# ENVIRONMENTAL MANAGEMENT

**Created by Teachers Engineers, and Scientists** 



Lesson Plan Created By: Nancy Hazuka (Grades 9 - 12) Mary Jane Glitz (Grades 9 - 12) David L. Herring (Grades 9 - 12) David L. Murray (Grades 6 - 8)

In Collaboration With: Brian Frankhouser, Environmental Engineer United States Department of Energy Federal Energy Technology Center

### **Environmental Landfill Management**

### **BACKGROUND INFORMATION:**

**Environmental Management** is one of five primary missions of the Federal Energy Technology Center. To accomplish this mission, the Department of Energy (DOE) must find new and more cost-effective remedies for protecting human health and the environment. Because of the unique composition and large quantities of hazardous and radioactive wastes, the Office of Energy Research (OER) is committed to developing fundamental scientific knowledge.

Over its two decade history, the DOE has shifted its emphasis and focus as the needs of the nation have changed. During the late 1970's, the DOE emphasized energy development and regulation. In the 1980's, nuclear weapons research, development, and production took a priority. Since the end of the Cold War, the DOE has focused on environmental clean up of the nuclear weapons complex, nonproliferation and stewardship of the nuclear stockpile, energy efficiency and conservation, and technology transfer and industrial competitiveness.

Today, the DOE contributes to the future of the nation by ensuring our energy security, maintaining the safety and reliability of our nuclear stockpile, cleaning up the environment from the legacy of the Cold War, and developing innovations in science and technology.

The four major focus areas of the DOE are: Mixed Waste Characterization, Treatment, and Disposal, Radioactive Tank Waste Remediation, Subsurface Contaminant Plume Containment, and Decontamination and Decommissioning.

**Bioremediation** is defined by the American Academy of Microbiology (AAM) as "the use of living organisms to reduce or eliminate environmental hazards resulting from accumulations of toxic chemicals and other hazardous wastes (Gibson and Sayler, 1992)." The optimal strategy for any given problem will depend on the nature and concentration of the contaminant(s), the characteristics of the *hydrogeologic* environment, and the extent of contamination. At the present time, bioremediation is often the preferred method for remediation of petroleum hydrocarbons because it is cost effective, and converts the petroleum hydrocarbons into harmless by-products such as water.

Bioremediation is a safe and natural solution to contaminated soil and water. It produces a clean, rich soil that can be reused as backfill and the treatment (in most cases) is less expensive than the other two alternatives: land filling and thermal destruction.

With commercial treatment of several contaminant types well in hand, research is continuing on the biological reclamation of soils contaminated with increasingly toxic compounds. Independently and in close cooperation with site owners and universities, the DOE is constantly pushing back the limits of biological reclamation technologies.

The containerized bioremediation technology uses about 25 percent of the land area necessary for land treatment cell types of bioremediation. Containers are sealed so temperature and moisture conditions are easily controlled. No leachate or offensive off gasses are produced. Degradation rates are easily monitored. Nutrients and/or microbes are added if necessary and may be added at different times for efficient degradation. The resulting end product can be backfilled in the excavation or used as fill elsewhere.

**Landfills** are a major environmental problem that pollute our ground water, streams, lakes, and ponds. They affect and kill some animals and plants. Landfills can create major health concerns to the general population.

Most landfills have vast amounts of waste or refuse produced by humans. Rain is an example of Mother Nature's effect on a landfill. Rain infiltration into the ground eventually will leach through the landfill mass, thus creating additional contaminants within the surface of the earth. These additional contaminants sometime reach the local ground and drinking water supplies needed by humans, animals, and agricultural applications (farming).

**Landfill barriers** are one technology that are presently used to alleviate and/or remove pollutants from the ground water and our environment. In order to optimize the working conditions of a barrier for pollutant containment, the internal piezometric level (i.e. the hydraulic head on the liner system) must be kept as low as possible. Therefore the drainage system efficiency is crucial for the correct management of a landfill.

