

ENCYCLOPEDIA MAN ACTIONARYOGRAPHY



ISLAND OF DOCTOR BRAIN

WELCOME TO THE ISLAND OF
DR. BRAIN AND WORLD FAMOUS

ENCYCLOALMANACTIONARYOGRAPHY



SIX YEAR CALENDAR

1993

| JANUARY | | | | | | | FEBRUARY | | | | | | | MARCH | | | | | | | APRIL | | | | | | |
|---------|----|----|----|----|----|----|----------|----|----|----|----|----|----|-------|----|----|----|----|----|----|-------|----|----|----|----|----|----|
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1994

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1996

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What is an EncycloAlmanacTionaryOgraphy? Well, it's a combination of an encyclopedia, an almanac, a dictionary, and a bibliography, and it's yours free just for playing this game.

The goal of the EncycloAlmanacTionaryOgraphy is to present a variety of topics in one concise, easy-to-read and easy-to-find source. You may just find yourself carrying this manual around with you for your research projects. However, it's especially beneficial for learning more about the puzzles in the game.

There are three main SECTIONS to the EncycloAlmanacTionaryOgraphy.

In SECTION ONE, you'll find all the necessary information about playing the game (i.e., learning the Icon Bar, saving your game, setting difficulty levels from Easy to Standard to Expert, operating your Hint Watch, and scoring). There's also a free Chart of the Cerebral Hemisphere (needed for solving your first puzzle of the game).

In SECTION TWO, you'll find related background information on many of the puzzles in your game. This section is designed to help you get started on your own research projects. For example, under the heading *You Might Look it Up (on Dr. Brain's Bookshelf)*, you can find answers to questions like these: Is Zambezi a river or a country? On which continent is Belize? And where is Mt. Kilimanjaro anyway? In a band, is an English horn a brass or woodwind instrument? In what system of your body are phalanges found? Are yaks generally found in high mountain regions?

In SECTION THREE, you'll find a Glossary of Terms, a Bibliography, and an index to your EncycloAlmanacTionaryOgraphy. You'll also find some additional useful reference charts. Things you might like to look up in this section are as follows: Who was Gregor Mendel and what did he discover? (You can find this in your Glossary.) Who wrote Who's Afraid of Virginia Woolf? (This is found in your Bibliography.) Is AU the abbreviation for gold? (You can look it up in your Periodic Table of the Elements.)

These are just some of the uses we've come up with for the EncycloAlmanacTionaryOgraphy. We're sure you will come up with other uses. The world needs good, dedicated lab assistants such as yourself! Good luck in all your endeavors!

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SECTION ONE

SOME NOTES
ON GAME PLAY

THE ISLAND OF DR. BRAIN

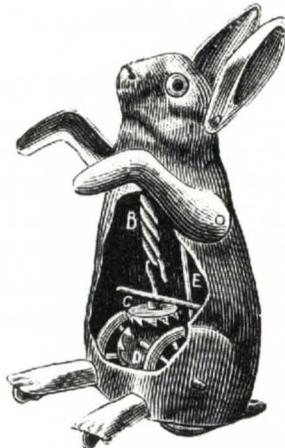
In the *Island of Dr. Brain*, you'll need to apply yourself in many different ways. Although no experience is required, you'll need to use your thinking skills in at least some of the following subject areas: math, science, foreign language, music, and art history. Your persistence in these areas will help you win the game.

Hint Calls

When you begin the game, Dr. Brain gives you a hint watch (with one hint call left). If you get stuck trying to solve a puzzle, press the hint watch button from the top of your puzzle bar (for more details, see *How the Puzzle Box Works*).

In some puzzles a hint call will buy a solution to part of the puzzle. If a hint call buys a solution, several hint calls (if you have them) will buy more solutions.

In other puzzles a hint call will buy a strategy (think about 'em) hint about



solving the puzzle. If a hint call buys this kind of hint, you can press the hint call button repeatedly without using more hint calls.

The more hint calls you have left over at the end of the game, the higher your score will be. Therefore, use your hint calls wisely.

Difficulty Level

There are three difficulty levels in the *Island of Dr. Brain*. You can set the difficulty level to Novice, Standard, or Expert at any time. The higher the difficulty level, the more points you will earn for solving the puzzles and the more your brain will ache.

If you replay one of the puzzles in the *Island of Dr. Brain*, you will discover that it requires a new and different solution. Therefore, you may receive one additional point for up to three replays of any puzzle. In some puzzles, such as the Coconut Tree Word Search, you can receive even more additional points.

How the Puzzle Box Works

Most puzzles come up in a puzzle box. Each puzzle box has three buttons as follows:

Hint Call Button: Pressing the **Hint Call Button** gets you more help (hints) with the puzzle if you have any hint call charges left. For more information on hint calls, see the previous section entitled *Hint Calls*.

Exit: Pressing the **Exit** button closes the puzzle box. If you are unable to complete the puzzle or want to quit the game and do something else, pressing the **Exit** button will allow you to leave the puzzle and come back to it later.

Question Mark: Pressing the **Question Mark Button** tells you about the puzzle — what you need to do, how to use the controls, and what kind of help your hint calls will supply.

THE DR. BRAIN ICON BAR

At the top of the game screen is an Icon Bar. Each icon represents an activity you can perform in the game. The icons in Dr. Brain are as follows:



From Left to Right:

Look: Looks like an eye. Choose **Look** when you want a description of something you see on the screen.

Do: Looks like a hand. Choose **Do** when you want to take an action on something on the screen.

Item: Looks like a picture frame. When you select an inventory **Item**, it will show in the frame.

Inventory: Looks like a beach bag. Choose **Inventory** when you want to see what items you have picked up, or to use one of your items. For more information on **Inventory**, see your *Sierra Game Manual*.

Go Back: Looks like an arrow pointing back the way you came. Choose **Go Back** when you want to leave the room you are in now and go back to the previous room you came from.

Controls: Looks like a slider bar on a control panel. Choose **Controls** when you want to change the volume or difficulty level of the game, or when you want to save, restore, restart or quit the game.

Help: Looks like a question mark. When you choose **Help** you will be able to get information by moving the question mark cursor on the other icons in the Icon Bar.

Dr. Brain: Click **Dr. Brain** to get a description of the island locale you currently occupy.

For more information on how icons work, see your *Sierra Game Manual*.

THE ACHIEVEMENT BOARD

To examine your progress and score in the game, consult the Achievement Board. You carry the Achievement Board around with you in your inventory. You may examine the Achievement Board at any time. Simply move the mouse cursor to the top of the screen and select the Inventory Icon. Now you'll see the Achievement Board Icon. Look at the Achievement Board at any time to find out your current score and discover which skills you've mastered.

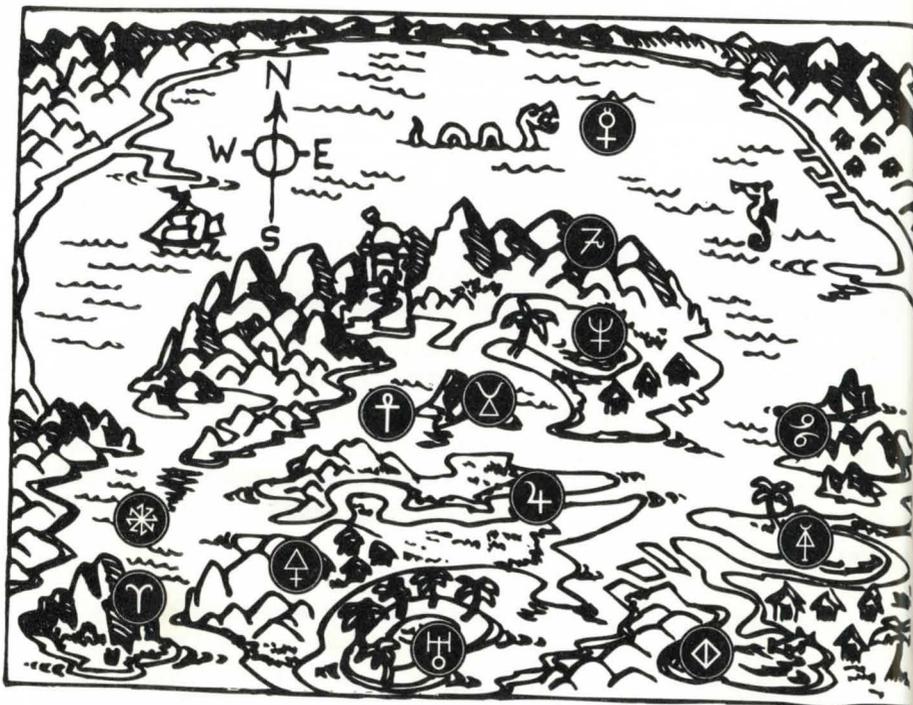
As you complete puzzles in the *Island of Dr. Brain*, each category of your Achievement Board will have a bronze, silver, or gold placard affixed to it. If a placard is affixed to the Achievement Board in one of the categories, this means you've solved one of the puzzles for that skill area. A bronze placard is awarded for Novice Level players, a silver placard for Standard Level players, and a gold placard for Experts.

NAVIGATING THE CEREBRAL HEMISPHERE

In order to get to the Island, you need to tell Dr. Brain's pilot where to go. To help you in this task, fourteen important landmarks are indicated on the following chart of the Cerebral Hemisphere.



Chart of the Cerebral Hemisphere



| | North/South distance from Castle | East/West distance from Castle |
|---|-------------------------------------|-----------------------------------|
| ⌋ | 83 deg. S | 53 deg. W |
| ⌋ | 60 deg. S | 64 deg. E |
| ⌋ | 23 deg. N | 102 deg. E |
| ⌋ | 23 deg. S | 206 deg. E |
| ⌋ | 63 deg. S | 60 deg. W |
| ⌋ | 45 deg. S | 47 deg. E |
| ⌋ | 29 deg. S | 30 deg. E |
| ⌋ | 103 deg. S | 151 deg. E |
| ⌋ | 65 deg. S | 25 deg. W |
| ⌋ | 72 deg. S | 177 deg. E |
| ⌋ | 104 deg. S | 66 deg. E |
| ⌋ | 41 deg. N | 53 deg. E |
| ⌋ | 14 deg. S | 92 deg. E |

Now What?

On Easy Level, the imaginary north-south line (Longitude) measuring at 0 degrees and the imaginary east-west line (Latitude) measuring at 0 degrees intersects at the castle. For example, suppose you need to instruct Dr. Brain's pilot to go to Ventricle Bay. Since Ventricle Bay is 14 degrees South and 92 degrees East of the castle, use the parallel rulers to line off these two locations.

Begin by marking the latitude location. (When you move the parallel rulers, notice how the degrees of latitude in the upper left-hand corner of the screen automatically increase South as you move down and North as you move up.) Move the parallel rulers cursor down to 14 degrees South and select it by pressing your mouse button or ENTER key.

Now mark the longitude location. (When you move the parallel rulers, notice how the degrees of latitude in the upper left-hand corner of the screen automatically increase West as you move left and East as you move right.) Move the parallel rulers right to 92 degrees East and select it by pressing your mouse button or ENTER key.

If you do this correctly, you'll land on the beach of the island and begin the game. If you miss, just try again. With a little practice, you'll become an experienced navigator in no time!

As a Matter of Fact...

Latitude and longitude lines are an important feature of most maps and charts. They can be very useful. Latitude and Longitude refer to imaginary lines that navigators and map makers use. The imaginary lines that go from East to West around the Cerebral Hemisphere are called lines of latitude. Imaginary lines that run from North to South are lines of longitude. Longitude



and latitude lines are measured in degrees, beginning with 0 degrees. The lines above the imaginary latitude 0 degree line are called north latitude. Those lines below are called south latitude. The lines to the left of the imaginary longitude 0 degree line are called west longitude. Those lines to the right are called east longitude. On most maps, these numbers are printed along the borders. When used together, these lines can be used to locate any point on the Cerebral Hemisphere and on Earth as well.

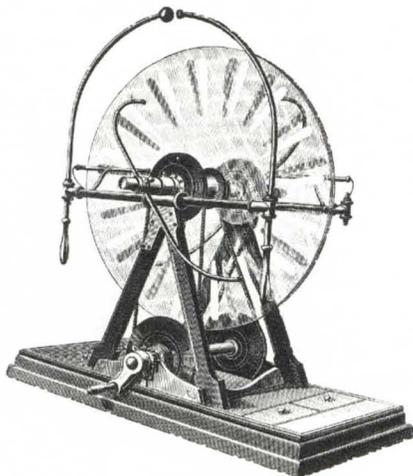
Things to Do...

If you enjoyed this puzzle, try it again on the Intermediate or Expert level. On these levels, you'll discover the castle is no longer at a 0,0 degree intersection. Therefore, you'll have to calculate an offset. For example, suppose the castle is at 10 degrees North and 10 degrees East. This time to get to Ventricle Bay, instruct the pilot to travel to 4 degrees South and 102 degrees East.

You might also like to check out the map of Earth and the United States in the section entitled *You Might Look it Up (On Dr. Brain's Bookshelf)*.

Related Terms...

Lines of Latitude Lines of Longitude World Map



SECTION TWO

SOME THINGS TO DO
WITH THE PUZZLES

USING YOUR POLYOMINOES

Now What?

If you enjoyed playing the cave entrance puzzle on the beach, perhaps you'd like to try creating your own set of game pieces. These shapes are called polyominoes. If you'd like to create your own set of polyominoes, you could just copy the following page of polyominoes on a copy machine and then cut out the shapes with a pair of scissors. Alternatively, if you have some graph paper you could create these shapes yourself. To do this, study the shapes on the following page carefully. Notice how each shape is made of units or squares? Using your pen, draw lines around the squares on your graph paper to make each polyomino shape. Then use your scissors to cut them out. Congratulations! You've created your first set of polyominoes. If you'd like some ideas on what to do with your polyominoes, take a look at the following section entitled *Things to Do*.

As a Matter of Fact...

Polyominoes ("poly" means many) are a large set of shapes formed by joining together identical squares, making special subsets according to the number of squares involved. A one-

square shape is called a monomino. A two-square shape is called a domino. A three-square shape is called a tromino, a four-square, tetromino; a five-square, pentomino, and so on. Take a look at the names of these specific pieces in the examples on the following page.

Things to Do...

