ALABAMA POWER COMPANY
Farley Nuclear Plant Visitor's Center
Highway 95 South
Columbia, AL 36319

APPALACHIAN POWER COMPANY
John Amos Plant
P.O. Box 4000
St. Albans, WV 25177

ARIZONA PUBLIC SERVICE COMPANY
Palo Verde Nuclear Generating Station Visitors Center
5801 S. Wintersburg Road
Tonopah, AZ 85354

BALTIMORE GAS AND ELECTRIC COMPANY
Calvert Cliffs Visitors Center
1650 Calvert Cliffs Parkway
Lusby, MD 20657

BOSTON EDISON COMPANY
Pilgrim Nuclear Power Station
600 Rocky Hill Road
Plymouth, MA 02360

CAROLINA POWER AND LIGHT COMPANY
Brunswick Plant Visitor's Center
P.O. Box 10488
Southport, NC 28461

HARRIS VISITOR CENTER
Box 327
New Hill, NC 27562

CENTRAL HUDSON GAS & ELECTRIC CORPORATION
Roseton Generating Station
594 River Road
Newburgh, NY 12550

CENTRAL MAINE POWER COMPANY
Maine Yankee Information Center
P.O. Box 408
Wiscasset, ME 04578

CENTRAL POWER AND LIGHT COMPANY
South Texas Project Visitor Center
P.O. Box 246
Wadsworth, TX 77483

CONSOLIDATED EDISON COMPANY OF NEW YORK, INC.
Conservation Center
405 Lexington Avenue
New York, NY 10174

CONNECTICUT YANKEE ATOMIC POWER CO.
Information and Science Center
362 Injun Hollow Road
Haddam Neck, CT 06424

DETROIT EDISON COMPANY
Fermi 2 Visitors Center
6400 N. Dixie Highway
Newport, MI 48166

DUKE POWER COMPANY
The World of Energy at Keowee-Toxaway
7812 Rochester Highway
Seneca, SC 29672

ENERGY EXPLORIUM AT LAKE NORMAN
13339 Hagers Ferry Road
MG03E
Huntersville, NC 28078

ENERGY QUEST AT CATAWBA
4850 Concord Road
York, SC 29745

EL PASO ELECTRIC COMPANY
Newman Power Station
P.O. Box 982
El Paso, TX 79960

FLORIDA POWER CORPORATION
The Power Place
15760 West Power Line Street, SA1E
Crystal River, FL 34428-6708

GEORGIA POWER COMPANY
Edwin I. Hatch Visitors Center
Route 1, Box 720
US Highway 1 North
Baxley, GA 31513

TERRORA EDUCATION CENTER
Terrora Park
P.O. Box 9
Tallullah Falls, GA 30573

GENERAL PUBLIC UTILITIES NUCLEAR CORPORATION
Three Mile Island Visitors' Center
P.O. Box 480
Middletown, PA 17057

GULF STATES UTILITIES COMPANY
The River Bend Energy Center
P.O. Box 220
St. Francisville, LA 70775

EDISON PLAZA MUSEUM
P.O. Box 3652
Beaumont, TX 77706

HOUSTON LIGHTING & POWER COMPANY
Energy Information Center
P.O. Box 1700
Houston, TX 77251

ILLINOIS POWER COMPANY
Illinois Power, Energy & Environmental Center
P.O. Box 637
Clinton, IL 61727

INDIANA-MICHIGAN POWER
Cook Energy Information Center
P.O. Box 115
Bridgman, MI 49106

IOWA-ILLINOIS GAS AND ELECTRIC COMPANY
Nuclear Information Center
22511 206th Avenue North
Cordova, IL 61242

JERSEY CENTRAL POWER AND LIGHT COMPANY
Energy Spectrum
P.O. Box 592
Forked River, NJ 08731

KANSAS CITY POWER AND LIGHT COMPANY
Jeffery Energy Center
P.O. Box 40
St. Mary's, KS 66536

LOUISIANA POWER AND LIGHT COMPANY
Waterford III Energy Education Center
P.O. Box B
Killona, LA 70066

NEW ENGLAND POWER
25 Research Drive
Westborough, MA 01582

NEW ORLEANS PUBLIC SERVICE COMPANY, INC.
2330 Canal Street
New Orleans, LA 70160

NEW YORK POWER POOL
Visitor's Center
3890 Carman Road
Schenectady, NY 12303

NEW YORK STATE ELECTRIC & GAS CORPORATION
Energy Centers
4500 Vestal Parkway East
P.O. Box 3607
Binghamton, NY 13902-3607

NIAGARA MOHAWK POWER CORPORATION
The Energy Center
P.O. Box 81
Lycoming, NY 13093

NORTHEAST UTILITIES COMPANY
Millstone Energy Center
278 Main Street
Niantic, CT 06357

NORTHERN STATES POWER COMPANY
Cost Control Center
1414 W. Hamilton Avenue
Eau Claire, WI 54701

PENNSYLVANIA POWER AND LIGHT COMPANY
Susquehanna Energy Information Center
P.O. Box 467
Berwick, PA 18603

PHILADELPHIA ELECTRIC COMPANY
Limerick Energy Information Center
298 Longview Road
Linfield, PA 19468

MUDDY RUN INFORMATION CENTER

172 Bethesda Church Road, West
Holtwood, PA 17532

NORTH ATLANTIC ENERGY SERVICE CORP.
The Science and Nature Center at Seabrook Station
U.S. Route 1, P.O. Box 300
Seabrook, NH 03874

PUBLIC SERVICE ELECTRIC AND GAS COMPANY
Nuclear Public Information Office
P.O. Box 236, MCN08
Hancocks Bridge, NJ 08038

UNION ELECTRIC COMPANY
Callaway Visitors Center
P.O. Box 620
Fulton, MO 65251

VERMONT YANKEE NUCLEAR POWER CORPORATION
Energy Information Center
P.O. Box 157
Vernon, VT 05354

VIRGINIA POWER
North Anna Nuclear Information Center
P.O. Box 402
Mineral, VA 23117

SOUTHERN COMPANY SERVICES
Corporate Library
P.O. Box 2625
Birmingham, AL 35202

SURRY NUCLEAR INFORMATION CENTER
P.O. Box 315
Surry, VA 23883

TU ELECTRIC
Visitors Information Center
Comanche Peak Steam Electric Station
P.O. Box 1002
Glen Rose, TX 76043

