to some extent. However, they all look something like the chart on the next page.

This page can be accessed through ESA's Inside Edition (intranet) home page by clicking on the IT Security button at the left of the page.

ESA IT Security Awareness Page

This page provides links to security policies, procedures and other information to help you protect **ESA's information technology (IT) resources**.

- **Ways to Protect ESA IT Resources**
- **How to Password-Protect Your Screen Saver**
- **Changing Your Passwords**
- **ESA System Manager Contact Information**
- **ESA Computer Security Officer Contact Information**
- **IT Security FAQ's**
- **ESA IT Security Awareness Comment Form**
- **ESA Media Sanitation Policy**
- **Appropriate Use of DOL Information Technology**
- **DOL Computer Security Handbook (PDF)**
- **DOL System Development Life Cycle Manual (SDLCM)**
- **DOL Freedom of Information Act Regulations**
- **DOL Privacy Act Regulations**

ESA IT Resources ESA information technology (IT) resources include computer room operations, work sites, IT staff supporting ESA's mission; all microcomputers and peripherals, such as printers; wide and local area network components; information stored on ESA IT systems; and, software that stores, processes, generates, and manages information, including software common to the needs of all authorized users such as word processing and electronic mail (e-mail).

REMEMBER: Activate your Screen Saver each time you leave your workstation!

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Department of Labor
Employment Standards Administration

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Selected Information on Cancers

This information is excerpted from the National Cancer Institute's "PDQ cancer information summaries: treatments" page at: **http://www.cancer.gov/cancer_information/list.aspx?viewid=5f35036e-5497-4d86-8c2c-714a9f7c8d25**. The information is mostly from the choice for patients. However, Dr. Miller recommends using the choice for health professionals, which contains more useful information than the choice for patients.

Note: Always use the web site itself, NOT this printed information. That way, you will have the latest updates available. The information in this appendix is provided for use during the course.

Adult Acute Lymphoblastic Leukemia (PDQ®): Treatment

For contrast's purposes, the first general information section below is taken from the web site's choice for health professionals. All other information is taken from the web site's choice for patients.

"General Information [from choice for health professionals]

"Sixty percent to 80% of adults with acute lymphoblastic leukemia (ALL) can be expected to attain complete remission status following appropriate induction therapy. Approximately 35% to 40% of adults with ALL can be expected to survive 2 years with aggressive induction combination chemotherapy and effective supportive care during induction therapy (appropriate early treatment of infection, hyperuricemia, and bleeding). A few studies that use intensive multiagent approaches suggest that a 50% 3-year survival is achievable in selected patients, but these results must be verified by other investigators.

"As in childhood ALL, adult patients with ALL are at risk of developing central nervous system (CNS) involvement during the course of their disease. This is particularly true for patients with L3 histology.[5] Both treatment and prognosis are influenced by this complication. The examination of bone marrow aspirates and/or biopsy specimens should be done by an experienced oncologist, hematologist, hematopathologist, or general pathologist who is capable of interpreting conventional and specially stained specimens. Diagnostic confusion with acute myelocytic leukemia (AML), hairy-cell leukemia, and malignant lymphoma is not uncommon. Proper diagnosis is crucial because of the difference in prognosis and treatment of ALL and AML. Immunophenotypic analysis is essential because leukemias that do not express myeloperoxidase include M0 and M7 AML as well as ALL.

"Appropriate initial treatment, usually consisting of a regimen that includes the combination of vincristine, prednisone, and anthracycline, with or without asparaginase, results in a complete remission rate of up to 80%. Median remission duration for the complete responders is approximately 15 months. Entry into a clinical trial is highly desirable to assure adequate patient treatment and also maximal information retrieval from the treatment of this highly responsive, but usually fatal, disease. Patients who experience a relapse after remission can be expected to succumb within 1 year, even if a second complete remission is achieved. If there are appropriate

available donors and if the patient is younger than 55 years of age, bone marrow transplantation may be a consideration in the management of this disease.[6] Transplant centers performing 5 or fewer transplants annually usually have poorer results than larger centers. If allogeneic transplant is considered, transfusions with blood products from a potential donor should be avoided if possible.

"Patients with L3 morphology have improved outcomes when treated according to specific treatment algorithms. Age, which is a significant factor in childhood ALL and in AML, may also be an important prognostic factor in adult ALL. In one study, overall the prognosis was better in patients younger than 25 years; another study found a better prognosis in those younger than 35 years. These findings may, in part, be related to the increased incidence of the Philadelphia (Ph) chromosome in older ALL patients, a subgroup associated with poor prognosis.[1,2] Elevated B2-microglobulin is associated with a poor prognosis in adults as evidenced by lower response rate, increased incidence of CNS involvement, and significantly worse survival. Patients with Ph chromosome-positive ALL are rarely cured with chemotherapy. Many patients who have molecular evidence of the bcr-abl fusion gene, which characterizes the Ph chromosome, have no evidence of the abnormal chromosome by cytogenetics. Because many patients have a different fusion protein from the one found in chronic myelogenous leukemia (p190 versus p210), the bcr-abl fusion gene may be detectable only by pulsed-field gel electrophoresis or reverse-transcriptase polymerase chain reaction (RT-PCR). These tests should be performed whenever possible in patients with ALL, especially those with B-cell lineage disease. Two other chromosomal abnormalities with poor prognoses are t(4;11), which is characterized by rearrangements of the MLL gene and may be rearranged despite normal cytogenetics, and t(9;22). In addition to t(9;22) and t(4;11), patients with deletion of chromosome 7 or trisomy 8 have been reported to have a lower probability of survival at 5 years compared to patients with a normal karyotype. L3 ALL is associated with a variety of translocations which involve translocation of the c-myc proto-oncogene to the immunoglobulin gene locus (t(2;8), t(8;12), and t(8;22))."