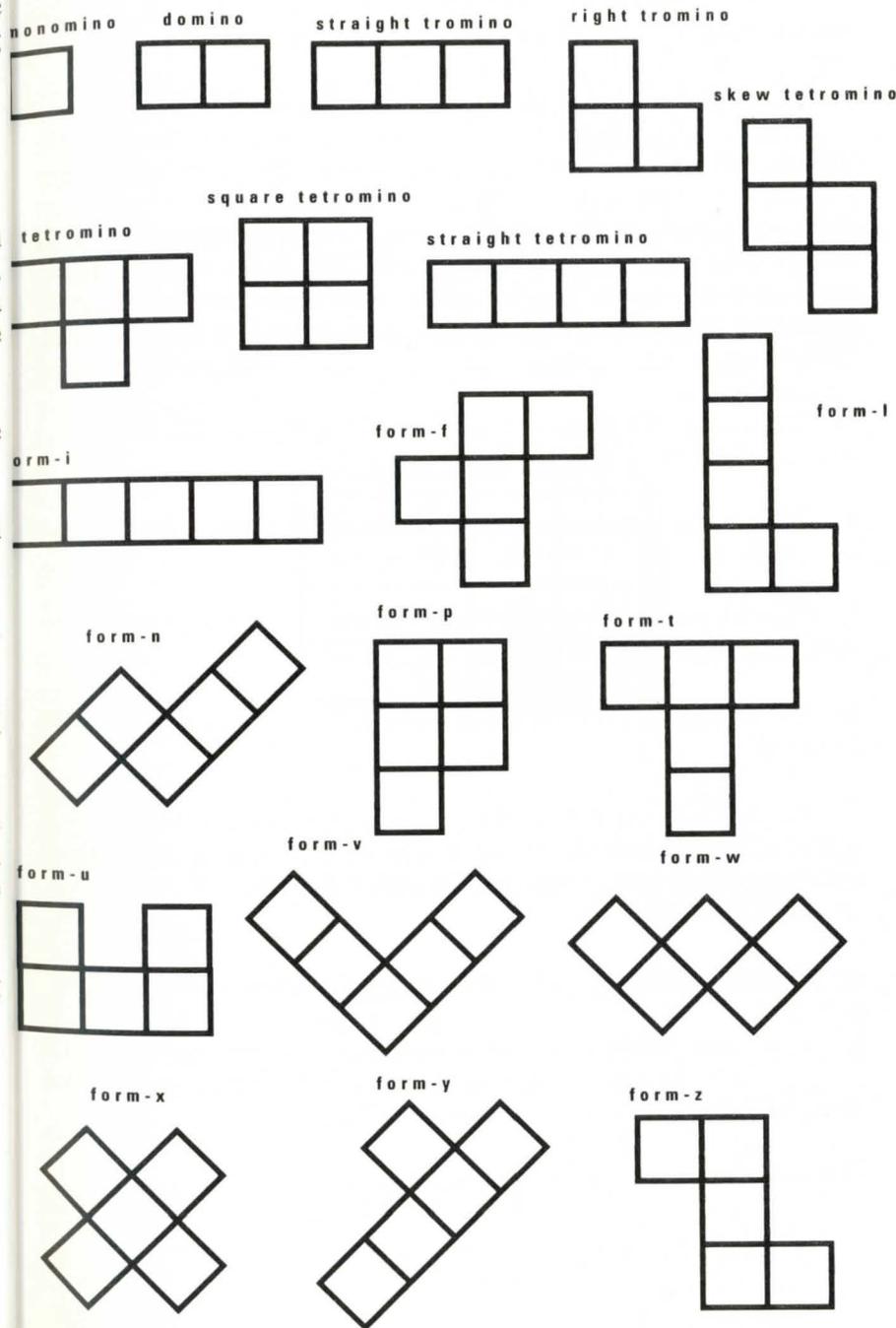
The whole point of polyominoes is to form different shapes with them. Once you've created your own set of polyomino shapes, you can experiment with them in a variety of ways. Here are a few ideas to get you started. See if you can form some of the following:

1. Arrange all the pieces to form the largest possible solid shape you can think of. How about the smallest?
2. What is the largest frame you can create with the pieces? And the smallest?
3. Use the pieces to create different-sized people, animals, boats, cars, airplanes, and other interesting objects.
4. Use the pieces to form different-sized rectangles, squares, and triangles.
5. Notice how some of the shapes resemble letters of the alphabet? (I, V, P, U, T, W, X, Y, Z, F, L, and N.) See if you can combine the pieces to create larger-sized letters. Can you create numbers as well?
6. Use the pieces to form four or five unique and interesting patterns.

Related Terms...

Polyominoes

POLYOMINOES



MAKE YOUR OWN MAGIC SQUARE

Now What?

The magic square you'll play in the *Island of Dr. Brain* is actually a variation of traditional magic squares. In traditional magic squares, all rows, columns, and diagonals add up to one magic number. Historically, the first magic square of this type was supposed to have been painted on the back of a tortoise shell and was presented to Emperor Yu around 2200 B.C. In the middle ages, people believed magic squares would protect them against the plague. And in 1514, Albrecht Dürer painted a magic square into his painting entitled, "Melancholia." His magic square looked like this.

| | | | |
|----|----|----|----|
| 16 | 3 | 2 | 13 |
| 5 | 10 | 11 | 8 |
| 9 | 6 | 7 | 12 |
| 4 | 15 | 14 | 1 |

Notice that the year he painted this work (1514) is in the bottom row. Can you figure out what his magic number is?

As a Matter of Fact...

Creating your own 3X3 magic square is a fun and easy task. In fact, if you'd like to make your own magic square, just follow these three steps.

1. Choose your first two numbers. (These can be any numbers which aren't in the ratio 1:2 or 2:1. For example, 1, 3; 1, 4; and 5, 2; 6, 2, etc.)

2. Choose a third, larger number. (This number may not be less than 5, but must be greater than the sum of the first two numbers. So if your first two numbers are 3 and 5, your third number must be 9 or larger because $3+5 = 8$.)

3. Place these numbers in the magic square grid. (You'll need to perform a special calculation for the diagonal numbers.)

Let's try making a magic square together. For our example, we'll use the numbers 3, 4 and 8. The largest number (8) goes in the center square.

| | | |
|--|---|--|
| | | |
| | 8 | |
| | | |

Next, fill in one diagonal at a time. The numbers in your first diagonal are the sum and difference of the first and third numbers. In our example, $8 + 3 = 11$ and $8 - 3 = 5$.

| | | |
|----|---|---|
| 11 | | |
| | 8 | |
| | | 5 |

The numbers in your second set of diagonals are the sum and difference of the second and third numbers. In our example, $8 + 4 = 12$ and $8 - 4 = 4$.

| | | |
|----|---|----|
| 11 | | 12 |
| | 8 | |
| 4 | | 5 |

Add up the diagonals to determine your magic number. In our example, the magic number is 24. Fill in the rest of the square so all rows, columns, and diagonals add up to the magic number.

| | | | |
|----|----|----|----|
| 11 | 1 | 12 | 24 |
| 9 | 8 | 7 | 24 |
| 4 | 15 | 5 | 24 |
| 24 | 24 | 24 | |

Congratulations! You've completed your first magic square.

Things To Do...

Now that you've created a solution to a 3x3 magic square, create a blank 3x3 grid, leaving only your magic number around the edges. Then ask a friend to complete it.

Related Terms...

Albrecht Dürer

Magic Number

DR. BRAIN'S SARCOPHAGUS

Now What?

The whole point of the Sarcophagus lock is to give you practice with number series. If you learn to look for patterns in number sequences, you will greatly enhance your problem-solving skills. Some patterns on the sarcophagus lock are as follows:

odd and even numbers:

| | | | | |
|---|---|---|---|----|
| 1 | 3 | 5 | 7 | 9 |
| 2 | 4 | 6 | 8 | 10 |

adding five:

| | | | | |
|---|----|----|----|----|
| 5 | 10 | 15 | 20 | 25 |
|---|----|----|----|----|

Multiplying a number by itself, such as $2 * 2 * 2 * 2 * 2$:

| | | | | |
|---|---|---|----|----|
| 2 | 4 | 8 | 16 | 32 |
|---|---|---|----|----|

Fibonacci sequence:

| | | | | |
|---|---|---|---|---|
| 1 | 1 | 2 | 3 | 5 |
|---|---|---|---|---|

As a Matter of Fact...

Here's an Ancient Chinese Secret: Did you know that the sum of consecutive odd numbers always produces a square number? For example:

$1 + 3 + 5 + 7 + 9 + 11 = 36$ (There are 6 consecutive odd numbers in this sequence.)

Count the odd numbers in this sequence and you will get 6. Six consecutive odd numbers add up to 36. Therefore, the square root of 36 is 6. Here's another example:

$1 + 3 + 5 + 7 + 9 + 11 + 13 = 49$ (There are 7 consecutive odd numbers in this sequence.)

Count the odd numbers in this sequence and you will get 7. Seven consecutive odd numbers add up to 49. Therefore, the square root of 49 is 7.

Who was Fibonacci?

The famous Italian mathematician Leonardo da Pisa (also called Fibonacci, which means son of Bonacci) created this sequence of numbers. He was a brilliant mathematician and would publicly display his amazing problem-solving skills to famous emperors and mathematicians of his day. He lived during the time when the famous Leaning Tower was being constructed, but died in the year 1230 before the tower was finished. In the year 1202, he published a book entitled *Liber Abaci*, which provided a foundation throughout Europe for future development in arithmetic and algebra.

What are Fibonacci Numbers?

Fibonacci numbers are cool. The Fibonacci sequence is found by finding the sum of two consecutive terms to give the next term. For example, $1 + 1 = 2$, $1 + 2 = 3$, $2 + 3 = 5$, etc. Therefore the first seven numbers of the sequence look like this:

1 1 2 3 5 8 13 ...

Things To Do...

Memorize the multiplication table in the reference section of your EncycloAlmanacTionaryOgraphy.

Come up with number sequences of your own.

Complete the following Fibonacci sequence:

1 _ _ _ _ _ _ _ _ _ _ 610

Related Topics...

Fibonacci Number Patterns

THE ANCIENT BRAHMIN TOWER OF HANOI

Now What?

If you play all three levels of the Tower of Hanoi puzzle, you may notice that each level requires significantly more moves than the previous level. This is because the number of moves are increasing exponentially. Imagine if you were given the task of sorting 64 disks. To solve the puzzle, it would require approximately 18,446,744,073,710,000,000 moves. Now if you were quick and could move each disk a second at a time, you would be able to complete the task in about 584,542,046,090.6 years! This is approximately 129.89 times the life of the earth and 30 times the life of our universe. Fortunately, Dr. Brain doesn't expect you to use anything like 64 disks to complete his version of the puzzle.

As a Matter of Fact...

There's an ancient Brahmin tale that goes something like this. Life in the universe is defined in terms of the time it will take a group of monks (working continuously) to move a set of 64 gold disks, all of different diameters, from one pole to another. There are specific rules about how the transfer should be done, which you will discover when you play this puzzle. These rules make the project far from trivial and also a very "long-term" project, to put it mildly.

Things to Do...

Why not try building your own Tower of Hanoi using more disks? (If you have good wood-working skills you might want to give it as a gift to one of your friends or family members.)

Related Terms...

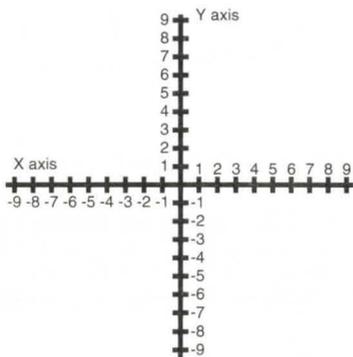
Brahmin Tower of Hanoi

DR. BRAIN'S MICROSCOPE

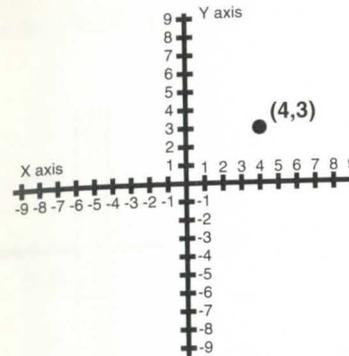
Dr. Brain's microscope is actually a graph. Graphs are pictures of functions. In fact, you're using functions to categorize microscopic life on Dr. Brain's microscope. In general, a function describes the way one quantity depends on another or the way one quantity varies with another. For example, a line can represent a linear function where for each X value, there is a subsequent Y value. Plotting all these relationships forms the line. Some graphs of functions illustrate how pressure is a function of temperature, others show how population is a function of time, and so on. You can experiment with many different kinds of functions on Dr. Brain's microscope.

As a Matter of Fact...

The lines formed on a graph are composed of many points on a plane called coordinates. Points plotted from left to right create lines on or parallel to the X axis of the graph. Points plotted from top to bottom create lines on or parallel to the Y axis of the graph. Here's a graph showing the X and Y axes.



When all the parallel lines are drawn on the graph, they form a rectangular grid on the entire plane. This grid allows us to coordinate each point on the plane. Thus, each point on a graph is represented like this (X, Y). These are called X and Y coordinates. The system of representing X and Y coordinates is called the cartesian coordinate system.



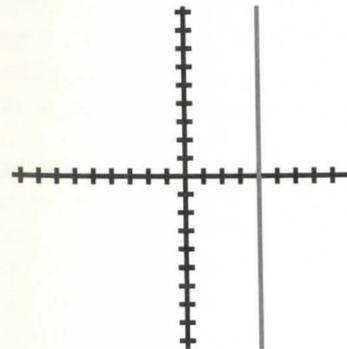
Cartesian coordinates are always represented in an (X, Y) order. This is called an ordered pair. So if we have an X value of 4 and a Y value of 3, we would plot this point as the ordered pair (4, 3). Here's what the point would look like on the graph. We describe this plotted point by stating it is drawn three above the X axis and four to the right of the Y axis in cartesian space.

On Dr. Brain's microscope, there are three kinds of functions that you can experiment with. These are simple functions, linear functions, and polynomial functions.

The Simple Functions:

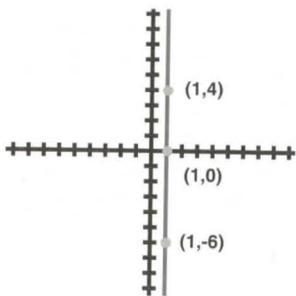
The simple functions in cartesian space are $X = ?$ and $Y = ?$. These functions state that for all values of their neighboring axis, their value is fixed. For example, given the equation $X = 4$; we know that regardless of all Y values, X will still be 4.

$X = 4$ looks like this:

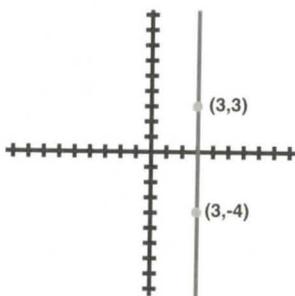


Therefore, as you change the X value, the line moves 1 space to the left or right. Increasing the X value moves the line to the right and decreasing the X value moves the line to the left.

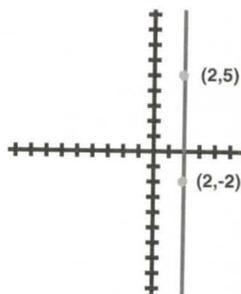
$X = 1$
looks like this:



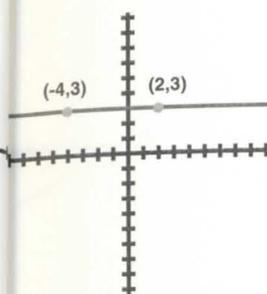
$X = 3$
looks like this:



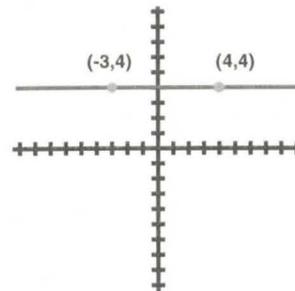
$X = 2$
looks like this:



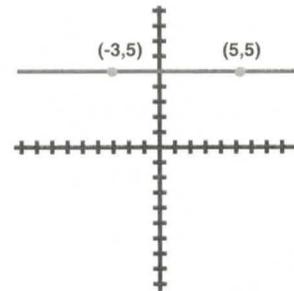
$Y = 3$
looks like this:



$Y = 4$
looks like this:

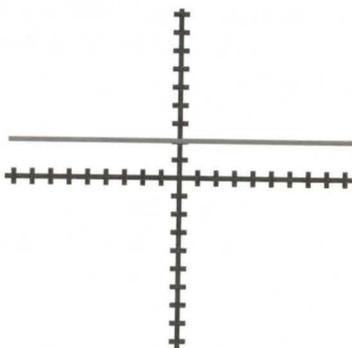


$Y = 5$
looks like this:



A fixed Y axis, such as $Y = 2$, is a line drawn through the Y axis at 2. Regardless of all X values, Y will still be 2.

$Y = 2$ looks like this:



As you change the Y value, the line moves 1 space up or down. Increasing the Y value moves the line up and decreasing the Y value moves the line down.

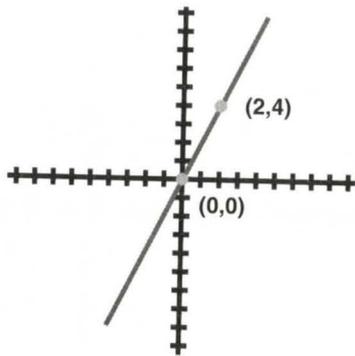
Linear Functions:

Linear functions are a little more complicated. These functions deal with ratios or slopes between X and Y. The slope of a line is the amount of change in Y over the amount of change in X. As the X multiplier (the number in the function that multiplies X) increases, the slope of a line becomes steeper (approaching a vertical line). As the Y multiplier increases, the slope of a line becomes flatter (approaching a horizontal line).