TVA ENERGY CENTER
1101 Market Street, BR4F
Chattanooga, TN 37402

WISCONSIN ELECTRIC POWER COMPANY
Point Beach Energy Center
6600 Nuclear Road
Two Rivers, WI 54241

WOLF CREEK NUCLEAR OPERATING CORPORATION
Dwight D. Eisenhower Learning Center
1675 Milo Lane NE
Burlington, KS 66839

YANKEE ATOMIC ELECTRIC COMPANY
Visitors Center
48 Yankee Road
Rowe, MA 01367

REGIONAL ELECTRICITY GENERATION

A pie chart is a circle-shaped graph. It is easy to read and useful for understanding how different sets of information relate to each other as a whole. Creating a pie chart involves many steps. In this activity you will make a pie chart using data in the table entitled *Net Generation by Energy Source, Census Division, and State, 1994*. On this table, the 50 States are divided into 10 census groups. You will be assigned one census division by your teacher.

Follow the directions below to complete the table and construct a pie chart. Use data for your census division from *Net Generation by Energy Source, Census Division, and State, 1994*.

1. Use *Net Generation by Energy Source, Census Division, and State, 1994* to fill in Column II. Then calculate the total gigawatthours of electricity produced by your census division in 1994. A gigawatthour is equal to one million kilowatt hours.

2. In Column III, convert each value in Column II to a percent. Treat NA (not applicable) values as zero for this exercise. Round all answers to the nearest 100th of a percent. Because many of the numbers in *Net Generation by Energy Source, Census Division, and State, 1994* have been rounded, the sum of the percentages you calculate may not be precisely 100 percent.

3. A complete circle contains 360 degrees; therefore, it will be necessary to convert the percentages in Column III to degrees for Column IV. Round your answers to the nearest whole degree. If you calculate a value that is greater than 0 but less than 0.5, round it to one degree. The sum of the degrees you calculate should be approximately 360.

4. Using a protractor, draw your pie chart in the blank circle.

5. Label each division (each slice of the pie) with the energy source and the percentage that it represents. Be sure to give your pie chart an appropriate, yet creative, title in the space provided.

Net Generation by Energy Source, Census Division, and State, 1994*
(Gigawatthours) = Million Kilowatthours

Census Division State	Coal 1994	Petroleum 1994	Gas 1994	Nuclear 1994	Hydroelectric 1994	Other 1994	Total 1993
New England	**15,495**	**15,009**	**4,624**	**41,206**	**4,125**	**511**	**80,970**
Connecticut	2,104	3,354	732	20,160	412	439	27,201
Maine	NA	702	NA	6,632	1,682	NA	9,016
Massachusetts	10,210	9,561	3,736	3,895	100	NA	27,502
New Hampshire	3,182	1,353	115	6,204	1,036	NA	11,888
Rhode Island	NA	34	35	NA	NA	NA	69
Vermont	NA	6	6	4,316	895	72	5,294
Middle Atlantic	**119,434**	**17,836**	**22,117**	**118,561**	**26,545**	**11**	**304,504**
New Jersey	4,646	1,656	3,440	22,129	-167	NA	31,705
New York	20,859	10,998	17,464	29,225	25,200	11	103,757
Pennsylvania	93,928	5,182	1,213	67,207	1,512	NA	169,043
East North Central	**383,432**	**2,617**	**4,547**	**109,267**	**3,280**	**265**	**503,410**
Illinois	61,214	1,208	2,624	72,654	45	NA	137,745
Indiana	102,043	209	826	NA	407	NA	103,485
Michigan	67,539	656	657	14,144	725	NA	83,721
Ohio	117,354	372	153	10,952	189	NA	129,021
Wisconsin	35,283	172	287	11,516	1,914	265	49,438
West North Central	**171,911**	**1,573**	**3,439**	**41,212**	**12,025**	**458**	**230,619**
Iowa	26,499	78	199	4,107	1,053	28	31,965
Kansas	26,489	83	2,183	8,529	NA	NA	37,284
Minnesota	26,400	597	452	12,224	831	414	40,917
Missouri	48,588	731	338	10,006	1,844	7	61,514
Nebraska	14,002	18	259	6,345	1,312	9	21,946
North Dakota	27,100	47	NA	NA	1,856	NA	29,004
South Dakota	2,833	19	8	NA	5,129	NA	7,989
South Atlantic	**335,071**	**42,719**	**26,458**	**169,081**	**15,746**	**NA**	**589,074**
Delaware	4,754	1,902	2,127	NA	NA	NA	8,783
District of Columbia	NA	274	NA	NA	NA	NA	274
Florida	60,770	33,330	20,734	26,682	274	NA	141,790
Georgia	64,728	153	80	28,927	4,857	NA	98,745
Maryland	25,394	4,134	993	11,222	2,010	NA	43,752
North Carolina	53,234	199	69	32,346	5,606	NA	91,455
South Carolina	26,678	101	279	44,475	2,347	NA	73,880
Virginia	22,449	2,374	2,152	25,429	289	NA	52,693
West Virginia	77,063	251	25	NA	363	NA	77,703
East South Central	**203,689**	**1,676**	**7,111**	**42,027**	**25,841**	**NA**	**280,344**
Alabama	62,768	121	373	20,480	11,429	NA	95,171
Kentucky	79,899	154	31	NA	4,014	NA	84,097
Mississippi	8,890	1,106	6,612	9,615	NA	NA	26,222
Tennessee	52,132	296	95	11,932	10,399	NA	74,854
West South Central	**189,967**	**1,097**	**145,998**	**54,347**	**7,457**	**303**	**399,170**
Arkansas	19,781	96	2,285	13,924	3,462	NA	39,548
Louisiana	20,125	680	26,586	12,357	NA	NA	59,748
Oklahoma	27,454	11	15,451	NA	2,465	NA	45,381
Texas	122,607	309	101,677	28,067	1,530	303	254,494
Mountain	**202,183**	**423**	**9,563**	**23,171**	**28,302**	**237**	**263,878**
Arizona	38,072	128	2,162	23,171	7,670	NA	71,204
Colorado	31,401	9	374	NA	1,540	NA	33,324
Idaho	NA	NA	NA	NA	7,303	NA	7,303
Montana	16,488	18	61	NA	8,096	42	24,705
Nevada	15,325	167	3,174	NA	1,866	NA	20,531
New Mexico	26,752	23	3,030	NA	213	NA	30,018
Utah	32,764	30	750	NA	716	195	34,455
Wyoming	41,380	47	13	NA	897	NA	42,337
Pacific Contiguous	**13,614**	**1,874**	**64,492**	**40,492**	**118,931**	**7,163**	**246,565**
California	NA	1,863	61,530	33,752	22,824	6,767	126,737
Oregon	3,814	5	2,755	NA	30,916	NA	37,490
Washington	9,800	6	206	6,740	65,190	396	82,338
Pacific Non-contiguous	**295**	**6,477**	**2,681**	**NA**	**1,364**	**NA**	**10,818**
Alaska	295	441	2,681	NA	1,345	NA	4,762
Hawaii	NA	6,036	NA	NA	19	NA	6,055
U.S. Total	**1,635,090**	**91,303**	**291,031**	**639,364**	**243,616**	**8,948**	**2,909,352**