General Information [from choice for patients]

"What is adult acute lymphoblastic leukemia? Adult acute lymphoblastic leukemia (also called acute lymphocytic leukemia or ALL) is a disease in which too many infection-fighting white blood cells called lymphocytes are found in the blood and bone marrow. Lymphocytes are made by the bone marrow and by other organs of the lymph system. The bone marrow is the spongy tissue inside the large bones in the body. The bone marrow makes red blood cells (which carry oxygen and other materials to all tissues of the body), white blood cells (which fight infection), and platelets (which make the blood clot). Normally, the bone marrow makes cells called blasts that develop (mature) into several different types of blood cells that have specific jobs to do in the body.

"Lymphocytes are found in the lymph which is a colorless, watery fluid present in the lymph vessels. The lymph vessels are part of the lymph system which is made up of thin tubes that branch, like blood vessels, into all parts of the body. Along the network of vessels are groups of small, bean-shaped organs called lymph nodes. Clusters of lymph nodes are found in the underarm, pelvis, neck, and abdomen. The spleen (an organ in the upper abdomen that makes

lymphocytes and filters old blood cells from the blood), the thymus (a small organ beneath the breastbone), and the tonsils (an organ in the throat) are also part of the lymph system.

"Lymphocytes fight infection by making substances called antibodies, which attack germs and other harmful bacteria in the body. In ALL, the developing lymphocytes do not mature and become too numerous. These immature lymphocytes are then found in the blood and the bone marrow. They also collect in the lymph tissues and make them swell. Lymphocytes may crowd out other blood cells in the blood and bone marrow. If the bone marrow cannot make enough red blood cells to carry oxygen, then anemia may develop. If the bone marrow cannot make enough platelets to make the blood clot normally, the bleeding or bruising may develop more easily. The cancerous lymphocytes can also invade other organs, the spinal cord, and the brain.
Leukemia can be acute (progressing quickly with many immature cancer cells) or chronic (progressing slowly with more mature looking leukemia cells). ALL progresses quickly and can occur in adults and children. Treatment is different for adults than it is for children. (For more information on childhood ALL, refer to the PDQ patient information statement on childhood acute lymphoblastic leukemia. Separate PDQ patient information statements are also available for chronic lymphoblastic leukemia, chronic myelogenous leukemia, adult or childhood acute myeloid leukemia, and hairy-cell leukemia).

"ALL is often difficult to diagnose. The early signs may be similar to the flu or other common diseases. A doctor should be seen if the following signs or symptoms won't go away: fever, persistant weakness or tiredness, achiness in the bones or joints, or swollen lymph nodes.
If there are symptoms, a doctor may order blood tests to count the number of each of the different kinds of blood cells. If the results of the blood tests are not normal, a doctor may do a bone marrow biopsy. During this test, a needle is inserted into a bone and a small amount of bone marrow is taken out and looked at under the microscope. A doctor may also do a spinal tap in which a needle is inserted through the back to take a sample of the fluid that surrounds the brain and spine. The fluid is then looked at under a microscope to see if leukemia cells are present. A doctor can then tell what kind of leukemia is present and plan the best treatment.

"The chance of recovery (prognosis) depends on how the leukemia cells look under a microscope, how far the leukemia has spread, and the patient's age and general health.

Stage Information

"Stages of adult acute lymphoblastic leukemia. There is no staging for ALL. Your choice of treatment depends on whether a patient has been treated before.

"Untreated. Untreated ALL means that no treatment has been given except to treat symptoms. There are too many white blood cells in the blood and bone marrow, and there may be other signs and symptoms of leukemia.

"In remission. Remission means that treatment has been given and that the number of white blood cells and other blood cells in the blood and bone marrow is normal. There are no signs or symptoms of leukemia.

"Recurrent. Recurrent disease means that the leukemia has come back after going into remission. Refractory disease means that the leukemia has failed to go into remission following treatment.

Treatment Option Overview

"How adult acute lymphoblastic leukemia is treated. There are treatments for all patients with ALL. The primary treatment of ALL is chemotherapy. Radiation therapy may be used in certain cases. Bone marrow transplantation is being studied in clinical trials.

"Chemotherapy uses drugs to kill cancer cells. Chemotherapy may be taken by pill, or it may be put into the body by a needle in a vein or muscle. Chemotherapy is called a systemic treatment because the drug enters the bloodstream, travels through the body, and can kill cancer cells throughout the body. Chemotherapy may sometimes be put into the fluid that surrounds the brain by inserting a needle in the brain or back (intrathecal chemotherapy).

"Radiation therapy uses x-rays or other high-energy rays to kill cancer cells and shrink tumors. Radiation for ALL usually comes from a machine outside the body (external radiation therapy). There are two phases of treatment for ALL. The first stage is called induction therapy. The purpose of induction therapy is to kill as many of the leukemia cells as possible and make patients go into remission. Once in remission with no signs of leukemia, patients enter a second phase of treatment (called continuation therapy), which tries to kill any remaining leukemia cells. A patient may receive chemotherapy for up to several years to stay in remission.
Radiation therapy or chemotherapy to the brain may be given to patients if leukemia cells have spread to the brain. Patients may also receive central nervous system (CNS) prohylaxis, another type of therapy, to prevent leukemia cells from growing in the brain during induction therapy and remission.

"Bone marrow transplantation is used to replace bone marrow with healthy bone marrow. First, all of the bone marrow in the body is destroyed with high doses of chemotherapy with or without radiation therapy. Healthy marrow is then taken from another person (a donor) whose tissue is the same as or almost the same as the patient's. The donor may be a twin (the best match), a brother or sister, or a person who is not related. The healthy marrow from the donor is given to the patient through a needle in the vein, and the marrow replaces the marrow that was destroyed. A bone marrow transplant using marrow from a relative or person not related to the patient is called an allogeneic bone marrow transplant.
"Another type of bone marrow transplant, called autologous bone marrow transplant, is being studied in clinical trials. To do this type of transplant, bone marrow is taken from the patient and treated with drugs to kill any cancer cells. The marrow is frozen to save it. Next, high-dose chemotherapy is given with or without radiation therapy to destroy all of the remaining marrow.

The frozen marrow that was saved is then thawed and given to the patient through a needle in a vein to replace the marrow that was destroyed.

"A greater chance for recovery occurs if the doctor chooses a hospital that does more than five bone marrow transplantations per year."