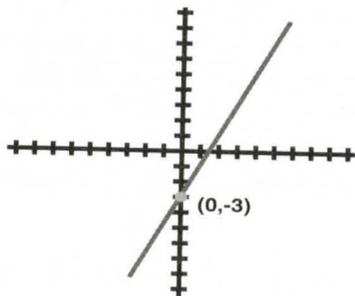
The function $Y = 2X$ has a ratio of two to one. This means that every time X increases, Y increases twice as much. Every time X decreases, Y decreases twice as much. We calculate the slope of a line by taking the X multiplier (the number in the function that multiplies X) and dividing it by the Y multiplier. For example, the slope of $Y = 2X$ is 2, because $2 \div 1 = 2$.

Let's draw some more functions together. To do this, we find two points that satisfy the function and connect them with a straight line. Suppose $X = 0$. In $Y = 2X$, this gives us $Y = 2 \cdot 0$ which equals 0. Therefore, when $X = 0$, $Y = 0$. We write this ordered pair like this (0,0). Suppose $X = 2$, then $Y = 2 \cdot 2$ which equals 4. This ordered pair is (2,4). We plot these two ordered pairs on the graph and then draw a line through them.

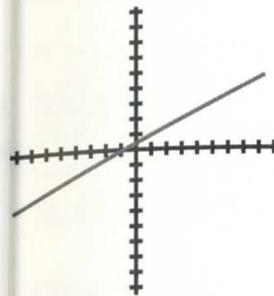
Therefore, graphing the function $Y = 2X$ looks like this:



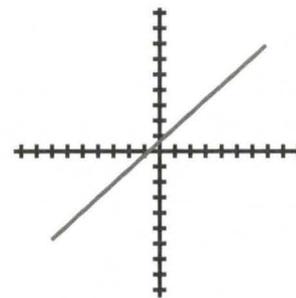
Graphing the function $Y = 2X - 3$ looks like this:



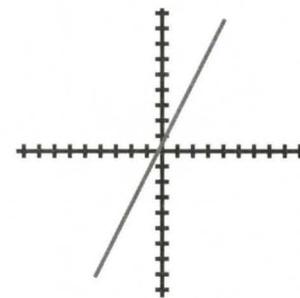
$2Y = X + 1$
looks like this:



$2Y = 2X + 1$
looks like this:



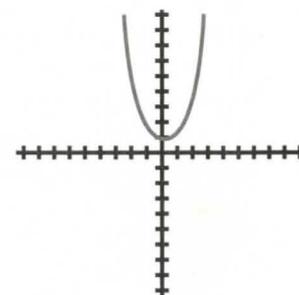
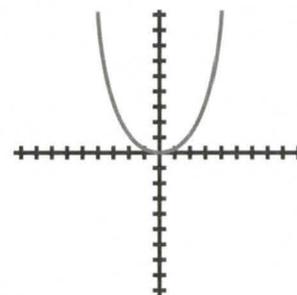
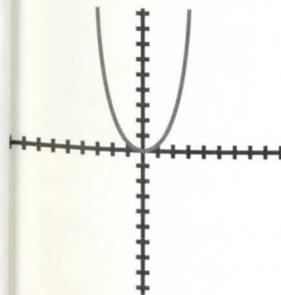
$Y = 2X + 1$
looks like this:



Polynomial Functions:

Polynomials are functions where Y is evaluated to some combination of powers of X . We use the base function $aY = bX^2 + cX + d$ where a , b , c , and d are integer multipliers of X and Y . This type of function creates a curved line known as a parabola. As the Y multiplier increases, the parabola widens. As the X^2 multiplier increases, the parabola narrows. As the X multiplier increases or decreases, the parabola moves left or right. As the d value increases or decreases, the parabola moves up or down. Examples:

$$1Y = 1X^2 + 0X + 0 \quad 2Y = 1X^2 + 0X + 0 \quad 2Y = 2X^2 + 2X + 2$$



Now What?

The gear and chain system used to move the elevator in the gear puzzle is called a chain drive. You may recognize the chain drive from an old friend of yours: the bicycle! To help us talk about chain drives, let's define a few words with your bicycle as an example.

First, we'll call the gear which your pedals are attached to the input gear. The gear on the rear wheel of your bicycle is called the output gear. In the gear puzzle, the input gear is peddled by the robot rat, while the output gear actually moves the elevator.

The simplified elevator in the puzzle has a counterweight which weighs just about the same as the elevator itself. To see how the elevator works, imagine trying to lift a bucket with several 2-liter bottles of soda up to your treehouse. You could throw a rope over a tree branch, tie the bucket of soda on one end of the rope and then tie a bucket of water on the other end. Then when you lift the bucket of soda, the bucket of water would move downward (which the bucket of water wants to do!). This helps you lift the bucket of soda; in fact, instead of lifting the weight of the sodas, now you are lifting the weight of the soda minus the weight of the water.

For this "treehouse elevator", the bucket of water is a "counterweight". The elevator and its counterweight work the same way, since the counterweight reduces the weight the robot rat needs to lift. In the gear puzzle, Dr. Brain made the counterweight weigh just a bit more than the elevator to make things hard for you. This way, the robot rat has to lift the counterweight in order to lower the elevator.

The chain drive in the puzzle works just like the one on your bicycle. Think about how you use the gears on your bicycle: if you need to climb a hill, you choose a large output gear on the rear wheel. In the puzzle, the robot rat is not lifting himself up a hill

like a bicycle rider, but he still needs to lift a weight (the counterweight). Thus, the rat will need a large output gear to enable him to lift the counterweight and lower the elevator.

If you'd like to know more about how a chain drive actually helps a robot rat lift a weight or a bicycle rider travel quickly on flat surfaces, see the next section entitled *As a Matter of Fact*.

As a Matter of Fact...

First, let's define a few phrases which will help us understand how a chain drive works. There are two kinds of force which a chain drive uses: turning force and push-pull force. A turning force can turn things like wheels and gears; you generate a turning force on the input gear of your bicycle when you pedal it. Engineers call a turning force "torque" or "moment". A push-pull force is just what it sounds like: a force which pushes or pulls things. You generate a push-pull force when you push your bicycle up a hill that is too steep to ride up. Another important phrase is "rotational speed", which is just a fancy way of saying how fast a gear or wheel spins around.

A chain drive can be thought of as a machine which changes turning force and rotational speed. For example, when you ride your bicycle, a large output gear on the rear wheel generates more turning force at the rear wheel which can help you climb a hill. The tradeoff is that the rotational speed of the output gear is reduced, and so your bicycle moves slowly. On the other hand, if a small output gear is used you must push hard on the pedals since the small gear does not generate as much turning force as a large gear. But as you know, a small output gear can make your bicycle go FAST! Your bicycle moves faster because the small output gear has a high rotational speed compared to a large output gear.



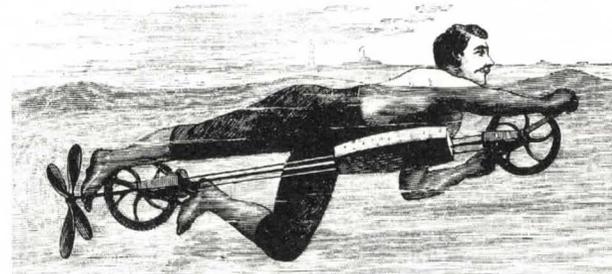
To help explain the change in speed that a chain drive produces, imagine watching the chain drive on your bicycle as it works. Pretend you can see the chain drive in slow motion, and that one link in the chain is painted red so that you can watch as it moves around the gears. The red link starts on the top between the two gears and moves towards the large input gear (the one you pedal). Then the red link touches the top of the input gear, moves around to the bottom of the input gear, leaves the input gear and travels to the output gear on the rear wheel of your bike. After the link touches the bottom of the small output gear, it must travel only a short ways before it leaves the top of the output gear. Thus, the small gear must turn several times for each time the large gear turns just to keep up! This is why small output gears make your bike go faster: they make your rear wheel spin fast. A large output gear does not need to turn as much to keep up with the input gear, and so your bike will not move as quickly.

A chain drive also can change the turning force at the rear wheel of your bike, but this is harder to explain. First of all, remember that turning force turns things like gears and bolts. Now imagine you are using a wrench to turn a bolt. Your hand and arm are actually pushing or pulling on the wrench, but the bolt is turning. The wrench helps you create a turning force on the bolt with only the push-pull force your hand and arm provides. The longer the wrench, the more turning force you can deliver to the bolt; this is why a longer wrench can help you turn a rusty, stubborn bolt. An engineer might call the wrench a “moment arm” (remember that a fancy name for turning force is “moment”). Notice that this change of push-pull force to turning force can also work in the other direction. For example, if the bolt were being turned by some turning force like an engine, then the wrench would push against your hand and arm.

To help see how a chain drive changes turning forces, imagine each tooth on the input gear of your bicycle as a wrench, so that

the gear is nothing more than a group of wrenches. As the chain drive works, each wrench (gear tooth) attaches to a chain link as the link touches the top of the gear. The gear turns and the wrench (gear tooth) releases the link when it reaches the bottom of the gear.

Now imagine you are pedaling the bicycle. Your feet provide turning force to the input gear. The turning force you produce is converted by the imaginary wrenches (the gear) to a push-pull force on the chain itself. The chain then “carries” this push-pull force to the output gear. The chain delivers push-pull force to the output gear, just like your hand delivers push-pull force to a wrench. And like the wrench you push with your hand, the output gear converts the push-pull force carried by the chain to a turning force at the rear wheel. If the output gear is smaller than the input gear, less turning force is delivered to the rear wheel than you produced at the input gear. This is okay though; remember that the output gear is also turning faster! If you were to change to a larger output gear, it’s like using a longer wrench to turn a bolt: more turning force is created at the rear wheel. An engineer would say that a large output gear provides a larger “moment arm” than a small output gear.



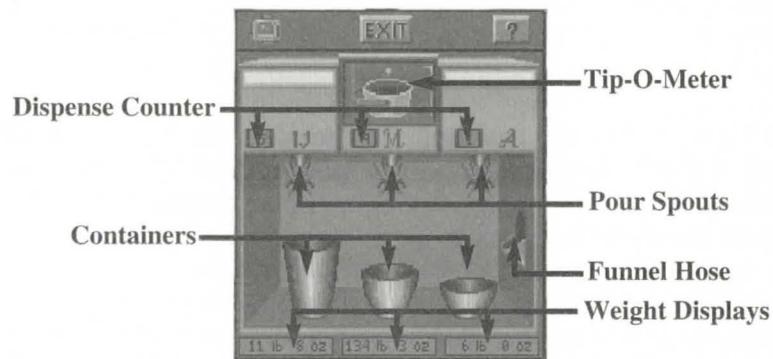
Things to Do...

If you found this explanation of chain drives interesting, you should look for physics classes that your school provides. Physics classes can help you to understand how machines work; for example, a pulley system could make the robot rat’s job even easier.

Related Terms...

Mechanical Advantage Pulleys Push-Pull Force Rotational Speed

MEASURING DR. BRAIN'S COUNTERWEIGHT



Tip-O-Meter: This display shows the funnel hose leading into the three sections of the counterweight below. On easy level, as you fill a container with a specified liquid, you'll notice the funnel hose will shift to the appropriate section to be filled. On expert level, take care filling each section of the counterweight because if you fill the left or right sections unevenly, the liquid will spill out of the counterweight. This is shown on the Tip-O-Meter.

Pour Spouts: There are three different liquids in Dr. Brain's fountain: W = Water, M = Mercury, and A = Alcohol.

Dispense Counter: There are a limited number of dispenses for each kind of liquid. This display indicates how many pours are left for each dispenser. Depending on the container you select, a pour spout will dispense a cup, quart, or gallon.

Containers: There are three containers: gallon, quart, and cup.

Funnel Hose: After filling a container, pour it into this funnel opening. The funnel is attached to a long hose which leads to one of the three sections in the counterweight below.

Weight Displays: The three weight displays correspond to the three sections of the counterweight. When you first start the puzzle, each display will show you the total amount of weight needed in each section of the counterweight to complete the puzzle.

As a matter of Fact...

Since you are given the weight of a cup of each kind of liquid, you can calculate how much a quart and gallon of each liquid weighs yourself.

First of all, there are four cups in a quart and sixteen cups in a gallon. Therefore, to get the weight of a quart, take the weight of each cup and multiply it by 4. And to get the weight of a gallon, take the weight of each cup and multiply it by 16.

Let's calculate the weights of a quart and gallon of water together. A cup of water weighs 8 ounces. Therefore, a quart weighs 4 (cups) X 8 (ounces in a cup) which equals 32 (ounces in a quart). Since a pound weighs 16 ounces, a quart of water weighs 2 pounds because $32 \text{ (ounces in a quart)} \div 16 \text{ (ounces in a pound)} = 2 \text{ (pounds)}$. Since there are four quarts in a gallon, a gallon of water weighs 2 (pounds in a quart) X 4 (quarts in a gallon) or 8 pounds. You could also calculate this in ounces by multiplying 8 (ounces in a cup) X 16 (cups in a gallon) to get 128 ounces.

On easy level, you can figure out which of the containers you'll use. First, subtract the weight of the heaviest container first. For example, suppose the counterweight total for water was 10 pounds. Subtract the weight of one gallon (or 8 pounds) from the total weight, $10 - 8$ and you're left with 2 pounds. Therefore, fill up a gallon of water and pour it into the funnel hose. Your weight display for water will now equal 2 pounds. Now look at your dispense counter beside the water pour spout. Compare it to the weight value on the weight display for water. If your dispense counter is 1, then fill up a quart (since a quart of water weighs 2 pounds) and pour it into the funnel hose. However, if your dispense counter is 4, you have two choices. You could fill up a quart (since a quart of water weighs 2 pounds) or you could fill up four cups (since 4 cups of water also equals 2 pounds) and pour them into the funnel hose.

Related Terms...

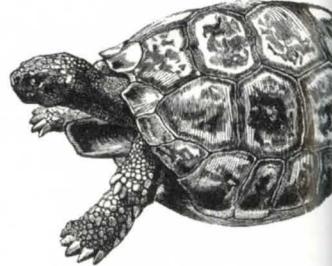
Cup Mercury Quart Water Gallon Alcohol

THE VOLCANO STACK COMPUTER (VSC) CONSOLE

Now What?

The Volcano Stack Computer's (VSC) sole function is to ensure that too much pressure doesn't build up inside Dr. Brain's volcano (thereby causing a pressure overload). Unfortunately, when you crossed over to the mountain top in the middle of the game, the VSC short-circuited and such a condition occurred. Thus repairing the VSC will involve three basic steps as follows:

- 1) Determine which computer chip is the problem,
- 2) Use the Integrated Scanner (IS) for further chip analysis, and
- 3) Use the Circuit Programmer (CP) for programming a replacement chip.



For detailed procedure information, see the sections entitled *At the VSC Console*, *At the Integrated Scanner (IS)*, and *At the Circuit Programmer (CP)*.

It takes a creative mind, persistence and perseverance, and good organizational skills to succeed in designing the Volcano Stack Computer (VSC) chip from the logic gates and tools provided. To ensure your success, you may wish to follow a good Experimental Plan. Many successful Project Engineers often follow such a plan. An example Experimental Plan Checklist is provided for you in Table 1.

Table 1 *An Experimental Plan Checklist*

| | |
|--------------------|---|
| Objective | Repair the VSC Console before the volcano explodes. |
| Preparation | Learn the following logic gates: OR, NOR, AND, NAND, X-OR, X-NOR and NOT (INVERTER). Study the example completed circuit in Figure 2. |
| Instruments | Become familiar with VSC Console operation as well as IS and CP functions. |
| Setup | Use your best educated "guess" to determine the |

logic gates you'll use. Make a list of your predictions and your expected results. Compare them to your final results.

Conditions

Remember this safety precaution: **WARNING!** Unsuccessful repair of the VSC will result in dire consequences.

Operation

Before ever installing a new chip in the VSC console, perform a comparison test in the IS. Often Project Engineers can delegate these tasks to other qualified personnel. However, since you're Dr. Brain's only lab assistant, you'll need to perform this task yourself.

Personnel

Conclusion

Have you met your original objective? (Is the VSC repaired?) If not, examine the following criteria: your prediction, your results, accuracy of your work, and analysis of the example circuit.

At the VSC Console

To repair the VSC, begin with the following:

1. Determine which chip is damaged. Look for smoke or sparks.
2. Carefully remove the damaged chip using the Hand cursor.