** Data for 1994 are preliminary.*

*** Value less than 0.5 gigawatt hours.*

Notes: Negative generation denotes that electric power consumed for plant use exceeds gross generation.
Totals may not equal sum of components because of independent rounding.

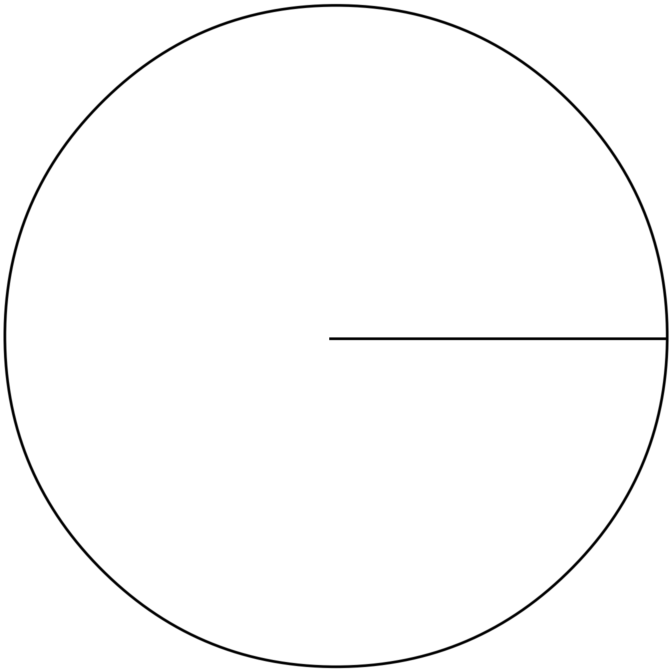
Source: Energy Information Administration, Form EIA-759, "Monthly Power Plant Report," December 1994.

REGIONAL ELECTRICITY GENERATION

Census Division: ______________________________

I **Energy Source**	II **Electricity Produced** (Gigawatthours)	III **Percent** (Nearest 100th)	IV **Degrees** (Nearest whole degree)
Coal			
Petroleum			
Gas			
Nuclear			
Hydroelectric			
Other			
Total			

Title: ____



MAKING A PIE CHART – UNITED STATES

I Energy Source	II Electricity Produced (Million Kilowatthours)	III Percent (Nearest 10th)	IV Degrees (Nearest whole degree)
Coal	1,635,090	56.2	202
Petroleum	91,303	3.1	11
Gas	291,031	10.0	36
Nuclear	639,364	22.0	79
Hydroelectric	243,616	8.4	30
Other	8,948	0.3	1
Total	**2,909,352**	**100.00**	**359**

Converting Electricity Produced to a Percent

$$\frac{x}{100} = \frac{\text{number million kilowatt hours/source}}{\text{total number million kilowatthours}}$$

Example: Coal - United States

Set up the proportion: $\frac{x}{100} = \frac{1{,}635{,}090}{2{,}909{,}352}\ (100)$

Cross multiply: $2{,}909{,}352(x) = 1{,}635{,}090$

$2{,}909{,}352(x) = 163{,}509{,}000$

Solve for x: $\frac{2{,}909{,}352(x)}{2{,}909{,}352} = \frac{163{,}509{,}000}{2{,}909{,}352}$

$x = 56.2\%$

Converting Electricity Produced to Degrees

$$\frac{x}{360} = \frac{\text{percent}}{100}$$

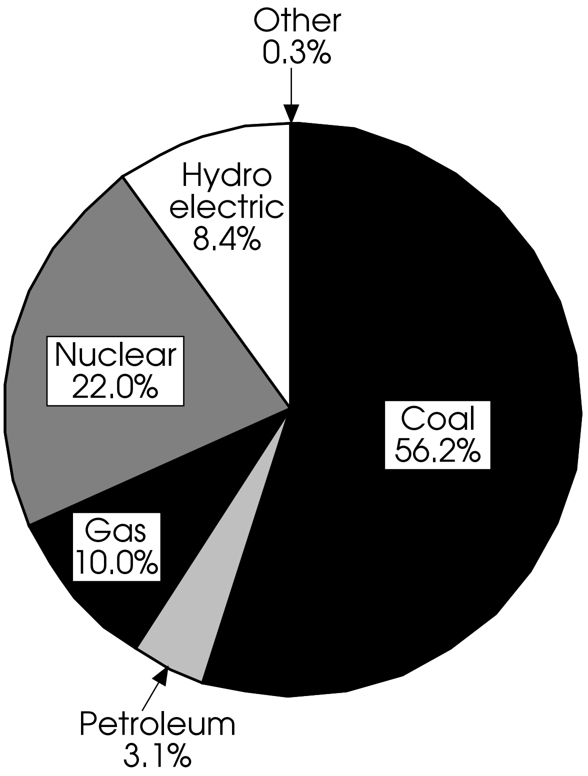
Set up the proportion: $\frac{x}{360} = \frac{56.2\%}{100}$

Cross multiply: $(100)(x) = (56.2)(360)$

$100(x) = 20{,}232.0$

Solve for x: $\frac{100(x)}{100} = \frac{20{,}232.0}{100}$

$x = 202°$



INVENTORIES OF SPENT FUEL

A thematic map provides information about a single topic, such as inventories of spent fuel. Thematic maps with shaded or colored areas are choropleth maps. Their shading enables map readers to see patterns quickly, and for this reason, shading is usually progressively darker as data values increase.