Acute Myeloid Leukemia

General Information

"What is adult acute myeloid leukemia? Adult acute myeloid leukemia (AML) is a disease in which cancer (malignant) cells are found in the blood and bone marrow. AML is also called acute nonlymphocytic leukemia or ANLL. The bone marrow is the spongy tissue inside the large bones in the body. The bone marrow makes red blood cells (which carry oxygen and other materials to all tissues of the body), white blood cells (which fight infection), and platelets (which make the blood clot).

"Normally, the bone marrow makes cells called blasts that develop (mature) into several different types of blood cells that have specific jobs to do in the body. AML affects the blasts that are developing into white blood cells called granulocytes. In AML, the blasts do not mature and become too numerous. These immature blast cells are then found in the blood and the bone marrow.

"Leukemia can be acute (progressing quickly with many immature blasts) or chronic (progressing slowly with more mature looking cancer cells). Acute myeloid leukemia progresses quickly. AML can occur in adults or children (refer to the PDQ summaries on Childhood Acute Myeloid Leukemia Treatment and Adult Acute Myeloid Leukemia Treatment for more information). (Refer to the PDQ summaries on Chronic Lymphocytic Leukemia Treatment; Chronic Myelogenous Leukemia Treatment; Adult Acute Lymphocytic Leukemia Treatment; and Hairy Cell Leukemia Treatment for more information.)

"AML is often difficult to diagnose. The early signs may be similar to the flu or other common diseases. A doctor should be seen if the following signs or symptoms won't go away: fever, weakness or tiredness, or achiness in the bones or joints.

"If there are symptoms, a doctor may order blood tests to count the number of each of the different kinds of blood cells. If the results of the blood tests are not normal, a doctor may do a bone marrow biopsy. During this test, a needle is inserted into a bone and a small amount of bone marrow is taken out and looked at under a microscope. A doctor can then tell what kind of leukemia is present and plan the best treatment.

"The chance of recovery (prognosis) depends on the type of AML and the patient's age and general health.

Staging Information

"Stages of adult acute myeloid leukemia. There is no staging for AML. The choice of treatment depends on whether the patient has been treated.

"Untreated. Untreated AML means no treatment has been given except to treat symptoms. There are too many white blood cells in the blood and bone marrow, and there may be other signs and symptoms of leukemia. Rarely, tumor cells can appear as a solid tumor called an isolated granulocytic sarcoma or chloroma.

"In remission. Treatment has been given, and the number of white blood cells and other blood cells in the blood and bone marrow is normal. There are no signs or symptoms of leukemia.

"Recurrent/refractory. Recurrent disease means the leukemia has come back after going into remission. Refractory disease means the leukemia has not gone into remission following treatment.

Treatment Option Overview

"How adult acute myeloid leukemia is treated. There are treatments for all patients with AML. The primary treatment of AML is chemotherapy. Radiation therapy may be used in certain cases. Bone marrow transplantation and biological therapy are being studied in clinical trials.

"Chemotherapy is the use of drugs to kill cancer cells. Drugs may be given by mouth, or they may be put into the body by a needle in a vein or muscle. Chemotherapy is called a systemic treatment because the drug enters the bloodstream, travels through the body, and can kill cancer cells throughout the body. Chemotherapy may sometimes be put into the fluid that surrounds the brain through a needle in the brain or back (intrathecal chemotherapy).

"Radiation therapy uses x-rays or other high-energy rays to kill cancer cells and shrink tumors. Radiation for AML usually comes from a machine outside the body (external radiation therapy). If the leukemia cells have spread to the brain, radiation therapy to the brain or intrathecal chemotherapy will be given.

"There are two phases of treatment for AML. The first stage is called induction therapy. The purpose of induction therapy is to kill as many of the leukemia cells as possible and make patients go into remission. Once in remission with no signs of leukemia, patients enter a second phase of treatment (called continuation therapy), which tries to kill any remaining leukemia cells. Chemotherapy may be given for several years to keep a patient in remission.

"Bone marrow transplantation is used to replace the bone marrow with healthy bone marrow. First, all of the bone marrow in the body is destroyed with high doses of chemotherapy with or without radiation therapy. Healthy marrow is then taken from another person (a donor) whose tissue is the same as or almost the same as the patient's. The donor may be a twin (the best match), a brother or sister, or a person who is not related. The healthy marrow from the donor is given to the patient through a needle in the vein, and the marrow replaces the marrow that was destroyed. A bone marrow transplant using marrow from a relative or from a person who is not related is called an allogeneic bone marrow transplant.

"Another type of bone marrow transplant, called autologous bone marrow transplant, is being studied in clinical trials. To do this type of transplant, bone marrow is taken from the patient and treated with drugs to kill any cancer cells. The marrow is then frozen to save it. Next, high-dose chemotherapy is given with or without radiation therapy to destroy all of the remaining marrow. The frozen marrow that was saved is then thawed and given to the patient through a needle in a vein to replace the marrow that was destroyed.

"Another type of autologous transplant is called a peripheral blood stem cell transplant. The patient's blood is passed through a machine that removes the stem cells (immature cells from which all blood cells develop), then returns the blood to the patient. This procedure is called leukapheresis and usually takes 3 or 4 hours to complete. The stem cells are treated with drugs to kill any cancer cells and then frozen until they are transplanted to the patient. This procedure may be done alone or with an autologous bone marrow transplant.

"A greater chance for recovery occurs if the doctor chooses a hospital that does more than five bone marrow transplantations per year.

"Biological therapy tries to get the body to fight cancer. It uses materials made by the patient's body or made in a laboratory to boost, direct, or restore the body's natural defenses against disease. Biological therapy is sometimes called biological response modifier therapy or immunotherapy."

Non-Small Cell Lung Cancer

General Information

"Non-small cell lung cancer is a disease in which malignant (cancer) cells form in the tissues of the lung. The lungs are a pair of cone-shaped breathing organs that are found within the chest. The lungs bring oxygen into the body and take out carbon dioxide, which is a waste product of the body's **cells**. There is a right lung and a left lung. Each lung has sections called lobes. The left lung has two **lobes**. The right lung, which is slightly larger, has three. A thin membrane called the **pleura** surrounds the lungs. Two tubes called **bronchi** lead from the **trachea** (windpipe) to the right and left lungs. Tiny air sacs called **alveoli** and small tubes called **bronchioles** make up the inside of the lungs. The bronchi are sometimes also involved in lung cancer.