At the Integrated Scanner (IS)

The three functions of the Integrated Scanner (IS) are as follows: to analyze and test computer chips for damage, to display the logic of the chip's programming, and to compare other computer chips' logic for analysis.

To use the IS, perform the following:

1. Place damaged chip in chip holder.
2. Press the Test button.
3. Study the logic of the damaged chip.

At the Circuit Programmer (CP)

The Circuit Programmer (CP) is used to program a blank chip with logic structures you create from logic gates. If you're not familiar with a logic gate, place it in the Test area to see a display of its logic on a truth table.

To use the CP, perform the following:

1. Select a logic gate.
2. Place this logic gate in the Test area (to determine its logic).
3. Compare the logic of the logic gate in the Test area to the logic of the damaged chip in the Integrated Scanner.
4. If the logic of the logic gate in the Test area doesn't match the logic of the damaged chip in the Integrated Scanner, select another logic gate and place it in the test area.
5. Repeat Steps 3 and 4 until a correct logic gate is found.
6. Once the correct gate is found, remove it from the Test box and place it in the Logic Gate Construction area.
[NOTE: Standard and Expert Players will place two or more logic gates to complete the programming of the chip.]
7. Press the Program button to program the new chip.
8. Remove the new chip from the Circuit Programmer chip holder.
9. Place the new chip in the chip holder of the Integrated Scanner.
10. Press the Test button of the Integrated Scanner (to perform the comparison test).
11. If your chip passes the comparison test, place it in the Volcano Stack Control Panel.

Congratulations! You've successfully repaired the VSC.

As a Matter of Fact...

Computers contain components called logic gates that are linked together to perform electronic calculations. In fact, logic gates are used in transistor logic units as well as logic chips. They are different from resistors, capacitors, and inductors in that they do not react to continuous voltages, but rather, respond to discrete voltage ranges. The purpose of a logic gate is to put out a response based upon a combination of its inputs.

Logic gates have two outputs: voltage (1) or no voltage (0). This output is dependent on the combination of two inputs: voltage (1) or no voltage (0). For instance, with an AND gate, both inputs must have voltage input in order to have a voltage output. In the truth tables and Karnaugh maps, voltage is indicated by a 1 and no voltage is indicated by a 0. When you repair the Volcano Stack Computer (VSC), you're experimenting with different kinds of logic gates.

If you're unfamiliar with logic gates, consult Figure 1. You may also wish to study an accurate, working, completed logic gate construction for the VSC. Figure 2 gives an example.

NOT (INVERTER) gate - The output of a NOT gate is a 1 if the input is a 0, and a 0 if the input is a 1.



AND gate - The output of an AND gate is a 1 if and only if all inputs are 1's.



OR gate - The output of an OR gate is a 1 if one or more of the inputs is a 1.



X-OR gate - The output of an X-OR gate is a 1 if one and only one of the inputs is a 1.



NAND gate - The output of a NAND gate is a 0 if both inputs are 1's.



NOR gate - The output of a NOR gate is a 1 if both inputs are 0's.



X-NOR gate - The output of an X-NOR gate is a 1 if both inputs are identical (either both 1's or 0's).



Figure 1 *Becoming Familiar with Logic Gates*

Easy Level

Let's look at a couple of example logic gates and examine their truth tables together. First, let's examine an OR gate. Sending all possible combinations of input (A and B) through the OR gate, the output is 1 if one or more of the inputs is a 1.

| (Inputs) | | Output |
|----------|---|--------|
| B | A | |
| 0 | 0 | 0 |
| 0 | 1 | 1 |
| 1 | 0 | 1 |
| 1 | 1 | 1 |



Learn the pattern in each of these rows for an OR gate.

For our second example, we will use an AND gate. Sending all possible combination of inputs (A and B) through the AND gate, the output is a 1 only if both inputs are 1.

| (Inputs) | | Output |
|----------|---|--------|
| B | A | |
| 0 | 0 | 0 |
| 0 | 1 | 0 |
| 1 | 0 | 0 |
| 1 | 1 | 1 |



Learn the pattern in each of these rows for an AND gate.

You can learn the different truth tables for each logic gate using the tester on the Circuit Programmer of the Volcano Stack Computer puzzle.

Standard Level

If we increase the number of inputs and gates used to program the volcano chip, it affects both the size of the corresponding truth table and the output. For our example, let's examine the following truth table.

| (Inputs) | | | | Output |
|----------|---|---|---|--------|
| C | B | A | | |
| 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 1 | 0 | 0 |
| 0 | 1 | 0 | 0 | 0 |
| 0 | 1 | 1 | 1 | 1 |
| 1 | 0 | 0 | 1 | 1 |
| 1 | 0 | 1 | 1 | 1 |
| 1 | 1 | 0 | 1 | 1 |
| 1 | 1 | 1 | 1 | 1 |

Look for a repeating pattern in each of the rows.

Notice that there are now eight rows in our truth table. First, we look for a consistent pattern in each of the rows of the truth table Output column. The first three rows are all 0's and the last five rows are all 1's. Comparing these to each of our logic gates, we see that no single logic gate will give us the desired output. Therefore, we have a new problem: how do we put two gates together to get the desired result?

Well, we begin by selecting a gate, then testing two of the inputs, such as A and B, or A and C, or B and C. We chart our results in a temporary column, T. (As you experiment with the volcano stack computer, you may wish to write this step down. However, as you become familiar with the logic gates, you will be doing this step in your head.)

Let's test inputs A and B using an AND gate. We get the following:

| (Inputs) | | | T |
|----------|---|---|---|
| B | A | | |
| 0 | 0 | 0 | 0 |
| 0 | 1 | 0 | 0 |
| 1 | 0 | 0 | 0 |
| 1 | 1 | 1 | 1 |
| 0 | 0 | 0 | 0 |
| 0 | 1 | 0 | 0 |
| 1 | 0 | 0 | 0 |
| 1 | 1 | 1 | 1 |



Look for a repeating pattern in each of the rows

Now we compare our temporary column, T, to our other input column C using another gate. In this case, let's try an OR gate. We get the following:

| (Inputs) | | | Output |
|----------|---|---|--------|
| C | T | | |
| 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 |
| 0 | 1 | 1 | 1 |
| 1 | 0 | 1 | 1 |
| 1 | 0 | 1 | 1 |
| 1 | 0 | 1 | 1 |
| 1 | 1 | 1 | 1 |



Compare your Output column to the original Output

Since our output column matches the original output column, we see that the use of an OR gate with inputs A and B connected to an AND gate with input C will give the desired result. Therefore, our solution uses a combination of both the AND and OR gates as follows:

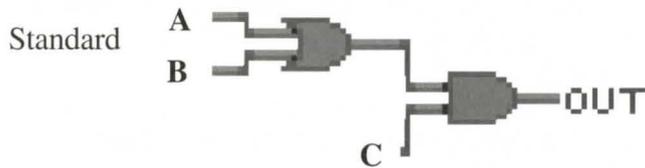


Figure 2 Example of Completed Circuit

You may experiment with these kinds of structures in the Standard and Expert level of the Volcano Stack Computer.

Related Terms..

Capacitor Resistor Truth table Karnaugh map

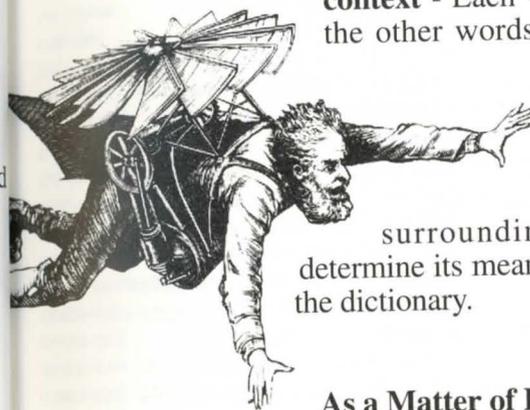
DR. BRAIN'S LANGUAGE GARDEN — CHOOSING JUST THE RIGHT WORD

Now What?

Using just the right word is important in writing. In fact, one of the best ways to improve your reading and writing skills is to improve your vocabulary. There are many things you can do to improve your vocabulary. Here are three important steps to take.

Use a dictionary - If you're unsure what a word means, look it up in the dictionary rather than guess its meaning. When you do, look at all the meanings listed, not just the first one. This will give you the complete definition and expand your vocabulary at the same time. Also, check the pronunciation of the words you look up. It is much easier to remember the definition of a word if you know how to pronounce it.

Use a thesaurus - A thesaurus can be a great help for improving your vocabulary. Next time you're feeling creative, rather than settle for just any word to describe something, use your thesaurus to find a synonym for that word. A really great thesaurus is Roget's University Thesaurus. Instead of organizing words alphabetically, it groups words according to the ideas they express. You will learn much from this source.



Learn unfamiliar words as they're used in context

- Each word you read depends on the other words in the sentence to make sense. These words make up the context of a word. Next time you read an unfamiliar word, examine the words surrounding it to see if you can determine its meaning before looking it up in the dictionary.

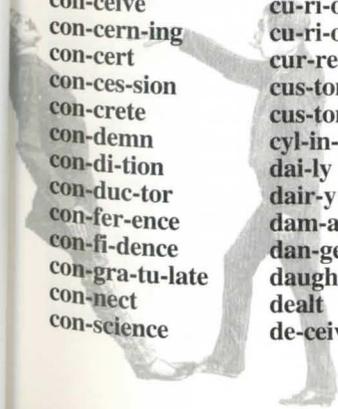
As a Matter of Fact...

Here is a list of some commonly misspelled words. To help you pronounce and spell the words in the following list, they are divided into syllables. This list is also useful for those writing assignments when you aren't sure where to divide a word at the end of a line. However, never leave a single letter on a line by itself i.e., a-fraid.

- | | | | |
|---------------------|------------------|---------------------|---------------|
| ab-bre-vi-ate | ac-count | ad-ver-tise (-ment) | al-co-hol |
| a-board | ac-cu-rate | ad-ver-tis-ing | a-like |
| a-bout | ac-cus-tom (-ed) | a-fraid | a-live |
| a-bove | ache | af-ter | al-ley |
| ab-sence | a-chieve (-ment) | af-ter-noon | al-low-ance |
| ab-sent | a-cre | af-ter-ward | all right |
| ab-so-lute (-ly) | a-cross | a-gain | al-most |
| a-bun-dance | ac-tu-al | a-against | al-read-y |
| ac-cel-er-ate | a-dapt | a-gree (-ment) | al-though |
| ac-ci-dent | ad-di-tion (-al) | a-gree-able | al-to-geth-er |
| ac-ci-den-tal (-ly) | ad-dress | ah | a-lu-mi-num |
| ac-com-pa-ny | ad-e-quate | aid | al-ways |
| ac-com-plice | ad-just (-ment) | air-y | am-a-teur |
| ac-com-plish | ad-mire | aisle | am-bu-lance |
| ac-cord-ing | ad-ven-ture | a-larm | a-mend-ment |

| | | | |
|------------------|-----------------|-----------------|-----------------------|
| a-mong | ar-ti-cle | be-fore | cab-bage |
| a-mount | ar-ti-fi-cial | be-gan | caf-e-ter-i-a |
| an-a-lyze | a-sleep | beg-gar | cal-en-dar |
| an-cient | as-sas-sin | be-gin-ning | cam-paign |
| an-gel | as-sign (-ment) | be-have | ca-nal |
| an-ger | as-sis-tance | be-hav-ior | can-celed |
| an-gle | as-so-ci-ate | be-ing | can-di-date |
| an-gry | as-so-ci-a-tion | be-lief | can-dle |
| an-i-mal | as-sume | be-lieve | can-i-ster |
| an-ni-ver-sa-ry | ath-lete | be-long | can-non |
| an-nounce | ath-let-ic | be-neath | can-not |
| an-noy-ance | at-tach | ben-e-fit (-ed) | ca-noe |
| an-nu-al | at-tack (-ed) | be-tween | can't |
| a-non-y-mous | at-tempt | bi-cy-cle | can-yon |
| an-oth-er | at-ten-dance | bis-cuit | ca-pac-i-ty |
| an-swer | at-ten-tion | black-board | cap-tain |
| ant-arc-tic | at-ti-tude | blan-ket | car-bu-re-tor |
| an-tic-i-pate | at-tor-ney | bliz-zard | card-board |
| anx-i-ety | at-trac-tive | both-er | ca-reer |
| anx-ious | au-di-ence | bot-tle | care-ful |
| an-y-bod-y | Au-gust | bot-tom | care-less |
| an-y-how | au-thor | bough | car-pen-ter |
| an-y-one | au-thor-i-ty | bought | car-riage |
| an-y-thing | au-to-mo-bile | bounce | car-rot |
| an-y-way | au-tumn | bound-a-ry | cash-ier |
| any-where | a-vail-a-ble | break-fast | cas-se-role |
| a-part-ment | av-e-nue | breast | cas-u-al-ty |
| a-piece | av-er-age | breath (n.) | cat-a-log |
| a-pol-o-gize | aw-ful (-ly) | breathe (v.) | ca-tas-tro-phe |
| ap-par-ent (-ly) | awk-ward | breeze | catch-er |
| ap-peal | bag-gage | bridge | cat-er-pil-lar |
| ap-pear-ance | bak-ing | brief | cat-sup |
| ap-pe-tite | bal-ance | bright | ceil-ing |
| ap-pli-ance | bal-loon | bril-liant | cel-e-bra-tion |
| ap-pli-ca-tion | bal-lot | broth-er | cem-e-ter-y |
| ap-point-ment | ba-nan-a | brought | cen-sus |
| ap-pre-ci-ate | ban-dage | bruise | cen-tu-ry |
| ap-proach | bank-rupt | bub-ble | cer-tain |
| ap-pro-pri-ate | bar-ber | buck-et | cer-tain (-ly) |
| ap-pro-val | bar-gain | buck-le | cer-tif-i-cate |
| ap-prox-i-mate | bar-rel | bud-get | chal-lenge |
| ar-chi-tect | base-ment | build-ing | cham-pi-on |
| arc-tic | ba-sis | bul-le-tin | change-a-ble |
| aren't | bas-ket | buoy-ant | char-ac-ter (-is-tic) |
| ar-gu-ment | bat-te-ry | bu-reau | chief |
| a-rith-me-tic | beau-ti-ful | bur-glar | chil-dren |
| a-round | beau-ty | bur-y | chim-ney |
| a-rouse | be-cause | bus-i-ness | choc-o-late |
| ar-range (-ment) | be-come | bus-y | choice |
| ar-riv-al | be-com-ing | but-ton | cho-rus |