The spent fuel inventory data can first be visualized on a number line. The pre-established number line and legend provides for well-distributed categories of volume spans. You can look off the number line when coloring in your map.

Directions: Fill in the number line and choropleth map showing inventories of spent fuel in the United States. Use the data about metric tons of spent fuel from the table on the enrichment activity entitled *Spent Fuel Inventories Number Line.*

Number Line:

1. The tick marks on the number line have been labeled by 100s, beginning with the lowest number at the far left of the top line. Using the table, locate the correct place on the line for each State.

2. Write the abbreviation for the State and the amount of stored spent fuel given in the table. If more than one State belongs in a given place, "stack" the abbreviations.

   For example, for Virginia and New Jersey:

   NJ - 1,080
   VA - 1,088
   1,000 1,100

3. Looking ahead to the map legend, see where the volumes are broken up into categories. The first category of States with inventories of spent fuel, for example, spans from one to 300 metric tons.

4. Draw an arrow on the number line under the numbers where spent fuel volumes are divided into categories to be colored for the map.

Map: Look at the number line for the groups of States with spent fuel inventories. Remember that each arrow represents a division from the legend.

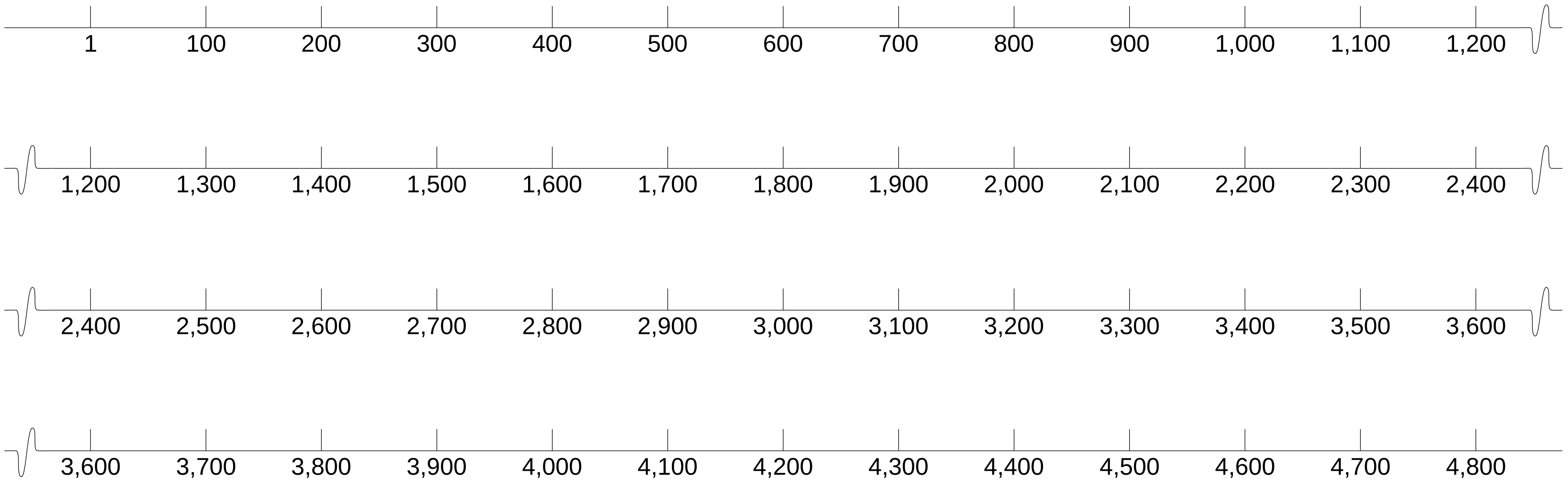
5. Select symbols or colors for the categories. Plan to leave States with no spent fuel blank. Use lighter symbols or colors for States with lower inventories of spent fuel and darker symbols or colors for States with greater inventories.

6. Fill in the map legend. Be sure to leave the box for States with no spent fuel blank.

7. Fill in the map with the colors or symbols you chose to show inventories of spent fuel in the United States.

8. Look at the filled-in map carefully. What patterns do you see? Where is the most or the least spent fuel located? What are some of the possible reasons for these patterns?

SPENT FUEL INVENTORIES NUMBER LINE



Symbol indicates that the number line is a segment of the range in values.

SPENT NUCLEAR FUEL

State	Spent Fuel 1993 (Metric Tons)	State	Spent Fuel 1993 (Metric Tons)	State	Spent Fuel 1993 (Metric Tons)	State	Spent Fuel 1993 (Metric Tons)
Alabama	1,334	Illinois	4,154	Mississippi	299	Pennsylvania	2,284
Arizona	430	Iowa	231	Missouri	242	South Carolina	1,684
Arkansas	554	Kansas	194	Nebraska	350	Tennessee	409
California	1,253	Louisiana	318	New Hampshire	63	Texas	320
Colorado	15	Maine	426	New Jersey	1,080	Vermont	365
Connecticut	1,189	Maryland	578	New York	1,792	Virginia	1,088
Florida	1,320	Massachusetts	431	North Carolina	1,460	Washington	191
Georgia	915	Michigan	1,149	Ohio	395	Wisconsin	779
Idaho	51	Minnesota	610	Oregon	358		

1993 INVENTORIES OF SPENT FUEL BY STATE
(In Metric Tons)

WORLDWIDE NUCLEAR WASTE MANAGEMENT

Fill in the matrix below while watching the videotape *Worldwide Nuclear Waste Management.* The matrix will give you the data needed to complete the discussion questions.

Country	Number of Powerplants	Number of Sites	Percent of Electricity Derived from Nuclear Power	Reprocess (Yes/No/NA*)	Year Repository is to Open or Be Sited
Belgium					
Canada					
Finland					
France					
Germany					
Japan					
The Netherlands					
Spain					
Sweden					
Switzerland					
United Kingdom					
United States					

*NA = Information not available

NOTE: Since 1992, nuclear waste management programs have also been considered in Argentina, India, and Italy.