With low infiltration, it may take from decades to centuries before the field capacity of the waste is reached and full leachate generation occurs. This means that the full capacity of the leachate collection system may not be required for many decades after construction. However, during this period of time degradation and biological clogging of the leachate collection system can be occurring unless the waste has been pretreated to convert it to an essentially inert form.

An alternative philosophy is to allow as much infiltration as would practically occur. This would bring the landfill to field capacity quickly and allow the removal of a large proportion of contaminants during the period when the leachate collection system is most effective and is being carefully monitored.

Leachate collection and removal systems are used with the purpose to minimize the leachate head above the liner by collecting leachate and removing it to a location where it may be treated properly or reused in an industrial plan.

### Duration: 5 days

### **OBJECTIVES:**

- 1. The students will be able to identify what a pollutant is and its affects on the environment.
- 2. The students will demonstrate knowledge of the vocabulary used in environmental management by the DOE and other federal agencies.
- 3. The students will attain a basic understanding of waste problems within our environment and the fundamental concepts of the laws of nature, science, physics, and engineering.
- 4. The students will construct and operate a small-scale leach-bed barrier system.
- 5. The students will gain an appreciation for the work done by scientists and engineers to restore the environment.
- 6. The students will explore scientific careers and other career opportunities involved in solving engineering and environmental problems pertaining to all aspects of the human socio-economic ecological arena.

### **Procedures/Activities:**

### 1. Present background information to the students.

\*Demonstrate a plume contaminant by placing a drop of food coloring into a clear bowl of water. (This will demonstrate a plume of pollution and the concept of molecular diffusion in water)

\*Make students aware of present DOE waste problems within our environment caused by the atom bomb (Manhattan Project, other related topics Cold War, Chernoybl, and Three Mile Island.)

### 2. Introduce and discuss science and environmental vocabulary

\*Present students with a glossary of terms. \*Discuss definition of terms. \*Discuss the role DOE has in Environmental Management.

## 3. Discuss waste problems in the environment and present the fundamental concepts of science, physics, and the laws of nature.

\*Explore what a waste or pollutant is and how it affects the environment and the ecosystem.

- \*Waste problems: nuclear and radioactive waste, mine drainage, ground water contamination, pesticide disposal, farm refuse (manure disposal), land-fill over use, toxic dumps, and human-generated waste refuse.
- \*Concepts of science: plumes, leaching, contaminant storage, and toxic chemical reactions. (There are many more items than listed here)
- \*Physics/fundamental laws of nature: gravity, pressure, friction, tension, torsion, compression, permeability, impermeability, momentum, force, mass, weight, light, diffusion and viscosity. (heat, buoyancy, shear forces molecular interactions, drag force, lift force, etc.)

### 4. Discuss function and purpose of leach-bed barrier.

\*Why use a leach-bed barrier? To help prevent pollution of the environment.

\*DOE research/technologies that are presently in use. Give examples (bioremediation, in-situ remediation, development of Humasorb <sup>™</sup>, reduction of mixed-hazardous and radioactive waste, etc. (see FETC website- www.fetc.doe.gov)

\*Discuss how an actual commercial land-fill leach bed is constructed.

\*Discuss purpose of a leach bed and containment field.

#### 5. Construct and operate small-scale leach-bed.

\*Gather materials for the experiment.< See materials list> Step by step directions:

- Step 1. Put 2" of dark sand (8 cups) in 5-gallon fish tank.
- Step 2. Place 1 five-pound bag of aquarium gravel on this layer of sand (mix the two together).
- Step 3. Put 2" of white sand (8 cups) on top of the preceding layer.
- Step 4. Place 2" of dark sand on top of the play sand layer.
- Step 5. Put 1 five-pound bag aquarium gravel on this layer.
- Step 6. You will now have a total of five layers of sand alternating from light to dark.
- Step 7. You will need to form a "V" in the middle using the disposable aluminum cookie sheet cut to the outside of the tank. <See photo below.>
- Step 8. The bottom of the "V" shape should rest  $5\frac{1}{2}$ " from the bottom of the tank in the center.
- Step 9. The top ends of the "V" should be  $10\frac{1}{4}$ " from end-to-end.
- Step 10. Next fill in sides with sand, leaving the "V" barrier in the middle.
- Step 11. Once you filled in the tank with 5 layers of sand, place <sup>1</sup>/<sub>2</sub>" top soil on top of sand. (this layer simulates the top sedimentary layer of the earth's strata layers)
- Step 12. After this you will fill in with the sand layers only on the sides of the "V" shape. The cookie sheet will be 16" long after being cut and 8 <sup>3</sup>/<sub>4</sub>" wide. Make a 1/2" lip around the outside of the "V" shape before it is bent. Place tape along sides of the "V" to protect from leakage of the liquid.
- Step 13. Place clear packing tape around the edges of the collection barrier in the tank to protect from leak through. The "V" shape should be bent so that it fits up to the tank top on both ends and allows a platform to be mounted in the middle that is 18 <sup>1</sup>/<sub>2</sub> centimeters (7") long and 23 centimeters (8<sup>3</sup>/<sub>4</sub>") wide.
- Step 14. Use brass fasteners to attach the platform to the sides.
- Step 15. Using a utility knife or other sharp tool, make holes in the plate to allow seepage into the collection area below the platform. Holes should not be too large as they will allow coffee grounds to get through too easily.

- Step 16. Place one cup of wet, freshly used coffee grounds on the leach-bed platform.
- Step 17. Next, place four crumpled up, damp paper towels on the leach-bed platform.
- Step 18. Pour red food coloring on grounds and then pour <sup>1</sup>/<sub>4</sub> cup of water over the grounds. Then have students time how long it takes for the pollutants to begin leaching through the platform. Add more water and chart how much water it takes before the water begins to leach. Create a graph of the results and then calculate the results on a full scale format. The platform is seven inches long and a local leach bed is seven hundred feet long. You have just placed <sup>1</sup>/<sub>2</sub> cup of coffee grounds on the platform along with two cups of water and food coloring. Have students estimate how long it would take to fill the leach-bed and it would begin to leak.



Partially-completed leach bed with labeled components.

### **Materials List**

20 liter (51/2 gallon) fish aquarium

45.1 cm. x 38.7 cm. x 0.6 cm. (17<sup>3</sup>/<sub>4</sub> inch x 15<sup>1</sup>/<sub>4</sub> inch x <sup>1</sup>/<sub>4</sub> inch) aluminum disposable oven liner

31.5 cm. x 1.4 cm. (12 13/26 inches x 9/16 of an inch) aluminum disposable pizza pan.

4.55 kilograms (10 pounds) aquarium rock

4.55 kilograms (10 pounds) white or lite play sand

4.55 kilograms (10 pounds) regular dark sand

30 cm. Ruler or 12 inch.

Scissors

 $\frac{1}{2}$  cup of coffee grounds

3 different colors of food coloring

30 cm. of plastic wrap

tape (packing or duct)

erasable marker

water

paper towels

### **Scientific Definition**

(Teacher Expanded Definition)

### **Glossary - Environmental Management**

**absolute pressure** The pressure above the absolute zero value of pressure that theoretically obtains in empty space or at the absolute zero of temperature, as distinguished from gauge pressure. (The hypothetical point at which a substance would have no molecular motion and no heat.)

**ambient pressure** The pressure of the surrounding medium, such as a gas or liquid, which comes into contact with an apparatus or with a reaction. (Pressure which encompasses on all sides.)

**atmospheric pressure** The pressure at any point in an atmosphere due solely to the weight of the atmospheric gases above the point concerned. Also known as **barometric pressure**. (The weight of the atmosphere per square inch of surface; the pressure of 14.69 pounds per square inch exerted in all directions, at sea level, by the atmosphere.)

**attraction** In physics, the tendency, force, or forces through particles, bodies, etc. that attract or pull together. (The inherent tendency in bodies to approach each other, to unite, and to resist separation.)

**attrition** Wear caused by rubbing or friction; for metal surfaces, also known as scoring; scouring. [*Attrit* (*v*) to wear] (The state or process of gradually being worn down.)