"There are two types of lung cancer: **non-small cell lung cancer** and **small cell lung cancer**. (Refer to the PDQ summary on **Small Cell Lung Cancer Treatment** for more information.)

"There are five types of non-small cell lung cancer. The five types of non-small cell lung cancer have different kinds of cancer cells. The cancer cells of each type grow and spread in different ways. The types of non-small cell lung cancer are named for the kinds of cells found in the cancer and how the cells look when viewed under a microscope:

- **Squamous cell carcinoma**: Cancer that begins in squamous cells, which are thin, flat cells that look like fish scales. This is also called epidermoid carcinoma.
- **Adenocarcinoma**: Cancer that begins in cells that have **glandular** (secretory) properties.

- **Large cell carcinoma**: Cancer in which the cells are large and look abnormal when viewed under a microscope.
- Adenosquamous carcinoma: Cancer that begins in cells that look flattened when viewed under a microscope. These cells also have glandular (secretory) properties.
- Undifferentiated carcinoma: Cancer cells that do not look like normal cells and multiply uncontrollably.

"Certain factors affect treatment options and prognosis (chance of recovery). The treatment options and **prognosis** (chance of recovery) depend on the **stage** of the cancer (whether it is in the lung only or has spread to other places), tumor size, the type of lung cancer, whether there are **symptoms**, and the patient's general health.

"For most patients with non-small cell lung cancer, current treatments do not cure the cancer."

Staging Information

"Occult (hidden) stage. In the occult (hidden) stage, cancer cells are found in sputum (mucus coughed up from the lungs), but no tumor can be found in the lung by **imaging** or bronchoscopy, or the **primary tumor** is too small to be assessed.

"Stage 0 (carcinoma in situ). In stage 0 (**carcinoma in situ**), cancer is limited to the lung and is found in a few layers of cells only. It has not grown through the top lining of the lung.

"Stage I. In **stage I**, the cancer is in the lung only, with normal tissue around the tumor. Stage I is divided into stages IA and IB, based on the size of the tumor.

"Stage II. In **stage II**, cancer has spread to nearby lymph nodes or to the **chest wall** (the ribs and muscles that make up the area of the body between the neck and the **abdomen**), the **diaphragm** (the thin muscle below the lungs and heart that separates the chest from the abdomen), the **mediastinal pleura** (the thin membrane that covers the outside of the lungs in the area near the heart), or the parietal pericardium (the outer layer of tissue that surrounds the heart). Stage II is divided into stage IIA and stage IIB, based on the size of the tumor and whether it has spread to the lymph nodes.

"Stage III. In **stage III**, cancer has either:

- spread to the lymph nodes in the mediastinum (the middle area between the lungs that contains the heart, major **blood vessels**, and other structures); or
- spread to the lymph nodes on the opposite side of the chest or in the lower neck.

Stage III is divided into stage IIIA (which is sometimes treated with surgery) and stage IIIB (which is rarely treated with surgery).

"Stage IV. In **stage IV**, cancer has spread to other parts of the body or to another **lobe** of the lungs.

Treatment Option Overview

"At diagnosis, patients can be divided into three treatment groups based on the stage of the cancer:

"Non-small cell lung cancer that can be treated with surgery. Stage 0, **stage I**, and **stage II** non-small cell lung cancer can often be removed by **surgery**. **Radiation therapy** may be used to treat patients who have other medical problems and cannot have surgery.

"Non-small cell lung cancer that has spread to nearby tissue or to lymph nodes. Non-small cell lung cancer that has spread to nearby **tissue** or to **lymph nodes** can be treated with one of the following:

- Radiation therapy alone.
- Radiation therapy and **chemotherapy** or other kinds of treatment.
- Surgery alone.

Non-small cell lung cancer that has spread to other parts of the body or to another lobe of the lungs. Radiation therapy may be used to shrink the cancer and to relieve pain in patients who have non-small cell lung cancer that has spread to other parts of the body. Chemotherapy may be used to treat some patients.

Small Cell Lung Cancer

"What is small cell lung cancer? Small cell lung cancer is a disease in which cancer (malignant) cells are found in the tissues of the lungs. The lungs are a pair of cone-shaped organs that take up much of the room inside the chest. The lungs bring oxygen into the body and take out carbon dioxide, which is a waste product of the body's cells. Tubes called bronchi make up the inside of the lungs.

"There are two kinds of lung cancer based on how the cells look under a microscope: small cell and non-small cell. (Refer to the PDQ summary on Non-Small Cell Lung Cancer Treatment for more information.)

"Small cell lung cancer is usually found in people who smoke or who used to smoke cigarettes. A doctor should be seen if there are any of the following symptoms: a cough or chest pain that doesn't go away, a wheezing sound when breathing, shortness of breath, coughing up blood, hoarseness, or swelling in the face and neck.

"If there are symptoms, a doctor may want to look into the bronchi through a special instrument, called a bronchoscope, that slides down the throat and into the bronchi. This test, called bronchoscopy, is usually done in the hospital. Before the test, the patient will be given a local anesthetic (a drug that causes a loss of feeling for a short period of time) in the back of the throat. Some pressure may be felt, usually with no pain. The doctor can take cells from the walls of the bronchi tubes or cut small pieces of tissue to look at under the microscope to see if there are any cancer cells. This is called a biopsy.

"The doctor may also use a needle to remove tissue from a place in the lung that may be hard to reach with the bronchoscope. A cut will be made in the skin and the needle will be put in between the ribs. This is called a needle aspiration biopsy. The doctor will look at the tissue under the microscope to see if there are any cancer cells. Before the test, a local anesthetic will be given to keep the patient from feeling pain.

"The chance of recovery (prognosis) and choice of treatment depend on the stage of the cancer (whether it is just in the lung or has spread to other places), and the patient's gender and general state of health."