Discussion Questions

1. What is the total number of nuclear powerplants for the 11 countries other than the U.S.?

   ____

2. Which country receives the highest percentage of electricity from nuclear power? _____________ The lowest percentage? ____

3. What is the average percentage of electricity from nuclear power for these 12 countries?

   ____

4. Which country has the most nuclear powerplants? _________ The least? ________________

5. Does the country with the most nuclear powerplants also have the highest percentage of nuclear

   power?____

6. If not, why would a country with fewer nuclear powerplants have a higher percentage of electricity derived from nuclear power? Explain.

   ____

   ____

   ____

   ____

7. How many countries reprocess their fuel? ____

8. What is the common goal for these and all other countries who operate nuclear powerplants?

   ____

   ____

9. In what kind of facility do these countries plan to store high-level nuclear waste?

   ____

10. When should siting or operation of these storage facilities begin for most of these countries?

LOW-LEVEL WASTE

Low-level nuclear waste and high-level nuclear waste have different characteristics and, therefore, are disposed of differently. Historically, some quantity of low-level radioactive waste has been generated in every State from a variety of commercial sources, including academic, government, and industrial research; manufacturing processes; medical diagnosis and therapy; and electricity generation. Currently, these wastes are disposed of at Federally licensed sites in Barnwell, South Carolina and Hanford, Washington. A third site, Beatty, Nevada, closed at the end of 1992, but still contains waste.

To provide a national disposal system to manage low-level wastes, the U.S. Congress passed the Low-Level Radioactive Waste Policy Act and amendments. These laws make disposal of commercially generated low-level radioactive waste a responsibility of each State. States are encouraged to form interstate compacts to manage and dispose of low-level waste on a regional basis. The District of Columbia and Puerto Rico must also comply with provisions of this law. Nine compact regions have been formed and ratified by Congress: Texas, Maine, and Vermont have agreed at the State level to form a tenth compact with Texas as the host State. This agreement has not been approved by Congress at this date. New York and Massachusetts have declared themselves independent host States. As of March 1994, three States, as well as Washington, D.C. and Puerto Rico, remain unaffiliated. Unaffiliated States and States in compacts without an operating disposal site are required to meet specific milestones and deadlines leading to the operation of new regional disposal facilities by January 1, 1993. However, as of 1994, these milestones had not been met by the affected States.

1993 Sources and Volumes of Low-Level Waste Received at Disposal Sites
(Cubic Feet)

	Academic	Government	Industry	Medicine	Utilities	Total
APPALACHIAN COMPACT	**1,503**	**6,326**	**3,760**	**117**	**48,811**	**60,517**
Delaware	4	1	489	7	0	501
Maryland	1,256	5,984	770	9	3,346	11,365
Pennsylvania	228	341	2,489	101	45,465	48,624
West Virginia	15	0	12	0	0	27
CENTRAL COMPACT	**647**	**251**	**205**	**39**	**23,598**	**24,740**
Arkansas	16	81	0	19	2,774	2,890
Kansas	118	4	160	16	2,428	2,726
Louisiana	331	1	30	1	6,798	7,161
Nebraska	165	5	0	0	11,598	11,768
Oklahoma	17	160	15	3	0	195
CENTRAL MIDWEST COMPACT	**420**	**22**	**2,891**	**214**	**63,436**	**66,983**
Illinois	218	2	2,645	214	63,436	66,515
Kentucky	202	20	246	0	0	468
MIDWEST COMPACT	**2,435**	**49**	**4,207**	**52**	**13,380**	**20,123**
Indiana	272	11	684	0	0	967
Iowa	525	0	8	0	1,474	2,007
Minnesota	655	2	282	0	4,118	5,057
Missouri	534	0	1,041	4	1,610	3,189
Ohio	400	31	2,175	48	4,023	6,677
Wisconsin	49	5	17	0	2,155	2,226

Table Continued

	Academic	Government	Industry	Medicine	Utilities	Total
NORTHEAST COMPACT	**1,212**	**983**	**5,331**	**86**	**28,066**	**35,678**
Connnecticut	642	872	1,667	18	11,403	14,602
New Jersey	570	111	3,664	68	16,663	21,076
NORTHWEST COMPACT	**1,469**	**114,909**	**16,018**	**237**	**15,445**	**148,078**
Alaska	0	447	0	0	0	447
Hawaii	0	2,361	0	0	0	2,361
Idaho	300	23	2	0	0	325
Montana	0	0	0	0	0	0
Oregon	326	95,857	3,631	9	4	99,827
Utah	0	0	6,524	0	0	6,524
Washington §	843	16,221	5,861	228	15,441	38,594
Wyoming	0	0	0	0	0	0
ROCKY MOUNTAIN COMPACT	**326**	**0**	**12**	**0**	**38,333**	**38,671**
Colorado	326	0	0	0	38,333	38,659
Nevada	0	0	0	0	0	0
New Mexico	0	0	12	0	0	12
SOUTHEAST COMPACT	**2,727**	**51,699**	**120,851**	**1,340**	**99,275**	**275,892**
Alabama	10	214	187	21	12,645	13,077
Florida	184	143	813	74	11,312	12,526
Georgia	313	63	1,271	79	11,506	13,232
Mississippi	31	71	554	13	6,703	7,372
North Carolina	1,522	38	15,061	1,099	19,309	37,029
South Carolina §	243	8,513	8,315	5	18,401	35,477
Tennessee	320	6	82,364	44	1,924	84,658
Virginia	104	42,651	12,286	5	17,475	72,521
SOUTHWEST COMPACT	**115**	**10,511**	**3,560**	**419**	**13,366**	**27,971**
Arizona	0	5	0	0	8,148	8,153
California	115	10,493	3,560	419	5,218	19,805
North Dakota	0	4	0	0	0	4
South Dakota	0	9	0	0	0	9
UNAFFILIATED (Not members of any compact as of 1992)	**1,318**	**6,599**	**27,925**	**2,632**	**55,055**	**93,529**
Army Outside of U.S.	0	2,506	0	0	0	2,506
District of Columbia	0	0	0	0	0	0
Maine*	0	0	0	0	0	0
Massachusetts	200	3,384	4,819	131	16,431	24,965
Michigan	0	0	0	0	0	0
New Hampshire	0	0	0	0	0	0
New York	633	386	19,787	2,472	28,346	51,624
Puerto Rico	0	0	0	0	0	0
Rhode Island	0	0	0	0	0	0
Texas*	464	322	3,319	29	5,667	9,801
Vermont*	21	1	0	0	4,611	4,633
TOTAL	**12,172**	**191,349**	**184,760**	**5,136**	**398,765**	**792,182**

Note: Due to computer-generated rounding, totals may not add up exactly.