| | | | |
|----------------------|-----------------|------------------|------------------|
| cir-cum-stance | con-scious | de-ci-ded | di-vi-sion |
| cit-i-zen | con-ser-va-tive | de-ci-sion | doc-tor |
| civ-i-li-za-tion | con-sti-tu-tion | dec-la-ra-tion | doesn't |
| class-mates | con-tin-ue | dec-o-rate | dol-lar |
| class-room | con-tin-u-ous | de-fense | dor-mi-to-ry |
| cli-mate | con-trol | def-i-nite (-ly) | doubt |
| climb | con-tro-ver-sy | def-i-ni-tion | dough |
| clos-et | con-ve-nience | de-li-cious | du-al |
| cloth-ing | con-vince | de-pen-dent | dup-li-cate |
| coach | cool-ly | de-pot | ea-ger (-ly) |
| co-coa | co-op-er-ate | de-scribe | econ-o-my |
| co-coon | cor-po-ra-tion | de-scrip-tion | edge |
| cof-fee | cor-re-spond | de-serve | e-di-tion |
| col-lar | cough | de-sign | ef-fi-ci-en-cy |
| col-lege | couldn't | de-sir-a-ble | eight |
| col-o-nel | coun-ter | de-spair | eigh-th |
| col-or | coun-ter-feit | des-ert | ei-ther |
| co-los-sal | coun-try | de-te-ri-o-rate | e-lab-o-rate |
| col-umn | coun-ty | de-ter-mine | e-lec-tric-i-ty |
| com-e-dy | cour-age | de-vel-op | el-e-phant |
| com-ing | cou-ra-geous | de-vel-op-ment | el-i-gi-ble |
| com-mer-cial | court | de-vice | el-lipse |
| com-mis-sion | cour-te-ous | de-vise | em-bar-rass |
| com-mit | cour-te-sy | di-a-mond | e-mer-gen-cy |
| com-mit-ment | cous-in | di-a-phragm | em-pha-size |
| com-mit-tee | cov-er-age | di-a-ry | em-ploy-ment |
| com-mu-ni-cate | co-zy | dic-tio-na-ry | en-close |
| com-mu-ni-ty | crack-er | dif-fer-ence | en-cou-rage |
| com-pan-y | crank-y | dif-fer-ent | en-gi-neer |
| com-par-i-son | crawl | dif-fi-cul-ty | e-nor-mous |
| com-pe-ti-tion | cred-i-tor | din-ing | e-nough |
| com-pe-ti-tive (-ly) | cried | di-plo-ma | en-ter-tain |
| com-plain | crit-i-cize | di-rec-tor | en-thu-si-as-tic |
| com-plete (-ly) | cru-el | dis-a-gree-a-ble | en-tire-ly |
| com-plex-ion | crumb | dis-ap-pear | en-trance |
| com-pro-mise | crum-ble | dis-ap-point | en-ve-lop (v) |
| con-ceive | cup-board | dis-ap-prove | en-ve-lope (n) |
| con-cern-ing | cu-ri-o-si-ty | dis-as-trous | en-vi-ron-ment |
| con-cert | cu-ri-ous | dis-ci-pline | e-quip-ment |
| con-ces-sion | cur-rent | dis-cov-er | e-quipped |
| con-crete | cus-tom-er | dis-cuss | e-quiv-a-lent |
| con-demn | cyl-in-der | dis-cus-sion | es-cape |
| con-di-tion | dai-ly | dis-ease | es-pe-cial-ly |
| con-duc-tor | dair-y | dis-sat-is-fied | es-sen-tial |
| con-fer-ence | dam-age | dis-tin-guish | es-tab-lish |
| con-fi-dence | dan-ger (-ous) | dis-tri-bute | ev-ery |
| con-gra-tu-late | daugh-ter | di-vide | ev-i-dence |
| con-nect | dealt | di-vine | ex-ag-ger-ate |
| con-science | de-ceive | di-vi-si-ble | ex-ceed |



ex-cel-lent
 ex-cept
 ex-cep-tion-al (-ly)
 ex-cite
 ex-er-cise
 ex-haust (-ed)
 ex-hi-bi-tion
 ex-is-tence
 ex-pect
 ex-pen-sive
 ex-per-i-ence
 ex-plain
 ex-pla-na-tion
 ex-pres-sion
 ex-ten-sion
 ex-tinct
 ex-traor-din-ar-y
 ex-treme (-ly)
 fa-cil-i-ties
 fa-mil-iar
 fam-i-ly
 fa-mous
 fas-ci-nate
 fash-ion
 fa-tigue (d)
 fau-cet
 fa-vor-ite
 fea-ture
 Feb-ru-ar-y
 fed-er-al
 fer-tile
 field
 fierce
 fi-er-y
 fif-ty
 fi-nal-ly
 fi-nan-cial (-ly)
 fol-i-age
 for-ci-ble
 for-eign
 for-feit
 for-mal (-ly)
 for-mer (-ly)
 forth
 for-tu-nate
 for-ty
 for-ward
 foun-tain
 fourth
 frag-ile

freight
 friend (-ly)
 fright-en
 ful-fill
 fun-da-men-tal
 fur-ther
 fur-ther-more
 gad-get
 gauge
 gen-er-al-ly
 gen-er-ous
 ge-nius
 gen-tle
 gen-u-ine
 ge-og-ra-phy
 ghet-to
 ghost
 gnaw
 gov-ern-ment
 gov-er-nor
 grad-u-a-tion
 gram-mar
 grate-ful
 grease
 grief
 gro-cer-y
 grudge
 grue-some
 guar-an-tee
 guard
 guard-i-an
 guess
 guid-ance
 guide
 guilt-y
 gym-na-si-um
 ham-mer
 hand-ker-chief
 han-dle (d)
 hand-some
 hap-haz-ard
 hap-pen
 hap-pi-ness
 ha-rass
 hast-i-ly
 hav-ing
 haz-ard-ous
 head-ache
 height
 hem-or-rhage

hes-i-tate
 his-to-ry
 hoarse
 hol-i-day
 hon-or
 hop-ing
 hop-ping
 hor-ri-ble
 hos-pi-tal
 hu-mor-ous
 hur-ried-ly
 hy-drau-lic
 hy-giene
 hymn
 i-ci-cle
 i-den-ti-cal
 il-leg-i-ble
 il-lit-e-rate
 il-lus-trate
 im-ag-i-nar-y
 im-ag-i-na-tive
 im-ag-ine
 im-i-ta-tion
 im-me-di-ate (-ly)
 im-mense
 im-mi-grant
 im-mor-tal
 im-pa-tient
 im-por-tance
 im-pos-si-ble
 im-prove-ment
 in-con-ve-nience
 in-cred-i-ble
 in-def-i-nite-ly
 in-de-pen-dence
 in-de-pen-dent
 in-di-vid-u-al
 in-dus-trial
 in-fe-ri-or
 in-fi-nite
 in-flam-ma-ble
 in-flu-en-tial
 in-i-tial
 in-i-ti-a-tion
 in-no-cence
 in-no-cent
 in-stal-la-tion
 in-stance
 in-stead
 in-sur-ance

in-tel-li-gence
 in-ten-tion
 in-ter-est-ed
 in-ter-est-ing
 in-ter-fere
 in-ter-pret
 in-ter-rupt
 in-ter-view
 in-ves-ti-gate
 in-vi-ta-tion
 ir-ri-gate
 is-land
 is-sue
 jeal-ous (-y)
 jew-el-ry
 jour-nal
 jour-ney
 judg-ment
 juic-y
 kitch-en
 knew
 knife
 knives
 knock
 knowl-edge
 knuck-les
 la-bel
 lab-o-ra-to-ry
 la-dies
 lan-guage
 laugh
 laun-dry
 law-yer
 league
 lec-ture
 le-gal
 leg-i-ble
 leg-i-sla-ture
 lei-sure
 length
 li-a-ble
 li-brar-y
 li-cense
 lieu-ten-ant
 light-ning
 lik-able
 like-ly
 li-quit
 lis-ten
 lit-er-a-ture

liv-ing
 loaves
 lone-li-ness
 loose
 lose (r)
 los-ing
 lov-a-ble
 love-ly
 ma-chin-er-y
 mag-a-zine
 mag-nif-i-cent
 main-tain
 ma-jor-i-ty
 mak-ing
 man-u-al
 man-u-fac-ture
 mar-riage
 ma-te-ri-al
 math-e-ma-tics
 max-i-mum
 may-or
 meant
 mea-sure
 med-i-cine
 med-i-um
 mes-sage
 mile-age
 min-i-a-ture
 min-i-mum
 min-ute
 mir-ror
 mis-cel-lan-e-ous
 mis-chie-vous
 mis-er-a-ble
 mis-sile
 mis-spell
 mois-ture
 mol-e-cule
 mon-o-to-nous
 mon-u-ment
 mort-gage
 moun-tain
 mus-cle
 mu-si-cian
 mys-te-ri-ous
 na-ive
 nat-u-ral (-ly)
 nec-es-sar-y
 ne-go-ti-ate
 neigh-bor (-hood)

nei-ther
 nick-el
 niece
 nine-teen
 nine-teenth
 nine-ty
 nois-y
 no-tice-a-ble
 nu-cle-ar
 nu-i-sance
 o-be-di-ence
 o-bey
 ob-sta-cle
 oc-ca-sion
 oc-ca-sion-al (-ly)
 oc-cur
 oc-curred
 of-fense
 of-fi-cial
 of-ten
 o-mis-sion
 o-mit-ted
 o-per-ate
 o-pin-ion
 op-po-nent
 op-por-tu-ni-ty
 op-po-site
 or-di-nar-i-ly
 orig-i-nal
 out-ra-geous
 pack-age
 paid
 pam-phlet
 par-a-dise
 par-a-graph
 par-al-lel
 par-a-lyze
 pa-ren-the-ses
 par-tial
 par-tic-i-pant
 par-ti-ci-pate
 par-ti-cu-lar (-ly)
 pas-time
 pas-ture
 pa-tience
 pe-cu-liar
 peo-ple
 per-haps
 per-ma-nent
 per-pen-dic-u-lar

per-sis-tent
 per-son-al (-ly)
 per-son-nel
 per-spi-ra-tion
 per-suade
 phase
 phy-si-cian
 piece
 pitch-er
 planned
 pla-teau
 play-wright
 pleas-ant
 pleas-ure
 pneu-mo-nia
 pol-i-ti-cian
 pos-sess
 pos-si-ble
 prac-ti-cal (-ly)
 prai-rie
 pre-cede
 pre-cious
 pre-cise (-ly)
 pre-ci-sion
 pref-er-a-ble
 pref-erred
 prej-u-dice
 pre-par-a-tion
 pres-ence
 pre-vi-ous
 prim-i-tive
 prin-ci-pal
 prin-ci-ple
 pris-on-er
 priv-i-lege
 prob-a-bly
 pro-ce-dure
 pro-ceed
 pro-fes-sor
 prom-i-nent
 pro-nounce
 pro-nun-ci-a-tion
 pro-tein
 psy-chol-o-gy
 pump-kin
 pure
 quar-ter
 ques-tion-naire
 qui-et
 quite

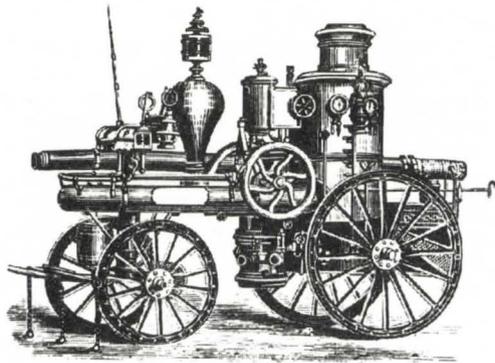
quo-tient
 raise
 re-al-ize
 re-al-ly
 re-ceipt
 re-ceive
 re-ceived
 rec-i-pe
 rec-og-nize
 rec-om-mend
 reign
 re-lieve
 re-li-gious
 re-mem-ber
 re-pe-tition
 rep-re-sen-ta-tive
 res-er-voir
 re-sis-tance
 re-spect-ful-ly
 re-spon-si-bi-li-ty
 res-tau-rant
 re-view
 rhyme
 rhythm
 ri-dic-u-lous
 route
 safe-ty
 sal-ad
 sal-a-ry
 sand-wich
 sat-is-fac-to-ry
 Sat-ur-day
 scene
 sce-ner-y
 sched-ule
 sci-ence
 scis-sors
 scream
 screen
 sea-son
 sec-re-ta-ry
 seize
 sen-si-ble
 sen-tence
 sep-a-rate
 sev-er-al
 sher-iff
 shin-ing
 sim-i-lar
 since

sin-cere (-ly)
ski-ing
sleigh
sol-dier
sou-ve-nir
spa-ghet-ti
spe-ci-fic
sphere
sprin-kle
squeeze
squir-rel
stat-ue
stat-ure
stat-ute
stom-ach
stopped
straight
strength
stretched
stud-y-ing
sub-tle
suc-ceed
suc-cess
suf-fi-cient
sum-ma-rize
sup-ple-ment
sup-pose
sure-ly
sur-prise

syl-la-ble
sym-pa-thy
symp-tom
tar-iff
tech-nique
tem-per-a-ture
tem-po-ra-ry
ter-ri-ble
ter-ri-to-ry
thank-ful
the-ater
their
there
there-fore
thief
thor-ough (-ly)
though
through-out
tired
to-bac-co
to-geth-er
to-mor-row
tongue
touch
tour-na-ment
to-ward
trag-e-dy
trea-sur-er
tried

tries
tru-ly
Tues-day
typ-i-cal
un-con-scious
un-for-tu-nate (-ly)
u-nique
uni-ver-si-ty
un-nec-es-sa-ry
un-til
us-a-ble
use-ful
us-ing
usu-al (-ly)
u-ten-sil
va-ca-tion
va-cuum
valu-a-ble
va-ri-ety
var-i-ous
veg-e-ta-ble
ve-hi-cle
very
vi-cin-i-ty
view
vil-lain
vi-o-lence
vi-si-ble
vi-si-tor

voice
vol-ume
vol-un-tary
vol-un-teer
wan-der
weath-er
Wed-nes-day
weigh
weird
wel-come
wel-fare
whale
where
wheth-er
which
whole
whol-ly
whose
width
wom-en
worth-while
wreck-age
writ-ing
writ-ten
yel-low



KNOW WHEN TO USE THE RIGHT WORD

a, an - *A* is used before words which begin with a consonant sound; *an* is used before words which begin with a vowel sound. *A pile, a dog, a history test, an aunt, an elevator, an honor.*

accept, except - The verb *accept* means "to receive." "Your mother would never *accept* that answer." The preposition *except* means "with the exception of." "All of the boys *except* Josh would do it." The verb *except* means "to exclude." "In the main dining hall, smoking is *excepted*. Therefore, please refrain from smoking."

affect, effect - *Affect* is always a verb; it means "to influence." "The raise *affected* us." *Affect* also means "to pretend or imitate." "Bruce *affects* a Scottish accent flawlessly." *Effect* can be a verb, but it is most often used as a noun. As a verb, *effect* means "to produce or make happen." "When will doctors *effect* a cure for the common cold?" As a noun, *effect* means "result." "Your insults had no *effect* on Alice."

allowed, aloud - The verb *allowed* means "permitted" or "let happen." "We weren't *allowed* to shout 'fire!' in the theater." *Aloud* is an adverb which means "in a normal voice." "Please do not read *aloud* in the library."

allusion, illusion - An *allusion* is a brief reference or mention of a famous person, place, thing, or idea. "She made an *allusion* to Shakespeare's 'Merchant of Venice'." An *illusion* is a false impression or idea. "It was an optical *illusion*."

a lot, alot, allot - *A lot* is colloquial when used for "many" or "much." "She was an okay substitute, but she accused us of talking *a lot*." *Alot* is a misspelling. *Allot* means "to apportion or give by some plan." "The judge *allotted* motel rooms for each member of the jury."

already, all ready - *Already* means "previously." "My little boy reads *already*." *All ready* means "completely ready." "After brushing his teeth for an hour, Andy was *all ready* for the dentist."

alright, all right - *Alright* is the incorrect spelling of *all right*. *All right* means "correct." "Her answers to the test questions were *all right*."

altogether, all together - *Altogether* means "completely." "This is *altogether* too much fun." *All together* means "in a group." "The holiday season is special because our family is *all together*."

among, between - *Among* is used when speaking of more than two persons or things. "As the three boys lay in the hospital itching furiously with poison oak, one said, 'I think there's a fungus *among* us.'" *Between* is used when speaking of only two. "One of the others scolded, 'Can't you tell the difference *between* a fungus and a rash?'"

amount, number - *Amount* refers to things which can be weighed or measured, but not counted. "Although she lost a large *amount* of blood, she survived the accident." *Number* refers to countable persons or things. "A *number* of bananas."

ant, aunt - *Ant* is an insect. "John collected *ants* for his ant farm." *Aunt* is a relative. "Aunt Edna will stay with us for three weeks."

ascent, assent - *Ascent* is "the act of rising." "The plane's *ascent* to thirty-thousand feet went as scheduled." *Assent* is "agreement." "The mayor's *assent* with the city council's plan to build a new city hall was sound."

bare, bear - *Bare* means "to be naked." "Without any leaves, the tree looked *bare*." A *bear* is a large, furry animal. "He ran from the *bear*." The verb *bear* means "to put up with" or "to carry." "Daryl could not *bear* being teased by Frances."

base, bass - *Base* is the foundation or the lower part of something. "The *base* of the pedestal was made of marble." *Bass* is a deep sound or tone. "The best player in that band was their *bass* player." *Bass* (rhymes with mass) is also a fish. "In the fishing tournament, he caught a nine-pound *bass*."