Staging Information

"Once small cell lung cancer has been found, more tests will be done to find out if cancer cells have spread from one or both lungs to other parts of the body (staging). A doctor needs to know the stage of the disease to plan treatment. The following stages are used for small cell lung cancer:

"Limited stage. Cancer is found only in one lung and in nearby lymph nodes. (Lymph nodes are small, bean-shaped structures that are found throughout the body. They produce and store infection-fighting cells.)

"Extensive stage. Cancer has spread outside of the lung where it began to other tissues in the chest or to other parts of the body.

"Recurrent stage. Recurrent disease means that the cancer has come back (recurred) after it has been treated. It may come back in the lungs or in another part of the body.

"Treatment by Stage

"Limited Stage Small Cell Lung Cancer. Treatment may be one of the following:

1. Chemotherapy and radiation therapy to the chest with or without radiation therapy to the brain to prevent spread of the cancer (prophylactic cranial irradiation).
2. Chemotherapy with or without prophylactic cranial irradiation.
3. Surgery followed by chemotherapy with or without prophylactic cranial irradiation.

Clinical trials are testing new drugs and new ways of giving all of the above treatments.

"Extensive Stage Small Cell Lung Cancer. Treatment may be one of the following:

1. Chemotherapy with or without radiation therapy to the brain to prevent spread of the cancer (prophylactic cranial irradiation).
2. Radiation therapy to places in the body where the cancer has spread, such as the brain, bone, or spine to relieve symptoms.

Clinical trials are testing new drugs and new ways of giving all of the above treatments.

"Recurrent Small Cell Lung Cancer. Treatment may be one of the following:

1. Radiation therapy to reduce discomfort.
2. Chemotherapy to reduce discomfort.
3. Laser therapy, radiation therapy, and/or surgical implantation of devices to keep the airways open to relieve discomfort.
4. A clinical trial testing new drugs."

Colon Cancer

General Information

"Colon cancer is a disease in which malignant (cancer) cells form in the tissues of the colon. The **colon** is part of the body's **digestive system**. The digestive system removes and processes nutrients (vitamins, minerals, carbohydrates, fats, proteins, and water) from foods and helps pass waste material out of the body. The digestive system is made up of the **esophagus**, **stomach**, and the **small** and large **intestines**. The first 6 feet of the large intestine are called the large **bowel** or colon. The last 6 inches are the **rectum** and the anal canal. The anal canal ends at the **anus** (the opening of the large intestine to the outside of the body).

cancer is in the inner lining of the colon only, involves the whole colon, or has spread to other places in the body) and the patient's general health."

Staging Information

"Stage 0 (Carcinoma in Situ). In stage 0, the cancer is found in the innermost lining of the colon only. Stage 0 cancer is also called **carcinoma in situ**.

"Stage I. In **stage I**, the cancer has spread beyond the innermost lining of the colon to the second and third layers and involves the inside wall of the colon, but it has not spread to the outer wall of the colon or outside the colon. Stage I colon cancer is sometimes called Dukes' A colon cancer.

"Stage II. In **stage II**, cancer has spread outside the colon to nearby **tissue**, but it has not gone into the **lymph nodes**. (Lymph nodes are small, bean-shaped structures that are found throughout the body. They filter substances in a fluid called **lymph** and help fight infection and disease.) Stage II colon cancer is sometimes called Dukes' B colon cancer.

"Stage III. In **stage III**, cancer has spread to nearby lymph nodes, but it has not spread to other parts of the body. Stage III colon cancer is sometimes called Dukes' C colon cancer.

"Stage IV. In **stage IV**, cancer has spread to other parts of the body, such as the **liver** or lungs. Stage IV colon cancer is sometimes called Dukes' D colon cancer.

Treatment Options by Stage

"Stage 0 Colon Cancer (Carcinoma in Situ). Treatment of stage 0 (**carcinoma in situ**) may include the following types of **surgery**:

- Local excision (surgery to remove the **tumor** without cutting through the **abdominal** wall) or simple polypectomy (surgery to remove the **cancer** from a small bulging piece of **tissue**).
- **Resection/anastomosis** (surgery to remove the cancer and join the cut ends of the **colon**). This is done when the cancerous tissue is too large to remove by local excision.

"Stage I Colon Cancer. Treatment of **stage I colon cancer** is usually the following:

- Resection/anastomosis (surgery to remove the cancer and join the cut ends of the colon).

"Stage II Colon Cancer. Treatment of **stage II colon cancer** may include the following:

- Resection/anastomosis (surgery to remove the cancer and join the cut ends of the colon).
- **Clinical trials** of **chemotherapy**, **radiation therapy**, or **biological therapy** after surgery.

"Stage III Colon Cancer. Treatment of **stage III colon cancer** may include the following:

- Resection/anastomosis (surgery to remove the cancer and join the cut ends of the colon), with or without chemotherapy.
- Clinical trials of chemotherapy, radiation therapy, and/or biological therapy after surgery.

Stage IV Colon Cancer. Treatment of **stage IV colon cancer** may include the following:

- Resection/anastomosis (surgery to remove the cancer and join the cut ends of the colon or to **bypass** the tumor).
- Surgery to remove parts of other organs such as the **liver**, lungs, and **ovaries** where the cancer may have spread.
- Chemotherapy.
- Clinical trials of chemotherapy or biological therapy.
- Radiation therapy may be offered to some patients as **palliative therapy** (to relieve symptoms).

Thyroid Cancer

General Information

"Cancer of the thyroid is a disease in which cancer (malignant) cells are found in the tissues of the thyroid gland. The thyroid gland is at the base of the throat. It has two lobes, one on the right side and one on the left. The thyroid gland makes important hormones that help the body function normally.

"Cancer of the thyroid is more common in women than in men. Most patients are between 25 and 65 years old. People who have been exposed to large amounts of radiation, or who have had radiation treatment for medical problems in the head and neck have a higher chance of getting thyroid cancer. The cancer may not occur until 20 years or longer after radiation treatment. A doctor should be seen if there is a lump or swelling in the front of the neck or in other parts of the neck.