**barometer** An absolute pressure gauge specifically designed to measure atmospheric pressure. (An instrument for measuring atmospheric pressure and thus for forecasting the weather or finding height above sea level.)

**barometric pressure** See atmospheric pressure. Atmospheric pressure on a barometer. (A variation of atmospheric pressure.)

**barrier** Any physical or biological factor that restricts the migration or free movement. (Anything that marks the limits of a place, any limit or boundary, a line of separation.)

**bedrock** General term applied to the solid rock underlying soil. (Solid rock layer beneath the soil.)

**Bernoulli's theorem** An expression of conservation of energy in the steady flow of an incompressible, inviscid fluid; it states the quantity  $(p/rho) = gz = (v^2/2)$  is constant along any streamline, where p is the fluid pressure, v is the fluid velocity, rho is the mass density of the fluid, g is the acceleration due to gravity, and z is the vertical height. *Also known as the Bernoulli equation; Bernoulli's law.* 

**Bernoulli effect** As a consequence of the Bernoulli theorem, the pressure of a stream of fluid is reduced as its speed of flow is increased.

**bioremediation** The use of living organisms to reduce or eliminate environmental hazards resulting from accumulations of toxic chemicals and other hazardous wastes. Produces clean rich soil that can be used as a backfill.

**buoyancy** The resultant vertical force exerted on a body by a static fluid in which it is submerged or floating. (The upward pressure by any fluid on a body partly or wholly immersed therein; it is equal to the weight of the fluid displaced.)

**capillary** A fissure or a crack in a formation which provides a route for flow of water or hydrocarbons. (A tube with a very small bore.)

**capillary forces** The force that is the result of adhesion, cohesion, and surface tension in liquids which are in contact with solids, as in a capillary tube: when the cohesive force is greater, the surface of the liquid tends to rise in the tube; when the adhesive force is greater, the surface tends to be depressed in the tube. (Adhesion and repulsion which causes the movement of fluid.)

**compression** Reduction in volume of a substance due to pressure. A system of forces which tend to decrease the volume or shorten rocks. (The act of pressing or squeezing something together.)

**concentration** In solutions, the mass, volume or number of moles of solute present in proportion to the amount of solvent or total solution. (The volitazation of a fluid to increase the strength or density.)

**contaminant** Anything that creates an unclean environment. (To make impure; unclean; corrupt; to pollute; to tarnish.)

**contaminant transport** How any waste moves from the generated site to a new site (commercial, residential or agricultural).

**contamination** Something that will make other things unfit for use when it comes into contact with them. (When something becomes contaminated with a foreign substance; pollutant.)

control volume A fixed arbitrary volume in space through which fluid flows [example: a pipe].

**diffusion** The spontaneous movement and scattering of particles (atoms and molecules), of liquids, gases, or solids. (Intermingling the molecules of two or more substances.)

**dimension** A name given to measurable quantities such as time, length, velocity, mass, volume, and force. (Measurement in width, breadth, and height.)

**DOE** (**Department of Energy**) An agency of the Federal Government responsible for the research and development of energy and environmental issues related to solving national environmental and energy needs.

**DOE waste** Wastes that were created by the production of the atom bomb during World War II plus fossil energy by-products created by coal/gasification processes.

fluid A substance (as a liquid or gas) tending to flow or take the shape of its container.

**fluid flow** The forward continuous movement of a fluid, such as gases, vapors, or liquids, through closed or open channels or conduits.

fluid resistance The force exerted by a gas or liquid opposing the motion of a body moving through it.

force The influence on a body which causes it to accelerate.

**friction** A force which opposes the relative motion of two bodies whenever such motion exists or whenever there exist other forces which tend to produce such motion. The amount of energy exerted to accomplish a task. (The force of rubbing one body against another.)

**gauge pressure** The amount by which the total absolute pressure exceeds the ambient atmospheric pressure. (Atmospheric pressure or water pressure measured using a gauge.)

gravity The force that tends to draw all bodies in the earth's sphere toward the center of the earth.

**ground water** Water found underground in porous rock strata and soils, as in a spring. (Underground water in porous rock undisturbed.)