§ *Current location of disposal site. (Washington will host a site for the Northwest Compact and the Rocky Mountain Compact.)*

* *As of March 1994, Texas, Maine, and Vermont had agreed to form a tenth compact.*

Source: The 1993 State-by-State Assessment of Low-Level Radioactive Wastes Received at Commercial Disposal Sites *(DOE/LLW-205), September 1994*.

LOW-LEVEL WASTE

Part I

A thematic map provides information about a single topic. Thematic maps with shaded or colored areas are choropleth maps. Their shadings enable readers to see patterns quickly, and for this reason, shading is usually progressively darker as data values increase.

Directions: Make two thematic maps, called choropleth maps, to show 1) what States have joined which low-level waste compacts and 2) how much low-level waste from individual States was disposed of at federally licensed sites in 1993.

Use data from the table given, *Low-Level Waste Received at Disposal Sites – 1993* to fill in the data table and worksheet. This information will be used later to complete the maps.

1. Identify the range of numbers of low-level waste disposed of in the United States by recording the lowest and highest numbers.
   ____________ to ____________________________.

2. Because the range is so wide, it will be necessary to convert to units that can be managed more easily. Using the data table on the activity entitled *Low-Level Waste Number Line*, convert the data to units of thousands of cubic feet.

   a) Round the numbers to the nearest 1,000.
   (For example, 501 = 1,000; 11,365 = 11,000; 27 = 0)
   Record these numbers on the first blank for each State. In the second blank, record the data in units of thousands.

   For example:
   For Delaware: DE *1,000* *1*

   For Maryland: MD *11,000* *11*

3. Complete the number line on the worksheet. Each division on the number line represents 10,000 cubic feet of low-level waste.

   a. Locate the correct place on the line for each State.

   b. Write the abbreviation for the State and the amount of low-level waste as calculated in Step 2. If more than one State belongs in a given place, "stack" the abbreviations.

   For example, for DE and AR:

   DE - 1
   AR - 3
   0 10

4. List the low-level waste compacts and assign symbols or colors for each compact in the legend on the worksheet. Place States that have not joined a compact into a group such as "Unaffiliated States."

5. Using the information from Step 4, fill in the legend for the map titled "Low-Level Waste Compacts, – <u>December</u> 1993."

6. Fill in the map to identify what States have joined which low-level waste compacts.

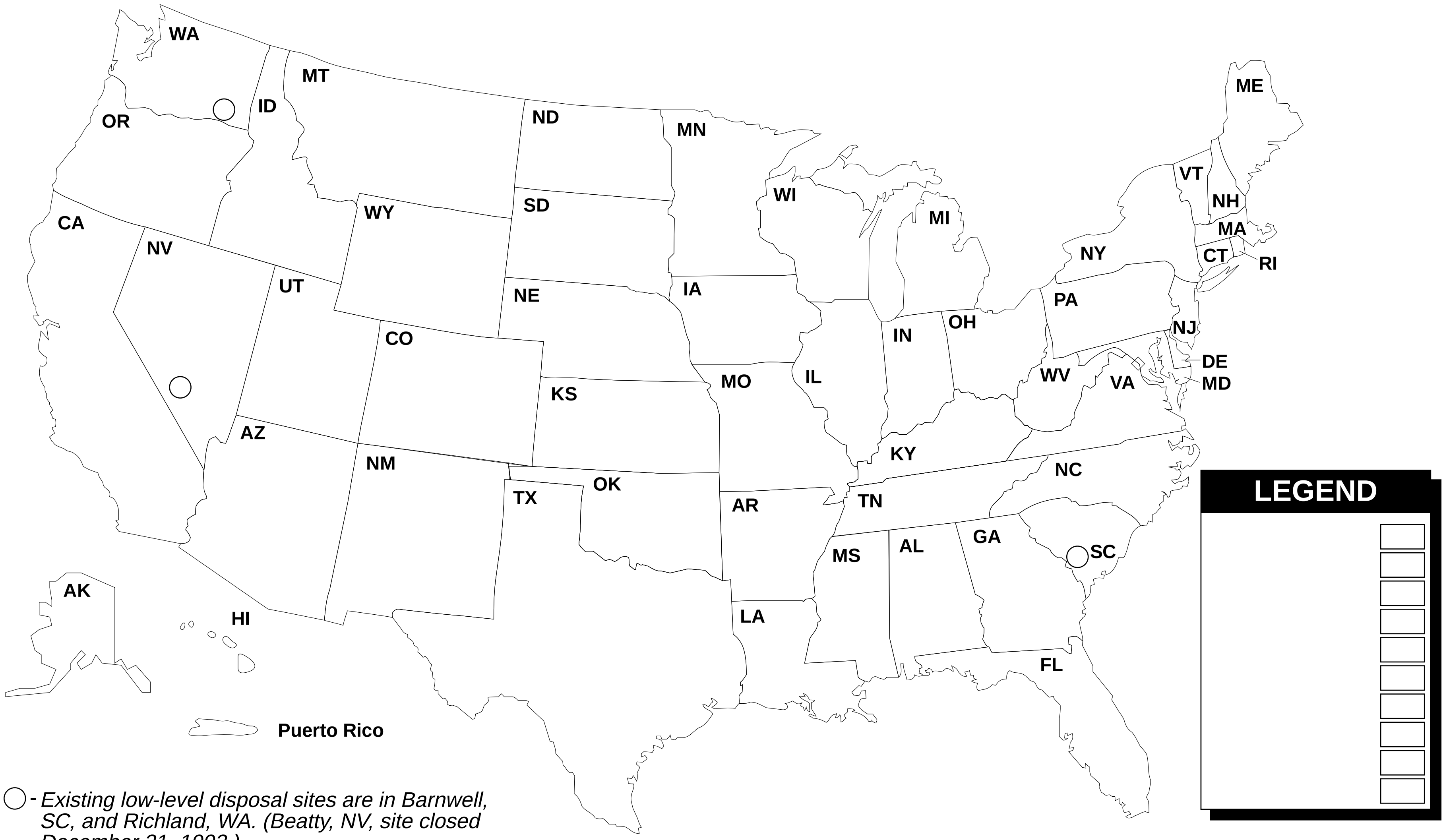
7. Next, establish four or five categories for the amount of waste received at disposal sites and fill in the second column of the legend on the worksheet. The categories do not have to represent equal breakdowns by numbers on the number line or by number of States.