"If there are symptoms, a doctor will feel the patient's thyroid and check for lumps in the neck. The doctor may order blood tests and special scans to see whether a lump in the thyroid is making too many hormones. The doctor may want to take a small amount of tissue from the thyroid. This is called a biopsy. To do this, a small needle is inserted into the thyroid at the base of the throat and some tissue is drawn out. The tissue is then looked at under a microscope to see whether it contains cancer.

"There are four main types of cancer of the thyroid (based on how the cancer cells look under á microscope): papillary, follicular, medullary, and anaplastic. The chance of recovery (prognosis) depends on the type of thyroid cancer, whether it is just in the thyroid or has spread to other parts of the body (stage), and the patient's age and overall health. Some types of thyroid cancer grow much faster than others.

"The genes in our cells carry the hereditary information from our parents. An abnormal gene has been found in patients with some forms of thyroid cancer. If medullary thyroid cancer is found, the patient may have been born with a certain abnormal gene which may have led to the cancer. Family members may have also inherited this abnormal gene. Tests have been developed to determine who has the genetic defect long before any cancer appears. It is important that the patient and his or her family members (children, grandchildren, parents, brothers, sisters, nieces and nephews) see a doctor about tests that will show if the abnormal gene is present. These tests are confidential and can help the doctor help patients. Family members, including young children, who don't have cancer, but do have this abnormal gene, may reduce the chance of developing medullary thyroid cancer by having surgery to safely remove the thyroid gland (thyroidectomy).

Staging Information for Follicular Thyroid Cancer

"Stage I follicular. Cancer is only in the thyroid and may be found in one or both lobes.

"Stage II follicular: In patients younger than 45 years of age, cancer has spread beyond the thyroid. In patitients older than 45 years of age, cancer is only in the thyroid and larger than 1 centimeter (about ½ inch).

"Stage III follicular. Cancer is found in patients older than 45 years of age and has spread outside the thyroid (but not outside of the neck) or to the lymph nodes.

"Stage IV follicular. Cancer is found in patients older than 45 years of age and has spread to other parts of the body, such as the lungs and bones.

Treatment Options by Stage for Follicular Thyroid Cancer

"Stage I Follicular Thyroid Cancer. Treatment may be one of the following:

1. Surgery to remove the thyroid (total thyroidectomy).
2. Surgery to remove one lobe of the thyroid (lobectomy), followed by hormone therapy. Radioactive iodine also may be given following surgery.

"Stage II Follicular Thyroid Cancer. Treatment may be one of the following:

1. Surgery to remove the thyroid (total thyroidectomy).
2. Surgery to remove one lobe of the thyroid (lobectomy) and lymph nodes that contain cancer, followed by hormone therapy. Radioactive iodine also may be given following surgery.

"Stage III Follicular Thyroid Cancer. Treatment may be one of the following:

1. Surgery to remove the entire thyroid (total thyroidectomy) and lymph nodes or other tissues around the thyroid where the cancer has spread.
2. Total thyroidectomy followed by radioactive iodine or external beam radiation therapy.

"Stage IV Follicular Thyroid Cancer. Treatment may be one of the following:

1. Radioactive iodine.
2. External beam radiation therapy.
3. Hormone therapy.
4. A clinical trial of chemotherapy.

Using Health Physics Concepts & Terminology

What is health physics?	Health physics is the science of protecting people and their environment from potential radiation hazards. It is an inter-disciplinary science that incorporates elements of physics, biology, chemistry, engineering, etc. Health physicists work with electronic instrumentation and statistics to evaluate and determine ways to deal with radiation health risks.
What is radiation?	Radiation is energy in the form of electromagnetic waves. Examples of electromagnetic waves include radio and television waves, microwaves, radiant heat (infrared), visible light, ultraviolet light, X-rays, etc.
Types of radiation	Radiation is classified as ionizing or non-ionizing. • Non-ionizing radiation is radiation that does not carry enough energy to knock electrons from their orbits around the nuclei (centers) of atoms. Visible light and most of the other examples of electromagnetic waves noted above, except for X-rays, are non-ionizing radiation. • Ionizing radiation is radiation that carries enough energy to knock electrons from their orbits. When electrons are removed, the atoms become charged or "ionized." Examples of ionizing radiation include alpha and beta particles, gamma rays and the very similar X-rays. Figure 1 on the next page gives an overview of the spectrum of electromagnetic waves. Appendix 14 details types of radiation.
Radioactivity	Radioactivity is the release of ionizing radiation by unstable atoms that spontaneously transform, decay, or disintegrate. Radioactive materials are any materials that contain unstable atoms. Most elements are stable and do not decay. However, uranium and the transuranic elements (elements that have higher atomic numbers than uranium and rarely, if at all, occur in nature) are radioactive. Unstable forms of elements that are radioactive are called radioisotopes or radionuclides. Most elements that are not naturally radioactive—such as cesium and iodine—can have radioisotopes.