be, bee - *Be* is the verb. "Will you *be* coming to the party?" *Bee* is the insect. "When she sniffed the flower, a *bee* stung her on the nose."

beat, beet - *Beat* means "to strike, to defeat." "He *beat* on the drums all day long." A *beet* is the vegetable. "Grandma had a recipe for sugar *beets*."

berth, birth - *Berth* is a space or compartment. "She rode in one of the *berths* on the train." *Birth* is the process of being born. "She also gave *birth* on the train."

beside, besides - *Beside* means "by the side of." "She always sits *beside* the window." *Besides* (as an adverb) means "more." "*Besides*, your breath stinks." *Besides* (a preposition) means "except." "*Besides* you and me, who else knows about it?"

billed, build - *Billed* means either "to be given a *bill*" or "to have a beak." "That female flamingo is beautifully *billed*." The verb *build* means "to construct." "When are they going to *build* your new house?"

blew, blue - *Blew* is the past tense of blow. "Those strong winds *blew* the smog right out of our city, clear into the next state." *Blue* is the color. "Her favorite color is *blue*."

boar, bore - *Boar* is a wild pig. "The natives barbecued the wild *boar* for dinner." *Bore* means "to tire with dullness" or "to make a hole by drilling." "His lecture was so *boring*, we all fell asleep."

board, bored - A *board* is a piece of wood. "Are you going to use this *board* in your new project?" *Bored* can mean "to make a hole by drilling" or "to become weary or tired of something." "This metal panel needs three more holes *bored* into it."

brake, break - A *brake* is a device used to stop a vehicle. "Hit the *brakes* or we'll all die!" *Break* means "to split, crack, or destroy." "Step on a crack, *break* your mother's back."

bring, take - *Bring* means "to come (here) with." "'Bring me some meat between two slices of bread,' said the Earl of Sandwich." *Take* means "to go (there) with." "Don't forget to *take* your sunglasses with you to the beach."

by, buy - *By* means "near or through." "We can swim in the river *by* your house." *Buy* is a verb meaning "to purchase." "If you aren't going to *buy* the magazines, then don't read them."

can, may - *Can* means "to be able." "*Can* you shut up?" *May* means "to have permission." "*May* I eat one of your cookies?"

cannon, canon - A *cannon* is a big gun. "They fired the *cannon* on the Fourth of July." A *canon* is a rule or law made by an authority in a church or organization. "The *canons* of our club forbid that kind of behavior."

canvas, canvass - *Canvas* is a heavy cloth. "He painted on the *canvas*." *Canvass* means "to go among the people asking them for votes or opinions." "After *canvassing* the people in front of the mall, John concluded that no one knew who they wanted to be the next president."

capitol, capital - *Capitol* is used only when talking about "the building in which the state or national legislature assembles." All other meanings, including the cities in which the legislature assembles, are spelled *capital*.

cell, sell - *Cell* means "a small room" or "a small unit of life which makes up all plants and animals." "An amoeba is a one-*celled* animal." *Sell* means "to give up for a price." "Are you *selling* your piano?"

cent, sent, scent - *Cent* is a coin. "I won't give you one more *cent* for that candy bar." *Sent* is the past tense of "to send." "She was *sent* to bed without any supper." *Scent* is an odor or smell. "The basset hounds had again picked up the *scent* of the escaped convict just beyond the river."

chord, cord - *Chord* is used to mean "the sound when three or more musical tones are played at the same time," as a piano *chord*. "Have you learned to play *chords* on the piano?" A *cord* is a string, rope, or wire. "Don't let the puppy chew on the lamp *cord*."

chose, choose - *Chose* is the past tense of *choose*. "Please *choose* where you'd like to eat." "She *chose* an expensive restaurant."

coarse, course - *Coarse* means "rough or crude." "That sandpaper is too *coarse* for the surface of this table." *Course* means "a path or direction taken"; *course* also means "a class or series of studies." "What *courses* are you taking this semester?"

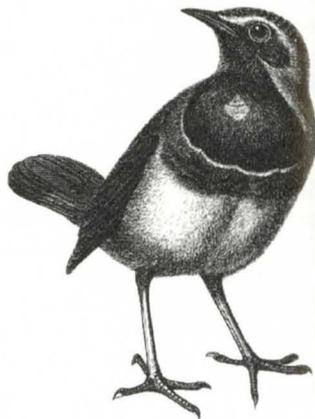
complement, compliment - *Complement* means "completes or goes with." "These illustrations will *complement* the story nicely." *Compliment* means to express admiration or praise. "My *compliments* to the chef."

continual, continuous - *Continual* means "frequently repeated." "He finished the game in spite of *continual* interruptions." *Continuous* means "without interruption." "They held hands on the beach listening to the *continuous* roar of the waves."

council, counsel, consul - *Council* means "a deliberative assembly of persons." "Our city *council* is incompetent." *Counsel* (noun) means "advice" or "attorney." "The *counsel* for the defense was a famous attorney." *Counsel* (verb) means "to give advice." "She will *counsel* him about career goals." *Consul* means "an officer in the foreign service." "Isn't that the distinguished Russian *consul*?"

creak, creek - *Creak* is a squeaking sound. "Oil that *creaky* chair!" *Creek* is a stream. "They swam in the *creek*."

cymbal, symbol - A *cymbal* is a metal instrument shaped like a plate. "Rob can really play that *cymbal* loudly." A *symbol* is something that stands



for or represents another thing or idea. "The lion is a *symbol* of courage."

dear, deer - *Dear* means "loved or valued." "Do be a *dear* and bring your grandma her medication," she said." *Deer* are animals. "We saw three *deer* on our vacation to Yosemite National Park."

desert, dessert - A *desert* is a barren wilderness. "Let's visit the *desert* on our next vacation." *Desert* also means "to abandon." "Please don't *desert* me tonight," she said sympathetically." *Dessert* is food served at the end of a meal. "We're having apple pie for *dessert* tonight."



die, dye - *Die* (dying) means "to stop living." "Live by the sword, *die* by the sword." *Dye* (dyeing) is used to change the color of something. "To everyone's surprise, Lorelei *died* her hair blue."

faint, feign, feint - *Faint* means "to be feeble, without strength." "It was so hot at the airport, no wonder grandma *fainted*!" *Feign* means "to pretend or make up." "The killdeer *feigned* a broken wing to lure the housecat away from its nest." *Feint* means "a move or activity which is pretended or false." "Stuart won the fencing match when he made a *feint* to the right before striking to the left."

farther, further - *Farther* refers to distance. "She ran *farther* than I did."

Further means "to a greater extent or degree." "There's no need to discuss the issue *further*."

fewer, less - *Fewer* refers to a measurable number. "He has *fewer* friends than I." *Less* refers to little bulk quantity. "He also has *less* talent than you."

fir, fur - *Fir* refers to a type of evergreen tree; *fur* is animal hair. "Let's get a Douglas *Fir* tree for Christmas next year." "She had the nerve to wear a mink *fur* coat to our party!"

flair, flare - *Flair* means "a natural talent." "She had a *flair* for painting." *Flare* means "to light up quickly or burst out." "It was John's nature to let his temper *flare*."

for, fore, four - *For* means "because" or "directed to." "What did you hit me *for*?" *Fore* means "earlier" or "the front." "Because she had a strong *forehand*, she won the tennis match." *Four* is the number 4. "He ate *four* candy bars."

good, well - *Good* is an adjective. "She did a *good* job." *Well* is nearly always an adverb. "The car runs *well*."

hare, hair - *Hare* refers to an animal similar to a rabbit. "Have you read Aesop's 'The Tortoise and the *Hare*'?" *Hair* refers to the growth covering the head and body of animals and human beings. "When are you going to get a *haircut*?"

heal, heel - *Heal* means "to mend or restore to health." "The doctor said her knee would not *heal* for two months." *Heel* is the back part of a human foot. "You may have won the race, but I was on your *heels* the whole way."

hear, here - You *hear* with your ears. "Did you *hear* what I said?" *Here* is the opposite of there and means "nearby." "Come over *here*."

heard, herd - *Heard* is the past tense of *hear*. "Yeah, I *heard* what you said." *Herd* is a large group of animals. "We saw a *herd* of wild elephants on our visit to Africa."

heir, air - *Heir* is a person who inherits something. "I'm naming you *heir* to my estate." *Air* is the stuff we breathe. "The *air* is so polluted in this town that it makes my eyes burn."

hole, whole - A *hole* is a cavity or hollow place. "The rabbit jumped across the field and into a *hole* on the other side." *Whole* means "entire or complete." "Tell us the *whole* truth this time."

immigrate, emigrate - *Immigrate* means "to come into a new country or area." "Many Irish people *immigrated* into the United States in the nineteenth century." *Emigrate* means "to go out of one country to live in another." "The Pilgrims *emigrated* from England in search of freedom."

it's, its - *It's* is the contraction of "it is." "*It's* a cold day outside." *Its* is the possessive form of *it*. "Why is that monkey chewing on *its* paws?"

kernel, colonel - A *kernel* is a seed or core. "All the popcorn *kernels* popped that time." A *colonel* is a military officer. "The enlisted men saluted the *colonel*."

knew, new - *Knew* is the past tense of *know*. "I *knew* you were spying on us!" *New* means "recent or modern." "When will your *new* house be built?"

know, no - *Know* means "to understand or to realize." "I *know* what you mean." *No* means "the opposite of yes." "*No*, we can't afford to go to Hawaii this Christmas."

later, latter - *Later* means "after a period of time." "I'll clean the house *later*." *Latter* refers to the second of two things mentioned. "When given the choice between a large dinner and a large dessert, I prefer the *latter*." If more than two things are mentioned, use *last*.

lay, lie - *Lay* (laid, laid, laying) means "to put or place" and is a transitive verb (takes an object). "He *lay* the book on the table." "He *laid* it there yesterday." "He has *laid* it there." "He has been *laying* brick." *Lie* (lay, lain, lying) means "to rest" and is an intransitive verb (never has an object). "She *lies* down every day." "She *lay* down yesterday." "She has *lain* down." "She has been *lying* down."

lead, led - *Lead* is the present tense of the verb meaning "to guide." "John can *lead* you up the path." The past tense of the verb is *led*. "We *led* them to that store." When the words are pronounced the same, then *lead* is the metal. "This thing weighs a ton! Is it made out of *lead*?"

leave, let - *Leave* means "to depart." "She must *leave* now." *Let* means "to permit." "*Let* her go."

like, as - *Like* is a preposition meaning "similar to." "She looks *like* her father." *As* is a conjunction meaning "such as." "The project went *as* he had hoped."

loose, lose, loss - *Loose* means "to release, to *loosen*, to set free." "Bill had a *loose* tooth." *Lose* means "to be deprived of, to fail to keep." "If we play a good game, we won't *lose*." *Loss* means "something lost." "When he left our company, it was a real *loss*."

made, maid - *Made* is the past tense of *make* which means "to create."

“Who *made* this delicious cake?” A *maid* is a female servant; *maid* is also used to describe an unmarried girl or young woman. “The *maid* will start in two weeks.”

mail, male - *Mail* refers to letters or packages handled by the postal service. “Our one-million dollar check came in the *mail* today.” *Male* refers to the masculine sex. “Is your cat *male* or female?”

main, mane - *Main* refers to the principal or most important part or point. “The *main* thing is that you are happy.” *Mane* is the long hair growing from the top or sides of the neck of certain animals such as a lion or horse. “The lion’s *mane* was beautiful.”

meat, meet - *Meat* is food or flesh. “I thought vegetarians don’t eat *meat*.” *Meet* means “to come together at a particular place.” “I’ll *meet* you after school.”

metal, meddle, medal, mettle - *Metal* is an element like iron or gold. “Is gold the most expensive *metal*?” *Meddle* means “to interfere.” “I wouldn’t have been caught if you kids didn’t *meddle* in my affairs.” *Medal* is an award. “He won a second-place *medal* at the track meet.” *Mettle*, a noun, refers to a quality of character. “Do you have the *mettle* to join our club?”

miner, minor - A *miner* digs in the ground for valuable ore. “Your great grandfather was a gold *miner*?” A *minor* is a person who is not legally an adult. “No *minors* were admitted into the theater.” A *minor* problem is one of no great importance.

moral, morale - *Moral* relates to what is right or wrong. “What kind of *moral* values do kids have these days anyway?” *Morale* refers to a person’s attitude or mental condition. “Your quitting wouldn’t be good for the *morale* of our team.”

morning, mourning - *Morning* refers to the first part of the day before noon. “I’ll meet you for breakfast tomorrow *morning*.” *Mourning* means “showing sorrow.” “The widow was *mourning* the death of her husband.”

oar, or, ore - An *oar* is a paddle used in rowing or steering a boat. “If we can’t get the boat motor started, we’ll have to use our *oars* to get back to shore.” *Or* is a conjunction indicating choice. “Do you want chocolate *or* vanilla?” *Ore* refers to a mineral made up of several different kinds of material, as in iron *ore*. “After digging all day, we found a rich deposit of iron *ore*.”

pain, pane - *Pain* is the feeling of being hurt. “She felt a sharp *pain* in her neck.” *Pane* is a section or part of something, as in a framed section of glass in a window or door. “The baseball flew through one of our window *panes*.”

pair, pare, pear - A *pair* is a couple (two). “Lori and Corey make a nice *pair*.” *Pare* is a verb meaning “to peel.” “Would you like to help mom *pare* some apples for her pie?” *Pear* is the fruit. “Eat a peach, eat a *pear*, and you won’t despair.”

past, passed - *Past* can be used as a noun, as an adjective, or as a preposition. “She had a dark and secret *past*.” *Passed* is always a verb. “We just *passed* a police car on the freeway.”

peace, piece - *Peace* means “harmony or freedom from war.” “The police officer said his primary objective was to keep the *peace*.” *Piece* is a part or fragment. “Would you like another *piece* of cake?”

personal, personnel - *Personal* means “private.” “I can’t tell you because it’s too *personal*.” *Personnel* are people working at a particular job. “All *personnel* will attend the safety meeting.”

plain, plane - *Plain* means “an area of land which is flat or level”; it also

means “clearly seen or clearly understood.” “That’s *plain* enough for anyone to understand.” *Plane* means “flat, level, and even”; it is also a tool used to smooth the surface of wood. “He used a *plane* to make the board smooth.”

pore, pour, poor - A *pore* is an opening in the skin. “That makeup will clog your *pores*.” *Pour* means “a constant flow or stream.” “She *poured* him a drink.” *Poor* means “needy.” “Are you going to give money to the *poor* this year?”

principal, principle - *Principal* (as an adjective) means “chief” or “main.” “Her *principal* concern was to find a job that paid more money.” *Principal* (as a noun) means “a chief official” or “a sum of money.” “The school *principal* spoke to our class today about discipline.” *Principle* means “fundamental truth.” “It’s the *principle* of the matter.”

quiet, quit, quite - *Quiet* is the opposite of noisy. “It’s too *quiet* in here.” *Quit* means “to stop.” “He *quit* his job.” *Quite* means “completely or entirely.” “That’s not *quite* true!”

raise, rays, raze - *Raise* is a verb meaning “to lift or elevate.” “*Raise* the bridge!” *Rays* are thin lines or beams, as in rays of sunlight. “Want to go to the beach and catch some *rays*?” *Raze* means “to tear down completely.” “They plan to *raze* that old bank to build a parking lot.”

real, very, really - Do not use *real* in place of the adverbs *very* or *really*. “The movie was about *real* life.” “He was very smart.” “Kathy is a *really* talented dancer.”

red, read - *Red* is the color. “*Red* was her favorite color.” *Read* is the verb meaning “to understand the meaning of written letters, words, and symbols.” “Have you *read* John Grisham’s ‘The Firm’?”

right, write, wright, rite - *Right* means “correct or proper”; it also refers to anything which a person has a legal claim to, as in copyright. “It wouldn’t be the *right* thing to do.” *Write* means “to record in print.” “Would you put that in *writing*?” *Wright* is a person who makes or builds something. “The *shipwright* works at the harbor entrance.” *Rite* is a ritual or ceremonial act. “The priest read the prisoner his last *rites*.”