   In determining the categories, look for major clusters in distribution along the number line. Distinguish groups that are basically alike or clearly different.

8. Select symbols or colors for the categories you created in Step 7. Fill in the legend for the map titled "Low-Level Waste Received at Disposal Sites – <u>1993</u>."

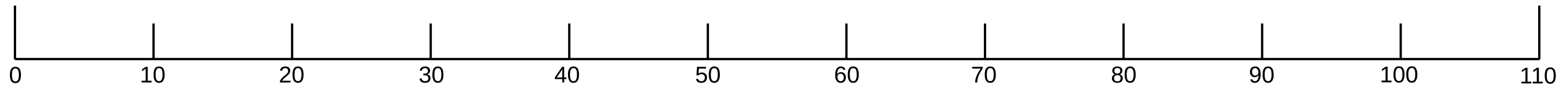
9. Fill in the map "Low-Level Waste Compacts, <u>December</u> 1993" to depict the amount of low-level waste each state has sent to disposal sites.

LOW-LEVEL WASTE COMPACTS, <u>DECEMBER</u> 1993



○ - *Existing low-level disposal sites are in Barnwell, SC, and Richland, WA. (Beatty, NV, site closed December 31, 1992.)*

Low-Level Waste Number Line



DE __________ _____
MD __________ _____
PA __________ _____
WV __________ _____
AR __________ _____
KS __________ _____
LA __________ _____
NE __________ _____
OK __________ _____
IL __________ _____
KY __________ _____
IN __________ _____
IA __________ _____
MN __________ _____
MO __________ _____
OH __________ _____
WI __________ _____

CT __________ _____
NJ __________ _____
AK __________ _____
HI __________ _____
ID __________ _____
MT __________ _____
OR __________ _____
UT __________ _____
WA __________ _____
WY __________ _____
CO __________ _____
NV __________ _____
NM __________ _____
AL __________ _____
FL __________ _____
GA __________ _____
MS __________ _____

NC __________ _____
SC __________ _____
TN __________ _____
VA __________ _____
AZ __________ _____
CA __________ _____
ND __________ _____
SD __________ _____
DC __________ _____
ME __________ _____
MA __________ _____
MI __________ _____
NH __________ _____
NY __________ _____
PR __________ _____
RI __________ _____
TX __________ _____
VT __________ _____

LOW-LEVEL WASTE RECEIVED AT DISPOSAL SITES - 1993

○ - *Existing low-level disposal sites are at Barnwell, SC, and Hanford, WA. (Beatty, NV, site closed December 31, 1992.)*

LOW-LEVEL WASTE

Part II

Directions: Study and complete the table and pie chart below for low-level waste volumes disposed of in the U.S. as of 1993. Then construct a pie chart (circle graph) for low-level waste disposed of in your state and compare the two charts.

Percentages of low-level waste disposal in the United States.

1. Complete the U.S. volume-to-degree conversions as practice before calculating percentages for your own state. For example, to get the academic source percentage of low-level waste for the pie chart below:

   12,172 ÷ 792,182 = 0.0154 (source/total)

   Convert to percent = 1.5% (rounded to nearest half-percent)

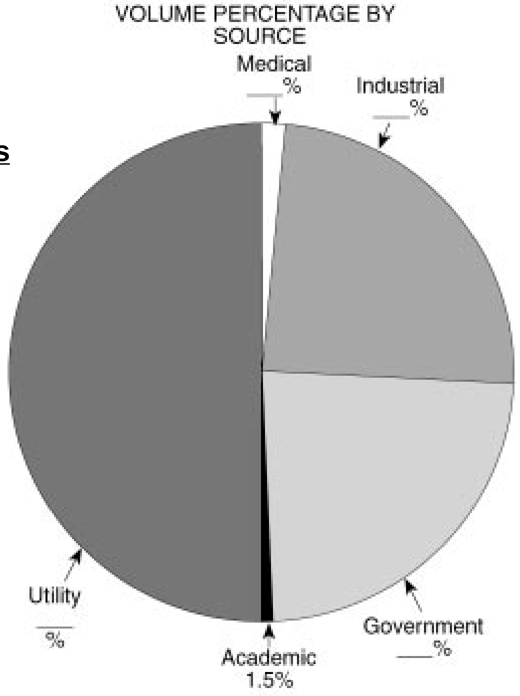
   Convert to degrees = 1.5% x 360° ÷ 100% = 5.5°

   (See the electricity production enrichment activity Making a Pie Chart - United States, *or ask your teacher for help in converting volumes to percents and degrees)*

2. Fill in the missing percentages and degrees for the pie chart below.

Low-Level Waste Disposed of in the United States:

Source	Volume (Cubic Feet)	Decimal Fraction	Percent	Degrees
Academic	12,172	*0.0154*	*1.5%*	*5.4°*
Government	191,349	*0.2415*	____	____
Industrial	184,760	*0.2332*	____	____
Medical	5,136	*0.0065*	____	____
Utility	398,765	*0.5034*	____	____
Total	**792,182**		**100%**	**360°**



Percentages of low-level waste disposal in your State.

Using the data given in the table entitled *1993 Volumes of Low-Level Waste Received at Disposal Sites*, make a pie chart to show the percentage of low-level waste disposed of by your home State in 1993 that came from each of the following sources: academic, government, industrial, medical, electrical utilities. (If your home State did not dispose of low-level waste at one of the disposal sites in 1993, or if all the waste disposed of came from a single source, use the data for the compact your State belongs to or a neighboring State.)

1. Identify below the State for which calculations are being made and write in the volumes from the table entitled *1993 Volumes of Low-Level Waste Received at Disposal Sites*.