**ground water table** The planar surface between the zone of saturation and the zone of aeration. Also known as water table; level of saturation; ground water surface; water level; waterline; saturated surface.

**heat** Energy in transit due to a temperature difference between the source from which the energy is coming and a sink toward which the energy is going.

**hydro geology** The science dealing with the occurrence of surface and ground water, its utilization, and its functions in modifying the earth [primarily by erosion and deposition].

impermeable Not permitting water or other fluid to pass through. Also known as impervious.

**intermolecular forces** The force between two molecules. **Repulsion** is a force that tends to increase the distance between two bodies having like electric charges. **Attraction** is a force that causes adhesion between objects.

landfill Disposal of solid waste by burying in layers of earth in low stratus layers of the earth.

**leachate** A solution formed by leaching.

leach bed A porous, perforated, or sieve like vessel that holds material to be leached.

**leaching** The dissolving, by a liquid solvent, of soluble material from its mixture with and insoluble solid; leaching is an industrial separation operation based on mass transfer; examples are the washing of a soluble

salt from the surface of and insoluble precipitate.

**loam** Soil mixture of sand, silt, clay, and humus.

**manometer** A liquid-column gage (U-shaped tube) used to measure the difference between two fluid pressures.

**medium** That entity in which objects exist and phenomena take place; examples are free space and various fluid and solids.

(An intervening thing through which a force acts or an effect is produced; as, the other is supposed.) **momentum** The speed at which an object moves.

(The quantity of motion of a moving object, equal to the product of its mass and its velocity.)

**Pascal's law** The law that a confined fluid transmits externally applied pressure uniformly in all directions, without change in magnitude.

**pebble sand layer** An unconsolidated sedimentary deposit containing at least 75% sand and up to a maximum of 25% pebbles.

permeable The ability of a membrane or other material to permit a substance to pass through it.

**plume** A feather like expansion, *as in a plume of smoke*. (Feather like expansion of a pollutant in water, soil, air, like smoke)

**pollutant** Something that pollutes; a harmful chemical or waste material discharged into the water or atmosphere.

**pollution** Destruction or impairment of the purity of the environment.

**pressure** A type of stress which is exerted uniformly in all directions; its measure is the force exerted per unit area. (Force exerted against an opposing body; the thrust distributed over a surface.)

**pressure [drop] gradient** The rate of decrease (that is, the gradient) of pressure in space at a fixed time; sometimes loosely used to denote simply the magnitude of the gradient of the pressure field.

primary dimension Dimensions which are independent of other dimensions.

**property** A characteristic or trait of an object. (Any trait or attribute proper to a thing, any of the principal characteristics of a substance.)

radioactive Of, caused by, or showing radioactivity.

**radioactivity** The property possessed by some elements, such as uranium, of spontaneously emitting alpha or beta particles or gamma rays.

secondary dimension Dimensions which are expressed in terms of the primary dimensions.

sedimentary soil layer Any matter that settles to the bottom of water or other liquid.

**shear strain** A deformation of a solid body in which a plane in the body is displaced parallel to itself relative to a parallel planes in the body; quantitatively, it is the displacement of any plane relative to a second plane, divided by the perpendicular distance between planes.

standard atmosphere A unit of pressure which is the air pressure measured at mean sea level.

**stratum** (strata [pl.]) A single layer of sedimentary rock representing the deposition of a single geological period. These layers are stacked on top of one another.

**surface-active agent** A soluble compound that reduces the surface tension of liquids, or reduces interfacial tension between two liquids or a liquid and a solid. Also known as **surfactant**.

tension A force or combination of forces exerting a pull or push against something.

**torsion** The alteration in the relative position of the parts of any solid due to rotation about a common axis, as by twisting one end of a wire or rod while the other remains fixed.

**unit** A definite standard of a dimension.

**vadose zone [zone of aeration]** A subsurface zone containing water below atmospheric pressure and air or gases at atmospheric pressure. Also known as unsaturated zone; zone of suspended water.

**viscosity** The resistance that a gaseous or liquid system offers to flow when it is subjected to a shear stress. Also known as flow resistance.

volume [flow rate] The volume of the fluid that passes through a given surface in a unit time.