scene, seen - *Scene* refers to the setting or location where something happens; it also may mean “sight or spectacle.” “Don’t make a *scene* in this restaurant.” *Seen* is a form of the verb “see.” “I’ve *seen* that movie at least a hundred times.”

seam, seem - *Seam* is a line formed by connecting two pieces of material. “Her dress tore at the *seams*.” *Seem* means “to appear to exist.” “It just *seems* like this day will never end.”

sew, so, sow - *Sew* is a verb meaning “to stitch.” “She *sews* her own clothes.” *So* is a conjunction meaning “in order that.” “Speak directly into the microphone *so* we may hear you better.” The verb *sow* means “to plant.” “The farmer *sowed* cotton seeds last week.”

sight, cite, site - *Sight* means “something that is seen.” “After the fire, her house was quite a *sight*.” *Cite* means “to quote or refer to.” “The old actor *cited* a passage from Shakespeare.” *Site* means “location or position.” “This is a great *site* for camping.”

sit, set - *Sit* means “to put the body in a seated position.” “Will you please *sit* down?” *Set* means “to place.” “*Set* the glass of milk on the counter.”

sole, soul - *Sole* means “single, only one”; *sole* also refers to the bottom surface of a foot or shoe. “You run so much that you’re going to wear out the *soles* of your shoes.” *Soul* refers to the spiritual part of a person. “Grandma’s

soul has gone to heaven.”

some, sum - *Some* means “a certain unknown number or part.” “*Some* thieves broke in and stole our television set last week.” *Sum* means “an amount.” “You still owe a *sum* of forty-five dollars.”

sore, soar - *Sore* means “painful.” “After yesterday’s workout, are you *sore* today?” *To soar* means “to rise or fly high into the air.” “The bird *soared* over the tops of the buildings.”

stationary, stationery - *Stationary* means “not movable.” “Their mobile home was pretty *stationary* after they braced its wheels with wooden blocks.” *Stationery* is the paper and envelopes used to write letters. “She wrote him a letter on perfumed *stationery*.”

steal, steel - *Steal* means “to take something without permission.” “Did Jon *steal* that new couch?” *Steel* is a metal. “Your head is as hard as *steel*.”

than, then - *Than* is used in a comparison. “You know better *than* that.” *Then* is an adverb expressing time. “*Then* we left.”

their, there, they’re - *Their* is a possessive pronoun, one which shows ownership. “It is *their* turn.” *There* is a pronoun used to point out a location. “Let’s go *there*.” *They’re* is the contraction of “they are.” “*They’re* leaving.”

threw, through - *Threw* is the past tense of “throw.” “He *threw* the ball.” *Through* means “passing from one side of something to the other.” “It went right *through* the window.”

to, at - *To* should not be used in place of *at* in a sentence. “She is *at* (not *to*) home.”

to, too, two - *To* is the preposition which can mean “in the direction of.” “He came *to* class.” (*To* also introduces the infinitive.) “He wanted *to* kiss her.” *Too* is an adverb meaning “also.” “Will you come to the party, *too*?” *Too* also means “more than.” “I ate *too* much at the party.” *Two* is the number. “Are the *two* of you coming to the party?”

vain, vane, vein - *Vain* means “worthless.” It may also mean “thinking too highly of one’s self; stuck-up.” “She is so *vain*.” *Vane* is a flat piece of material set up to show which way the wind blows. “The weather *vane* almost blew off the roof during the storm.” *Vein* refers to a blood vessel or a mineral deposit. “She’s so mean that she must have ice water flowing through her *veins*.”

vary, very - *Vary* is a verb that means “to change.” “The weather can *vary* from snow to sunshine in a single day.” *Very* can be an adjective meaning “in the fullest sense” or “complete.” “The movie was the *very* opposite of funny.” *Very* can also be an adverb meaning “extremely.” “The movie was *very* exciting.”

waist, waste - *Waist* is the part of the body just above the hips. “No punching below the *waist*.” The verb *waste* means “to wear away, decay.” “If you don’t eat something soon, the food will go to *waste*.” The noun *waste* refers to material which is unused or useless. “Would you empty the *waste* paper basket?”

wait, weight - *Wait* means “to stay somewhere expecting something.” “*Wait* in the lobby.” *Weight* is the measure of heaviness. “What is the *weight* of a pound of gold?”

ware, wear, where - *Ware* means “a product which is sold.” “The street

vendor sold his *wares* on the corner.” *Wear* means “to have on or to carry on one’s body.” “What are you *wearing* to the dance?” *Where* asks the question, “in what place?” or “in what situation?” “*Where* is Fresno anyway?”

way, weigh - *Way* means “path or route.” “Do you know the *way* to San Jose?” *Weigh* means “to measure weight.” “We’ll have to *weigh* you on that big scale over there.”

weather, whether - *Weather* refers to the condition of the atmosphere. “Hail in the summer is unusual *weather* indeed.” *Whether* refers to a possibility. “I don’t know *whether* we’ll be able to go.”

week, weak - A *week* is a period of 7 days. “I can finish that project in a *week*.” *Weak* means “not strong.” “She was too *weak* to lift it.”

which, witch - *Which* is a pronoun used to refer to or point out a choice of two or more options. “The car *which* had burned out taillights caused the accident.” *Witch* is “a woman that is credited with supernatural powers.” “Have you seen ‘The *Witches* of Eastwick’?”

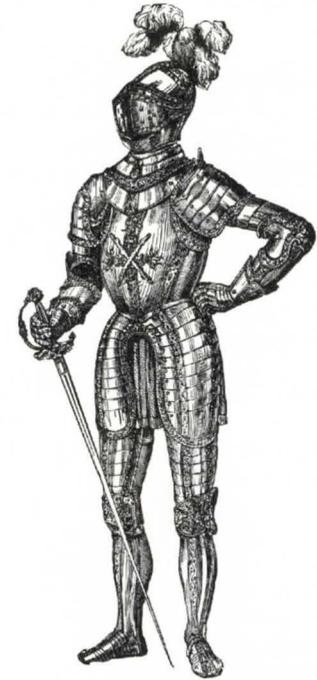
who, which, that - *Who* is used to refer to people. “*Who* does he think he is?” *Which* refers to nonliving objects or to animals; *which* should never refer to people. “The house *which* has a big backyard is still for sale.” *That* may refer to animals, people, or nonliving objects. “The letter *that* arrived yesterday contained a million-dollar check.”

who, whom - *Who* is used as the subject in a sentence. “*Who* did you meet there?” *Whom* is used as the object of a preposition or as a direct object. “About *whom* were you speaking?”

who’s, whose - *Who’s* is the contraction of who is. “He’s the one *who’s* always late.” *Whose* is a possessive pronoun, one which shows ownership. “*Whose* sweater is this?”

wood, would - *Wood* is the stuff of which trees are made. “The *woods* are lovely, dark, and deep. — Robert Frost.” *Would* is a form of the verb “will.” “*Would* you go to the dance with me?”

your, you’re - *Your* is a possessive pronoun, one which shows ownership. “Put on *your* shoes.” *You’re* is the contraction for “you are.” “He looked in the mirror and said, ‘*You’re* worth a million.’”



Now What?

Sometimes you and your secret spy friends will need to pass notes that should not be read by anyone's prying eyes. Dr. Brain's cipher techniques can help you disguise your messages. Practice the following ciphers at Dr. Brain's Secret Cipher Bridge.

Extra-Spaced Words - The letters of the words are written in the same order, but extra spaces are placed between letters and taken out between words. Example (in code): Le t'sd oit! Solution: Let's do it!



Backwards Words - Each word in the sentence is spelled backwards. Example (in code): hcnul yadot ta eno kcolc'o. Solution: Lunch today at one o'clock.

Backwards Words and Sentences - Each word in the sentence is spelled backwards and each word is in reverse order. Example (in code): !gnirob si ssalc siht Solution: This class is boring!

Phoney Letter in front: Each word in the sentence has a fake first letter tacked on. Next, extra spaces are placed between letters and taken out between words. Example (in code): eme etime ube hind at hewsc hool Solution: Meet me behind the school.

Phoney Letter in back: Each word in the sentence has a fake last letter tacked on. Next, extra spaces are placed between letters or taken out between words. Example (in code): Do n'th for geta toebr ingi thee ca kee. Solution: Don't forget to bring the cake.

Number Substitution: Each letter in the alphabet is substituted with numbers. These are as follows:

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z
26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1

Example (in code): 24121422 267 8183 Solution: Come at six.

As a Matter of Fact...

The use of codes and ciphers for secret communications is called Cryptography.

Related Terms

Cipher Plain text Encipher Decipher



Table 2 *Some Important Foreign Words and Phrases - Easy*

| English | German | French | Spanish |
|----------------|-----------------|-----------------|------------------|
| zero | null | zéro | cero |
| one | eins | un (m); une (f) | uno(m); una (f)* |
| two | zwei | deux | dos |
| three | drei | trois | tres |
| four | vier | quatre | cuatro |
| five | fünf | cinq | cinco |
| six | sechs | six | seis |
| seven | sieben | sept | siete |
| eight | acht | huit | ocho |
| nine | neun | neuf | nueve |
| ten | zehn | dix | diez |
| mother | mutter | mère | madre |
| father | vater | père | padre |
| son | sohn | fil | hijo |
| daughter | tochter | fille | hija |
| dog | hund | chien | perro |
| cat | katze | chat | gato |
| hand | hand | main | mano |
| hat | hut | chapeau | sombrero |
| hair | haar | cheveu | pelo |
| house | haus | maison | casa |
| street | straße | rue | calle |
| city | stadt | citè | ciudad |
| school | schwarm | école | escuela |
| today | heute | aujourd'hui | hoy |
| yesterday | gestern | hier | ayer |
| tomorrow | morgen | demain | mañana |
| good evening | guten abend | bon soir | buenas noches |
| hello | hallo | hol | hola |
| very well | sehr gut | très bien | muy bien |
| marvelous | wunderbar | merveille | maravilloso |
| good-bye | auf wiedersehen | au revoir | adiós |
| my name | mein name | mon nom | mi nombre |
| understand? | verstehen sie? | comprenez? | ¿comprende? |
| thank you | danke schön | merci | gracias |
| you're welcome | bitte | de rien | de nada |
| excuse me | verzeihung | pardon | perdón |

* Gender Note: In languages other than English, words can take on masculine and feminine genders.

Table 2 *Some Important Foreign Words and Phrases - Standard*

| English | German | French | Spanish |
|-----------|-------------|-----------------|-------------|
| island | insel | île | isla |
| doctor | arzt | médecin | médico |
| brain | gehirn | cerveau | cerebro |
| stop | anhalten | arrêter | parar |
| sunday | sonntag | dimanche | domingo |
| monday | montag | lundi | lunes |
| tuesday | dienstag | mardi | martes |
| wednesday | mittwoch | mercredi | miércoles |
| thursday | donnerstag | jeudi | jueves |
| friday | freitag | vendredi | viernes |
| saturday | sonnabend | samedi | sábado |
| dentist | zahnarzt | dentiste | dentista |
| sick | krank | malade | enfermo |
| pain | schmerz | douleur | dolor |
| left | links | gauche | izquierda |
| right | rechts | droit | derecha |
| please | bitte | s'il vous plaît | por favor |
| smart | gescheit | intelligent | inteligente |
| open | offen | ouvert | abierto |
| closed | geschlossen | ferm | cerrado |
| sad | traurig | triste | triste |
| happy | glücklich | heureux | feliz |
| pretty | hübsch | joli | bonito |
| ugly | häßlich | laid | feo |
| coffee | kaffee | du café | café |
| milk | milch | du lait | leche |
| water | wasser | eau | agua |
| bread | brot | pain | arroz |
| meat | fleisch | viande | carne |
| chicken | huhn | poulet | pollo |
| delicious | köstlich | délicieux | delicioso |
| fish | fisch | poisson | pescado |
| wait | ein moment | attendez | espere |
| again | noch einmal | encore | otra vez |
| now | jetzt | maintenant | ahora |
| later | später | plus tard | más tarde |

Table 2 *Some Important Foreign Words and Phrases - Expert*

| English | German | French | Spanish |
|------------------|----------------|----------------------|----------------|
| january | januar | janvier | enero |
| february | februar | février | febrero |
| march | märz | mars | marzo |
| april | april | avril | abril |
| may | mai | mai | mayo |
| june | juni | juin | junio |
| july | juli | juillet | julio |
| august | august | août | agosto |
| september | september | septembre | septiembre |
| october | oktober | octobre | octubre |
| november | november | novembre | noviembre |
| december | dezember | décembre | diciembre |
| your name | ihr name | votre nom | su nombre |
| bathroom | badezimmer | salle de bains | cuarto de baño |
| kitchen | küche | cuisine | cocina |
| what number? | welche nummer? | quel numéro? | ¿que número? |
| how much? | wie viel? | combien? | ¿cuánto? |
| not far | nicht weit | pas loin | no lejos |
| very expensive | sehr teuer | trés cher | muy caro |
| less expensive | billiger | moins cher | menos caro |
| luggage | gepäck | bagage | equipaje |
| market | markt | marché | mercado |
| department store | warenhaus | grand magasin | almacén |
| restaurant | restaurant | restaurant | restaurante |
| smaller | kleiner | plus petit | más pequeño |
| larger | größer | plus grand | más grande |
| approximate | annähernd | approchant | aproximado |
| what is this? | was ist das? | qu'est-ce que c'est? | ¿qué es esto? |
| the airport | der flughafen | l'aéroport | el aeropuerto |
| bank | bank | banque | banco |
| drugstore | apotheke | pharmacie | farmacia |
| possible | möglich | possible | posible |
| slowly | langsam | doucement | despacio |
| quickly | schnell | accélérer | pronto |
| funny | spaßig | amusant | chistoso |

Related Topics

Dr. Brain's Language Garden, Know When to Use the Right Word

DR. BRAIN'S VOLCANO DOOR ANALYZER

Now What?

The next time one of your competitive friends asks you what you're really made of, tell him or her the following! Human beings are made of the following chemical elements:

| | |
|-----------------|--------|
| Oxygen | 65% |
| Carbon | 18% |
| Hydrogen | 10% |
| Nitrogen | 3% |
| Calcium | 1.5% |
| Phosphorous | 1% |
| trace elements* | 1.5% |
| | = 100% |

*The trace elements include:

| | |
|-----------|----------|
| potassium | iron |
| silicon | chlorine |
| magnesium | sodium |
| sulfur | zinc |

As a Matter of Fact...

All substances are made up of tiny particles called molecules. Scientists can examine molecules only through the use of powerful microscopes. Molecules can be broken into even smaller particles called atoms. In 1869, Dmitri Mendeleev, a Russian chemist, tried to find a pattern that would explain how the elements are alike or different. He published the Periodic Table

of the Elements, which classified each element by their atomic number. Therefore, elements are substances composed of atoms having the same atomic number. You can find your own Periodic Table of the Elements in the reference section of your EncycloAlmanacTionaryOgraphy.

In Dr. Brain's hut door analyzer, you can find out the composition of many common items. For instance, you'll discover a tablet of aspirin is composed of molecules containing 9 atoms of carbon, 8 atoms of hydrogen, and 4 atoms of oxygen. Water is composed of molecules containing 2 atoms of hydrogen and 1 atom of oxygen. And a sea shell is composed of molecules containing 1 atom of calcium, 1 atom of carbon, and 3 atoms of oxygen.

Things to do...

Look up the atomic numbers of carbon, calcium, hydrogen, and oxygen on your Periodic Table of the Elements.

Memorize ten of the elements on your Periodic Table of the Elements and their atomic weights.

Related Terms...

atomic weight element Mendeleev, Dmitri

DR. BRAIN'S ART GALLERY

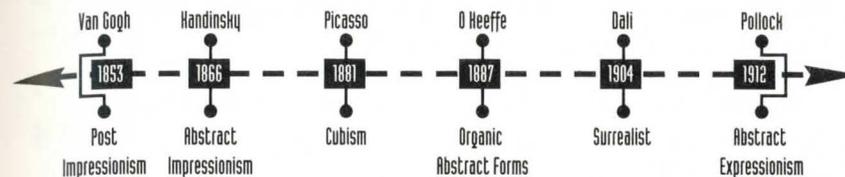


Figure 3 Timeline of Artists in Dr. Brain's Gallery

Now What?