2. Calculate the fraction, expressed as a decimal, of the total for each source.

3. Round off and convert the decimal to percent.

4. Figure the number of degrees of a circle that will represent each percentage. (Remember that a circle has 360°. This means 50% will equal 180°, 25% will equal 90°, 10% will equal 36°, etc.)

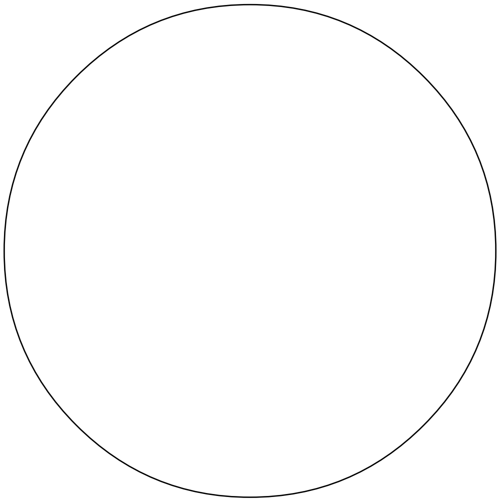
5. Using a protractor, use the circle below to make your pie chart.

6. Label the pie chart with the percentages and the categories they represent.

Low-Level Waste Disposed of in ______________________:

Source	**Volume (Cubic Feet)**	**Decimal Fraction**	**Percent**	**Degrees**
Academic	_________	______	______	______
Government	_________	______	______	______
Industrial	_________	______	______	______
Medical	_________	______	______	______
Utility	_________	______	______	______
Total	_________			

VOLUME PERCENTAGE BY SOURCE



(Answers will vary)

METRIC AND U.S. UNIT CONVERSIONS

Both American and metric units have been used in the curriculum, as appropriate to the issues being discussed. For example, inventories of spent fuel are routinely reported in the United States in terms of metric tons (1,000 kilograms) even though most Americans are familiar with the short ton (2,000 pounds). Classroom experiments are usually conducted using metric units as well. Yet the standards and tests for spent fuel transportation casks are written using temperature in degrees Fahrenheit, miles per hour, and other similar units.

To familiarize yourself with potentially unfamiliar metric units, a conversion chart has been prepared. To convert a given unit into its metric or U.S. equivalent, multiply the quantity by the number in the right hand column. For example, to convert 1,000 kilograms into its equivalent in pounds, multiply by 2.205 to get 2,205 pounds (1,000 kg x 2,205 lb/kg = 2,205 lb). Alternately, 2,000 pounds is equivalent to 2,000 lb x 0.4536 kg/lb or 907.2 kilograms.

People vary in their comprehension of metric units and unfamiliar U.S. units. Consider using this chart as an aid if you are confused or if you are especially interested in unit conversions.

Table 1. Approximate Conversions from Metric to English Units

If you know...

Length →	**multiply by** →	**to get**
millimeters (mm)	0.03937	inches (in)
centimeters (cm)	0.03281	feet (ft)
centimeters (cm)	0.3937	inches (in)
meters (m)	39.37	inches (in)
meters (m)	3.281	feet (ft)
meters (m)	1.094	yards (yd)
kilometers (km)	3,281.0	feet (ft)
kilometers (km)	0.5396	nautical miles (mi)
kilometers (km)	0.6214	statute miles (mi)
Area		
hectares (ha)	2.471	acres
hectares (ha)	1.076 X 105	square ft (ft^2)
Weight (mass)		
grams (gm)	0.03527	ounces (oz)
grams (gm)	0.002205	pounds (lb)
kilograms (kg)	2.205	pounds (lb)
metric tons (t)	1.102	short tons
metric tons (t)	0.984	long tons
Pressure		
kilopascals (kPa)	6.9	pounds/square inch (lb/in^2)
Volume		
cubic centimeters (cm^3)	0.06202	cubic inches (in^3)
cubic meters (m^3)	3.531	cubic feet (ft^3)
cubic meters (m^3)	1.307	cubic yards (yd^3)
liters (L)	2.113	pints* (pt)
liters(L)	0.2642	gallons* (gal)
Temperature		
Celsius	9/5, [then add 32]	Fahrenheit
Electric Current		
ampere (A)	1	ampere (A)
Energy, Work, Heat		
joule (J)	9.480 x 10^{-4}	BTU
Power		
watt (W)	1	watt (W)
watt (W)	3.4129	BTU per hour
watt (W)	1.341 x 10^{-3}	horsepower

Common Prefixes for Metric Units:

mega = million = 10^6
kilo = thousand
hecto = hundred
deka = ten

deci = one-tenth
centi = one-hundredth
milli = one-thousandth
micro = one-millionth

Examples:
kilogram = 1,000 grams
milliliter = 1/1,000 liter

*liquid measure

Table 2. Approximate Conversions from English to Metric Units

If you know...

Length →	**multiply by** →	**to get**
inches (in)	2.54	centimeters (cm)
feet (ft)	30.48	centimeters (cm)
feet (ft)	0.3048	meters (m)
miles (mi)	1.609	kilometers (km)
yards (yd)	0.9144	meters (m)
Area		
square inches (in^2)	6.5	square centimeters (cm^2)
square feet (ft^2)	0.09	square meters (m^2)
square yards (yd^2)	0.8	square meters (m^2)
acres	0.4047	hectares (ha)
square miles (mi^2)	2.6	square kilometers (k^2)
Weight (mass)		
ounces (oz)	28.349527	grams (gm)
pounds (lb)	0.4536	kilograms (kg)
tons (long)	1.016	metric ton (t)
Pressure		
pounds per square inch	70.31	grams per square centimeter
pounds per square inch	0.145	kilopascals
Volume		
cubic feet (ft^3)	0.02832	cubic meters (m^3)
cubic inches (in^3)	16.387	cubic centimeters (cm^3)
cubic yards (yd^3)	0.765	cubic meters (m^3)
gallons* (gal)	3.785	liters (L)
pints* (pt)	0.473	liters (L)
quarts* (qt)	0.946	liters (L)
Temperature		
Fahrenheit	[subtract 32, then multiply by 5/9]	Celsius
Electric Current		
ampere (A)	1	ampere (A)
Energy, Work, Heat		
BTU	1,055	joules (J)
Power		
watt (W)	1	watt (W)
BTU per hour	0.293	watt (W)
horsepower	745.712	watt (W)

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*liquid measure

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