**waste** Rubbish from a building. Dirty water from mining, industrial, and domestic use. The amount of excavated material exceeding fill.

### WEST VIRGINIA STATE INSTRUCTIONAL GOALS

Sixth Grade:	Seventh Grade:	Eighth Grade:
Science	Science	Science
6.3	7.4	8.4
6.4	7.13	8.13
6.5	7.15	8.15
6.15	7.16	8.16
6.16	7.17	8.17
6.17	7.18	8.18
6.18	7.19	8.19
6.19	7.20	8.20
6.21	7.21	8.21
6.22	7.22	8.22
6.27	7.23	8.23
6.48	7.42	8.25
6.52	7.50	8.49
6.73	7.53	8.75
6.74	7.54	8.82
6.75	7.69	8.83
6.76	7.70	
6.79	7.75	
6.80	7.76	
6.81	7.77	

### Social Studies Connection:

Study the significance of nuclear waste and it's impact on the world's environment. Perhaps a teacher may wish to study the Three Mile Power Plant Disaster of the 1980's. A teacher may wish to visit their local landfill and talk with people who work there.

### Language Arts Connection:

Write letters to the DOE in your area and request information about Leach-Bed Technology. Write letters to local landfill. Invite professional engineers and scientists to speak to your students about the Leach-Bed Technology.

### Math Connection:

Have students estimate and calculate formulas for the experiment.

#### Teacher Key: Environmental Management --- Vocabulary Study Guide

- 1. Hydro geology\_\_\_\_ is the science dealing with the occurrence of surface and ground water.
- 2. What is a landfill? Disposal of solid waste by burying in layers of earth in low ground.
- 3. When a membrane or other material permits a substance to pass through, it is *permeable\_\_\_*.
- 4. A *pollutant* Is a harmful chemical or waste material discharged into the water or atmosphere.
- 5. A *plume* is a feather like diffusion of a pollutant into the atmosphere, soil, or water.
- 6. *Loam* is a mixture of sand, silt, clay, and humus.
- 7. A porous, perforated, or sieve like vessel that holds material to be leached is a *leach-bed\_\_\_*.
- 8. The speed at which an object moves is its *momentum*\_\_\_.
- 9. What law states that fluid transmits externally applied pressure uniformly in all directions, without changing its magnitude is known as *Pascal's Law*.
- 11. A crack or hole that provides a route for flow of water or hydrocarbons is known as a *capillary* \_\_\_\_.
- 12. The Federal Agency responsible for the research and development of energy and environmental issues related to solving the national environmental needs is the *Department of Energy or DOE*\_\_.
- 13. How any waste moves from the generated site to a new site is called *contaminant transport*\_\_\_\_\_
- 14. A *barometer* is used to measure atmospheric pressure and is used to forecast weather.
- 15. A single layer of sedimentary rock representing the deposition of a single geological period of the the Earth's history. These layers are stacked one on the other and are called the Earth's *stratum*\_\_.
- 16. *Waste* is rubbish from any mine, industry, or other human activity.
- 17. *Viscosity* is the resistance that a gaseous or liquid system offers to flow when it is subjected to a shear stress.
- 18. *Surface-active agent* is a soluble compound that reduces the surface tension of liquids, or reduces interfacial tension between two liquids or a liquid and a solid.
- 19. *Pebble sand layer* An unconsolidated sedimentary deposit containing at least 75% sand and up to A maximum of 25% pebbles.
- 20. *Compression* is the reduction in volume of a substance due to pressure.

### **Environmental Management --- Vocabulary Study Guide**

- 1. \_\_\_\_\_\_ is the science dealing with the occurrence of surface and ground water.
- 2. What is a landfill?
- 3. When a membrane or other material permits a substance to pass through, it is \_\_\_\_\_
- 4. A is a harmful chemical or waste material discharged into the water or atmosphere.
- 5. A \_\_\_\_\_\_\_ is a feather like diffusion of a pollutant into the atmosphere, soil, or water.
- 6. \_\_\_\_\_\_ is a mixture of sand, silt, clay, and humus.