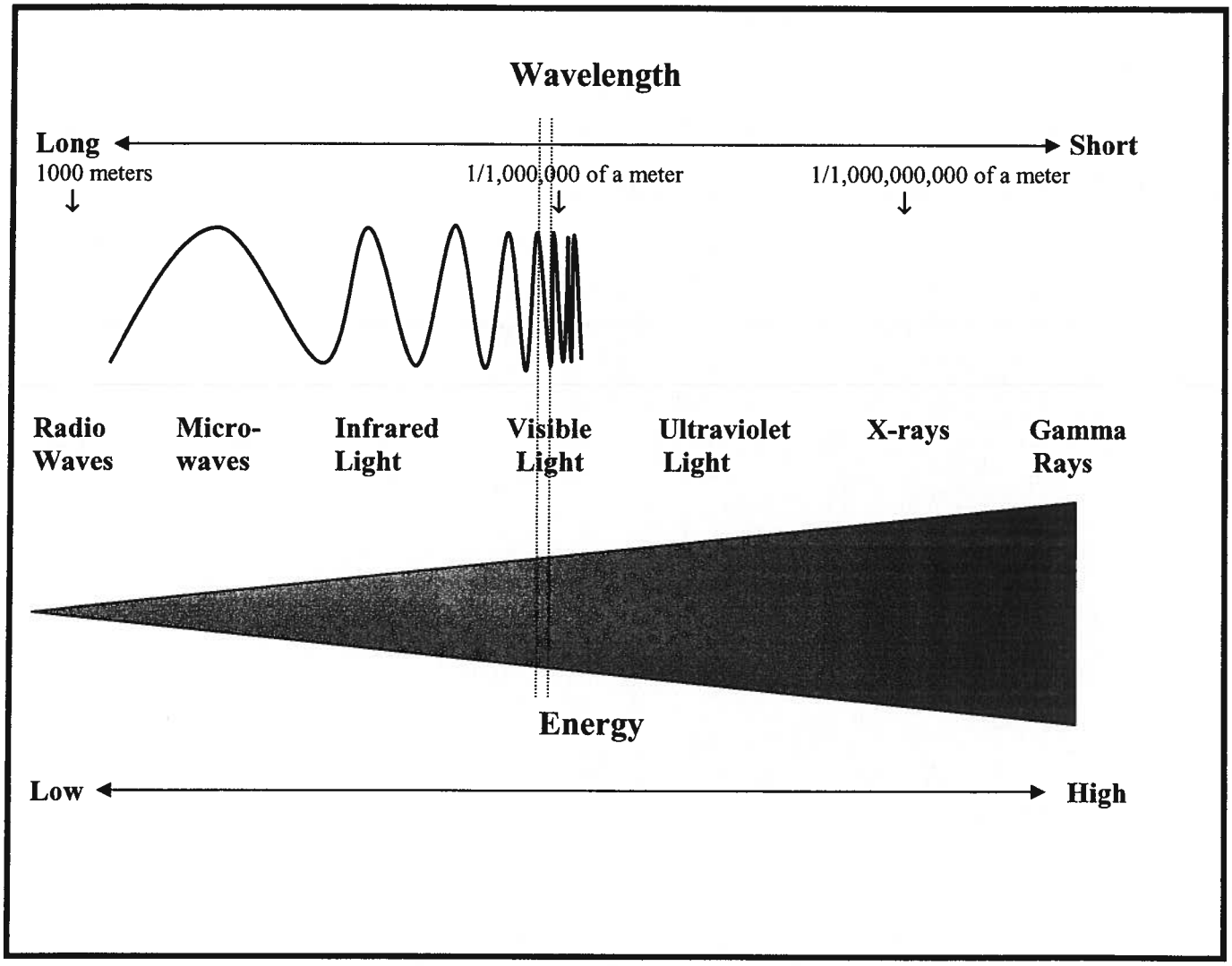

Figure 1:The Electromagnetic Specturm
(Not to scale)

Wavelength: The distance between peaks of a wave. They can be longer than a football field for some kinds of radio waves to smaller than molecules for X-rays. The electromagnetic spectrum is a continuum. What we call visible light is a tiny part of the spectrum.

Energy: The energy of a wave is inversely proportional to its wavelength. While a photon of a radio wave may have a billionth of an electron volt, an X-ray photon may have tens of thousands of electron volts.

Radioactivity in nature

Our world is radioactive and has been since it was created. Natural radioactivity is common in the rocks and soil that make up our planet, in water and oceans, and in our building materials and homes. Radionuclides are also found naturally in the air. There is no place on Earth that does not have natural radioactivity.

Radioactivity is even found in us, since we are products of our environment. Every day, we ingest and inhale radionuclides in our air and food and the water.

Over 60 radionuclides can be found in nature, and they can be placed in two general categories:

- Primordial - from before the creation of the Earth, and
- Cosmogenic - formed as a result of cosmic ray interactions with Earth elements.

Although they are present in only minor amounts compared to natural sources, there are over 1,500 different radionuclides altogether, when human produced radioisotopes are included.

Measuring doses of radioactivity

The amount of radiation emitted by radioactive substances can be measured "in the air." But, because different substances absorb radiation at different rates, the important measurement in health physics is the amount of radiation absorbed by human tissue in terms of the effective biological damage caused by the radiation. This is called the "equivalent effective dose," and is determined by multiplying the absorbed dose in various types of tissue by a quality factor (Q) that depends on the type of ionizing radiation.

Equivalent effective doses are measured in rems, or more commonly by thousandths of a rem, or millirems. While millirems are used as measures of equivalent doses throughout the U.S., the measure used internationally is the sievert, or millionths of a sievert (microsieverts). Since a sievert is 100 rem, a millirem is 10 microsieverts.

See Appendix 14 for more details about radiation measurement.

Dangers of radioactivity

In general, ionizing radiation is more dangerous than non-ionizing radiation because it strips electrons from atoms and can separate molecules. This damage is occurring at the atomic level, way below the cellular level. So, it can cause both immediate damage and damage that takes a long time to develop. Non-ionizing radiation at high energy levels can also be dangerous, but only at the cellular level. For example, strong ultraviolet radiation can cause sunburn, microwaves can cook flesh at close range, etc.

When people are exposed to ionizing radiation, they can suffer varying degrees of damage, ranging from virtually none to death. All of us are exposed to ionizing radiation every day: Cosmic rays, which pervade the universe, radon gas, which is present in many homes, and televisions and smoke detectors are examples of sources of ionizing radiation to which we are exposed. Most of us live normal lives in the presence of these everyday radiation sources, but when levels are unusually high, they may contribute to the development of disease. Extremely high doses, well beyond those that can be received from everyday sources of radiation, cause radiation sickness with nausea, weakness, and even death.

The danger of acute doses of radiation, such as may be experienced when a criticality incident, such as a core meltdown (Chernobyl) occurs, are well known. But, the effects of lower doses of radiation, which may be cumulative over time, can also be harmful. Doses received over a long period of time are called chronic doses.

Protection from radioactivity

The first line of defense against radioactivity is monitoring the levels of it that are present. Dosimeters are commonly used to measure the levels of radiation to which people are exposed.