7. A porous, perforated, or sieve like vessel that holds material to be leached is a \_\_\_\_\_\_

- 8. The speed at which an object moves is its \_\_\_\_\_.
- 9. What law states that fluid transmits externally applied pressure uniformly in all directions, without changing its magnitude is known as .
- 10. The use of living organisms to reduce or eliminate hazards resulting from accumulations of toxic chemicals and other hazardous wastes is called
- 11. A crack or hole that provides a route for flow of water or hydrocarbons is known as a \_\_\_\_\_\_.
- 12. The Federal Agency responsible for the research and development of energy and environmental issues related to solving the national environmental needs is the
- 13. How any waste moves from the generated site to a new site is called
- 14. A is used to measure atmospheric pressure and is used to forecast weather.
- 15. A single layer of sedimentary rock representing the deposition of a single geological period of the the Earth's history. These layers are stacked one on the other and are called the Earth's
- is rubbish from any mine, industry, or other human activity. 16.
- 17. \_\_\_\_\_\_ is the resistance that a gaseous or liquid system offers to flow when it is subjected to a shear stress.
- \_\_\_\_\_ is a soluble compound that reduces the surface tension of liquids, or reduces 18. interfacial tension between two liquids or a liquid and a solid.
- 19. \_\_\_\_\_\_ an unconsolidated sedimentary deposit containing at least 75% sand and up to a maximum of 25% pebbles.
- 20. \_\_\_\_\_\_ is the reduction in volume of a substance due to pressure.

Name: \_\_\_\_\_ Date: \_\_\_\_\_

### Matching

### Match Items in the Right Column with Definitions in the Left Column

1. The pressure of a stream of fluid is reduced as its speed of flow is increased.

2. Spontaneous movement and scattering of	9	A. Attractio
particles.		

3. Not permitting water or other fluid to pass through.

4. A liquid column gauge used to measure the difference between two fluids.

5. A force or combination of forces exerting a push or pull against something.

6. A characteristic or trait of an object.

7. A definite standard of a dimension.

8. Disposal of solid waste by burying it in layers of earth.

9. The tendency or force through which particles or bodies attract or pull together.

10. A fissure or crack in a formation which provides a route for flow of water or hydrocarbons.

9A. Attraction
2 B. Diffusion
8C. Landfill
1 D. Bernoulli effect
_10 E. Capillary
3 F. Impermeable
6 G. Property
7 H. Unit
4 I. Manometer
5 J. Tension

Date: Date:

### Matching

## Match Items in the Right Column with Definitions in the Left Column

1. The pressure of a stream of fluid is reduced as its speed of flow is increased.

2. Spontaneous movement and scattering of particles.

3. Not permitting water or other fluid to pass through.

4. A liquid column gauge used to measure the difference between two fluids.

5. A force or combination of forces exerting a push or pull against something.

6. A characteristic or trait of an object.

7. A definite standard of a dimension.

8. Disposal of solid waste by burying it in layers of earth.

9. The tendency or force through which particles or bodies attract or pull together.

10. A fissure or crack in a formation which provides a route for flow of water or hydrocarbons.

\_\_\_\_\_ A. Attraction \_\_\_\_\_ B. Diffusion \_\_\_\_\_ C. Landfill

D. Bernoulli effect

E. Capillary

\_\_\_\_\_ F. Impermeable

\_\_\_\_\_ G. Property

H. Unit

I. Manometer

J. Tension

### **Other Web Sites for further information:**

The search engine to use is WWW.METACRAWLER.COM

### The Internet sites to look at are as follow:

www.fetc.doe.gov - This is the Federal Energy Technology Center's web site.

Key Words to Search for:

environmental remediation

Under this heading you will find:

www.anl.gov/ITD/techon.html - Speeding up remediation solutions

www.ensr.com/serv/re.html - Remediation and Construction

If you look under the Internet site ENVIRONMENTAL REMEDIATION, you will be able to locate 43 other URL's available. You may also look under ENVIRONMENTAL MANAGEMENT.