There are many types of dosimeters, some of which are used to measure radiation levels in controlled areas and others of which are used to monitor personnel exposure. Dosimetry badges used to monitor radiation received by personnel can vary from simple film badges to sophisticated telemetry devices. They can also measure various types of radioactivity. Typically, people must turn in their dosimetery badges on a periodic basis to have their exposure tracked.

(Protection from radioactivity continues on next page)

Protection from radioactivity (Continued)

The next line of defense against radioactivity uses three principles: time, distance, and shielding.

Time. The amount of radiation exposure to external sources (primarily X-ray and gamma ray) increases with time.

Distance. The further you are from a radiation source, the less you are exposed. This is an inverse square relationship, so that you will receive a quarter of the radiation dose if you are two feet from the source that you would receive if you were one foot from it. Gamma and X-rays travel a long distance, alpha and beta particles don't.

Shielding. Alpha particles cannot penetrate a sheet of paper or the dead skin cells on the surface of your body, so no shielding is necessary. But, they can kill living cells, so you need to avoid inhaling alpha-emitters. This is why respirators and other breathing protection may be necessary with some radiation sources. Beta particles can penetrate more deeply, but may be stopped by heavy clothing or a thin sheet of aluminum. X-rays can penetrate many substances, including the skin, and must be stopped by thick metals or lead shields. And gamma rays, which have more energy than X-rays, require even thicker shielding.

So, the best protection from radiation is to be exposed to it for as short a time as possible, while remaining as far away from the source as possible, and using shielding (including respirators) appropriate for the type of radioactivity.

ALARA and regulatory limits

A basic principle of health physics is ALARA—"as low as reasonably achievable." This means that exposure to radiation should be kept below regulatory limits whenever possible, considering economic and social factors.

The regulatory limits set by DOE for DOE general employees in 1993 (42 U.S.C. 2201; 7191) is a total effective dose equivalent of 5 rems per year. This includes radiation from both external and internal (ingested, inhaled, or otherwise penetrating the body) exposures. According to ALARA, whenever possible the annual dose should be considerably lower than this.

The limit for members of the public entering a DOE controlled area is much lower: No more than 0.1 rem total effective dose equivalent per year.

Are people exposed to radioactivity "contagious"?	In a word, "no." People exposed to radioactivity are not radioactive unless they have radioactive material (e.g., plutonium dust) on them. It is like shining a flashlight on a person—the person is lit while the light is on, but no longer shines when the light is off. If you left little light bulbs on people, they would glow when powered, but once you removed the bulbs, they would not glow. So, once a person exposed to radioactivity is decontaminated—that is, has any radioactive material removed from his person—he is no longer a potential hazard to others. However, just as the effect of a sunburn persists long after the sun goes down, the effect of ionizing radiation persists, and may be far more serious than a sunburn.
Resources	There are a number of good resources for information on health physics and radiation: • Jeff Kotsch (pronounced "Coach") is a health physicist on staff at DEEOIC NO: **jkotsch@fenix2.dol-esa.gov** • The University of Michigan has an excellent site: **www.umich.edu/~radinfo** • The Health Physics Society has a very good site: **www.hps.org**. • HPS's **www.hps.org/documents/whatisradiation.pdf** has a terrific graphic of the electromagnetic spectrum. • A separate Health Physics Society site has a limited but excellent glossary: **www.hps1.org/glossary/glossary.htm**. • The Nuclear Regulatory Commission has a comprehensive glossary: **www.nrc.gov/reading-rm/basic-ref/glossary**

The **gray** (Gy) is a unit used to measure a quantity called absorbed dose. This relates to the amount of energy actually absorbed in some material, and is used for any type of radiation and any material. One gray is equal to one joule of energy deposited in one kg of a material. The gray can be used for any type of radiation, but it does not describe the biological effects of different types of radiation. Absorbed dose is often expressed in terms of hundredths of a gray, or centi-grays. One gray is equivalent to 100 rads.

The **sievert** (Sv) is a unit used to derive a quantity called equivalent dose. This relates the absorbed dose in human tissue to the effective biological damage of the radiation. Not all radiation has the same biological effect, even for the same amount of absorbed dose. Equivalent dose is often expressed in terms of millionths of a sievert, or micro-sievert. To determine equivalent dose (Sv), you multiply absorbed dose (Gy) by a quality factor (Q) that is unique to the type of incident radiation. One sievert is equivalent to 100 rem.

The **becquerel** (Bq) is a unit used to measure a radioactivity. One becquerel is that quantity of a radioactive material that will have 1 transformation in one second. Often radioactivity is expressed in larger units like: thousands (kBq), millions (MBq), or even billions (GBq) of becquerels. As a result of becquerel being equal to one transformation per second, there are 3.7×10^{10} Bq in one curie.

SI Prefixes

Many units are broken down into smaller units or expressed as multiples, using standard metric prefixes. As examples, a kilobecquerel (kBq) is 1000 becquerels, a millirad (mrad) is 10^{-3} rads, a microrem (urem) is 10^{-6} rem, a nanogram is 10^{-9} grams, and a picocurie is a 10^{-12} curies.

Factor	Prefix	Symbols	Factor	Prefix	Symbols
10^{18}	exa	E	10^{-1}	deci	d
10^{15}	peta	P	10^{-2}	centi	c
10^{12}	tera	T	10^{-3}	milli	m
10^{9}	giga	G	10^{-6}	micro	μ
10^{6}	mega	M	10^{-9}	nano	n
10^{3}	kilo	k	10^{-12}	pico	p
10^{2}	hecto	h	10^{-15}	femto	f
10^{1}	deka	da	10^{-18}	atto	a

Dosage of Radiation

very small particles. A grain of sand weighs about a hundred million trillion (100,000,000,000,000,000,000) times more than a proton or a neutron.

Radiation

Radiation is energy in the form of waves or particles . . . Radiation comes from sources such as radioactive material or from equipment such as X-ray machines, or accelerators.

Radioactive Decay

Radioactive decay describes the process where an energetically unstable atom transforms itself to a more energetically favorable, or stable, state. The unstable atom can emit ionizing radiation in order to become more stable. This atom is said to be "radioactive", and the process of change is called "radioactive decay".