The artists on display in Dr. Brain's art gallery are: Vincent Van Gogh, Wassily Kandinsky, Pablo Picasso, Georgia O'Keeffe, Salvador Dali, and Jackson Pollock. The timeline in Figure 3 shows these artists in relation to their period in art history.

As a Matter of Fact...

Vincent Van Gogh (1853-1890) - Post-Impressionist. Vincent Van Gogh's works are perhaps better known generally than those of any other painter. Some of his works in Dr. Brain's gallery are the following:

- "The Night Cafe" 1888.
- "Sunflowers" 1888.
- "Fishing Boats on the Beach at Saintes-Maries" 1888.
- "Road with Cypress and Stars" 1890.
- Van Gogh's self portrait. 1887.

Wassily Kandinsky (1866-1944) - Abstract Expressionist. Wassily Kandinsky is generally regarded as the originator of abstract art. Some of his works in Dr. Brain's gallery are the following:

- "Storeys" 1929.
- "White Stroke" 1920.
- "Colorful Ensemble" 1938.
- "Gorge Improvisation" 1914.

Pablo Picasso (1881-1973) - Spanish painter, sculptor, graphic artist, and ceramist. Although very versatile in his style, some of his most significant works developed a technique called Cubism.

Pablo Picasso is considered the foremost figure in 20th century art. Some of his works in Dr. Brain's gallery are the following:

- “The Dream” 1932.
- “Girl Before a Mirror” 1932.
- “Woman’s Head with Self Portrait” 1929.
- “Three Musicians” 1921.

Georgia O’Keeffe (1887-1986) - Famous American Painter. Painted organic, abstract forms in clear, strong colors. Some of her works in Dr. Brain’s gallery are the following:

- “Jack in the Pulpit #2” 1930.
- “Red Puppy No. VI” 1928.
- “Petunia and Coleus” 1924.
- “Black Iris II” 1936.

Salvador Dali (1904-1989) - Surrealist. Salvador Dali became the leader of surrealism. Some of his works in Dr. Brain’s gallery are the following:

- “The Three Sphinxes of Bikini” 1947.
- “The Dream” 1937.
- “Hallucinogenous Bullfighter” 1970.
- “Fifty Abstract Paintings in Which One Sees, at a Distance of Three Meters, Three Chinese-like Lenins, the Whole Forming the Face of a Royal Tiger” 1963.

Jackson Pollock (1912-1956) - Abstract Expressionist. His unique style and devotion to the act of painting, led to the term “Action Painting.” Some of his works in Dr. Brain’s gallery are the following:

- “Composition with Pouring II” 1943.
- “Overall Composition” 1938.
- “Convergence #10” 1952.
- “The Moon Woman Cuts the Circle” 1943.

Related Terms...

| | | |
|------------------|-------------------|------------------------|
| Action Painting | Vincent Van Gogh | Abstract Expressionism |
| Cubism | Postimpressionism | Wassily Kandinsky |
| Pablo Picasso | Surrealism | Salvador Dali |
| Georgia O’Keeffe | | |

DR. BRAIN’S MUSIC PUZZLE

Now what?

For those of you who know little about what to do with Dr. Brain’s keyboard, but would like to try it out, here’s a quick introduction.

Keys on the keyboard

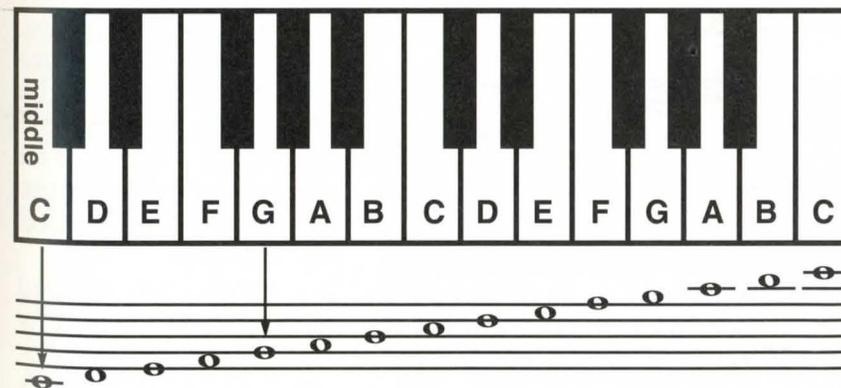
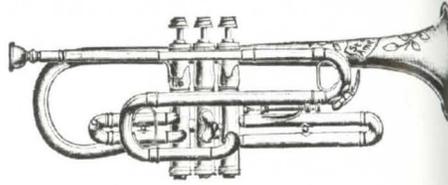


Figure 4 Keys on the Keyboard and Notes on the Staff

This puzzle is all about learning to play music. A good place to begin is by learning the notes. In music there are seven letter names—A B C D E F G. These seven letters are the names of the white keys. The next white key on the keyboard begins repeating the first note of this sequence. This sequence of keys is called an octave. There are also five black keys within each octave. These represent special kinds of notes called accidentals. Accidentals are also called sharp and flat notes. Flats and sharps are special kinds of notes which are one-half step between each of these seven notes. Flat notes are one-half step lower in pitch, while sharp notes are one-half step higher in pitch according to key signatures. Figure 4 labels the notes on the keyboard for you and also shows their relationship to placement of the notes on the musical staff.

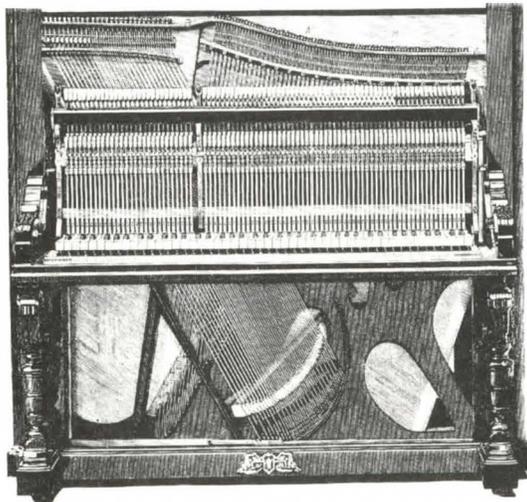


The Musical Staff and Notation

In order to identify a particular pitch, notes are placed on a treble clef staff composed of 5 lines and 4 spaces. There are two helpful expressions to help you remember where notes are placed on the treble clef staff. One is an acronym, FACE. The other is a phrase,

Every Good Boy Does Fine (EGBDF). The notes in the 4 spaces are F A C E or FACE. The notes on the five lines are E G B D F or Every Good Boy Does Fine.

The staff is also divided into measures. To show the division between measures, music notation is marked with a Bar line. To indicate the end of a section, movement, or piece, music notation is



marked with a double bar. Therefore, depending on the duration of each note, a measure may contain from one to eight notes on Dr. Brain's staff. Tempo also affects the duration of a note. With a faster tempo, a four-count note will be shorter. With a slower tempo, a four-count note will be longer.

The Duration of Notes and Rests

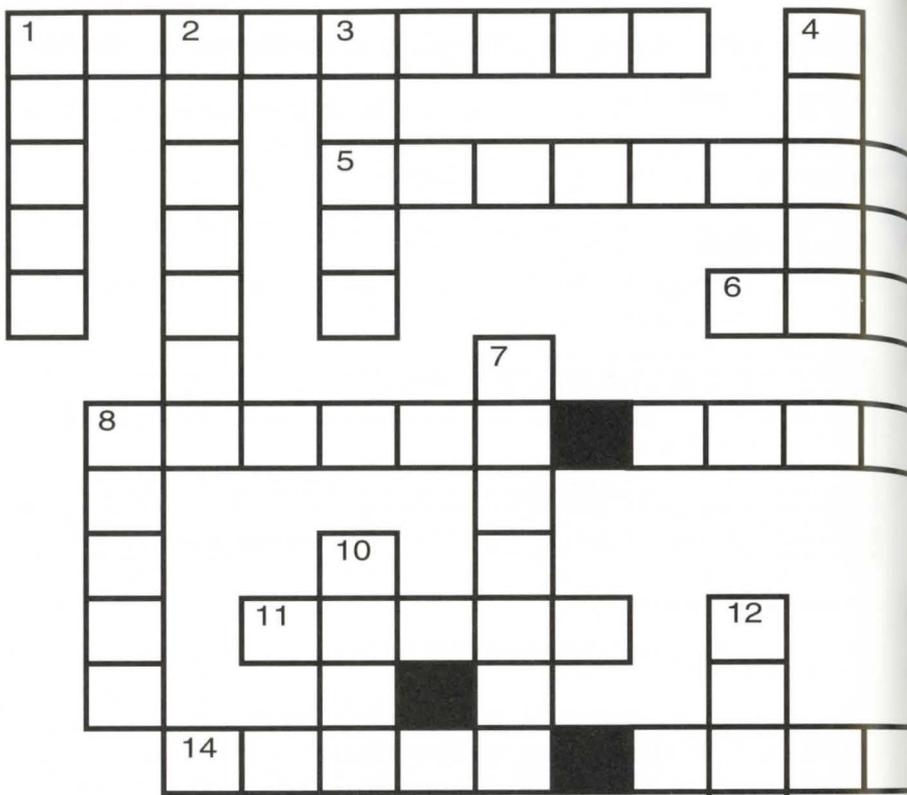


Figure 5 *The Duration of Notes and Rests*

The duration of notes used in Dr. Brain's music puzzle is shown in Figure 5. Basically, there are four kinds of notes and rests in his music puzzle—whole, half, quarter, and eighth. Our examples will use 4/4 time. The bottom 4 shows that a quarter note is given one beat and the top 4 means that there will be 4 beats in each measure. Therefore, a whole note gets four counts, a half note gets two, and a quarter note gets one count. Eighth notes get one-half count in a measure and several in a row are counted as one and two and three and, etc.

As a Matter of Fact...

See how many of the following music terms you can correctly identify in Dr. Brain's Music Crossword Puzzle. Definitions are found in your Glossary.



ACROSS

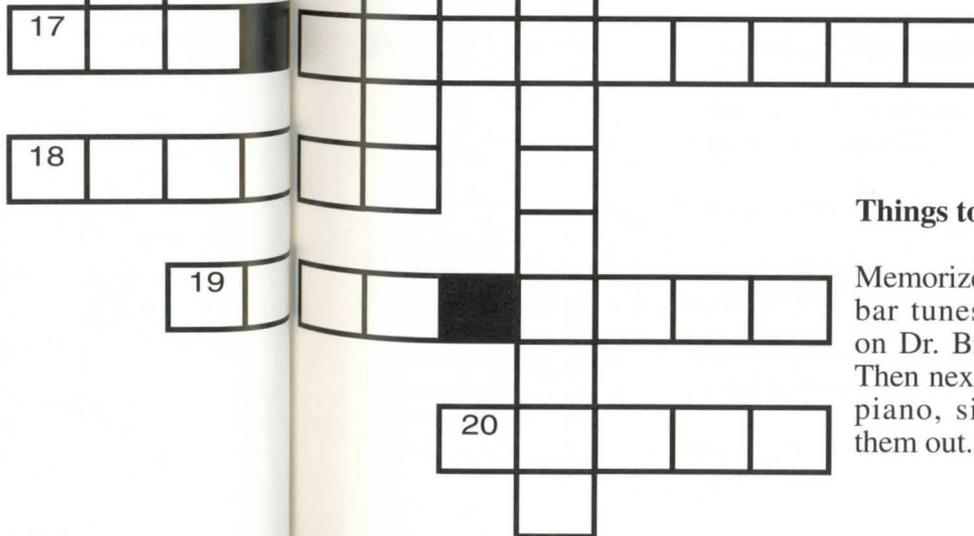
1. To change the key of a composition to one higher or lower.
5. A sign (# b) not in the key signature.
6. A series of tones arranged in a sequential order of ascending and descending pitches.
8. A time signature (C) indicating 4/4 time.
11. Soft (*p*).
13. A sign (♯) which cancels a previous flat or sharp.
14. Twice the distance of a half step.
15. The differences in pitch between two sounds.
17. Flats or sharps placed after the clef sign to indicate which notes to play flat or sharp.
18. Smooth and connected.
19. The distance from one key to the next in either direction.
20. Loud (*f*).

MUSICAL CROSSWORD PUZZLE

(answers on page 102)

DOWN

1. A chord of three tones consisting of a root, third, and fifth.
2. Quick, lively.
3. A sign (#) which indicates a pitch one half step higher.
4. The keynote of a scale.
7. Slowly.
8. A combination of three or more tones.
9. Very soft (*pp*).
10. Lively, brisk.
12. The interval from one letter name to the next note of the same name, either up or down.
16. A chord having a note other than the root in the bass.



Things to Do...

Memorize six of the four-bar tunes you've played on Dr. Brain's Keyboard. Then next time you're at a piano, sit down and try them out.

YOU MIGHT LOOK IT UP (ON DR. BRAIN'S BOOKSHELF)

When you're sorting books on Dr. Brain's bookshelf, you will find the following pages come in handy for reference. Other sections you might like to check out are the Bibliography, the Glossary, and occasionally the other main sections of the EncycloAlmanacTionaryOgraphy.

SOME INSTRUMENTS IN A BAND

Brass - You create music with these instruments by pinching your lips as you blow into the mouthpiece. The sounds vibrate down the tube of the instrument and become amplified.

cornet trumpet French horn bugle trombone tuba

Percussion - You create music with these instruments by shaking or beating them.

maracas bells gongs drums xylophone timpani

Strings - You create music with these instruments by vibrating their strings with your fingers or a bow.

violin cello viola guitar harp lute

Woodwind - You create musical notes with these instruments by blowing into them through a reed or across a mouth hole which makes the air inside vibrate.

flute oboe bassoon English horn saxophone
clarinet piccolo

SOME SYSTEMS IN THE BODY

Learning the systems of the body will come in handy. For a quick reference, consult Table 3 which contains a list of some systems in the body.

Table 3 *Some Systems in the Body*

| Digestive | Circulatory | Respiratory | Nervous | Skeletal |
|-----------------|-------------|-------------|--------------|-----------|
| stomach | heart | lungs | neurons | tarsals |
| intestine | veins | diaphragm | nerves | phalanges |
| mouth | arteries | alveoli | receptors | fibula |
| esophagus | blood | chest wall | effectors | tibia |
| colon | plasma | pharynx | brain | femur |
| liver | platelets | larynx | spinal chord | carpal |
| salivary glands | capillaries | trachea | axon | sacrum |
| pancreas | venules | cilia | dendrites | pubis |
| gall bladder | arterioles | bronchi | synapse | ulna |

OUTER SPACE

Space exploration is the investigation of physical conditions in space and on stars, planets, and natural satellites through the use of space probes or manned spacecraft. Figure 6 shows some of the things you'll see in outer space as well as listing some of the probes that have already been sent out for exploration.

| Constellations | Moons | Planets | Probes | Stars |
|----------------|----------|---------|---------|----------------|
| Delphinus | Phobos | Mercury | Luna | Sirius |
| Cetus | Deimos | Venus | Ranger | Polaris |
| Pegasus | Triton | Earth | Apollo | Betelgeuse |
| Aquarius | Nereid | Mars | Pioneer | Sun |
| Orion | Callisto | Jupiter | Mariner | Alpha Centauri |
| Perseus | Europa | Saturn | Helios | Arcturus |
| Andromeda | Io | Uranus | Venera | Vega |
| Cassiopeia | Ganymede | Neptune | Voyager | Capella |
| Hercules | Titan | Pluto | Giotto | Altair |
| Ursa Major | Oberon | | Galileo | Pollux |
| Cepheus | Charon | | | |

Figure 6 *Things in Outer Space*

GODS OF MANY CULTURES

Myths are traditional stories occurring in a timeless past and involving supernatural elements. In ancient cultures, myths were told to express and explain such serious concerns as the creation of the

universe and of humanity, the evolution of society, and the cycle of agricultural fertility. Gods often played a major role in mythology. Some of the Gods from around the world are found in Table 4.

Table 4 *Gods of Many Cultures*

| | Sky God Ruler | Queen | Sun Light | Moon | War Storms Thunder | Sea River Rain | Agriculture Fertility Earth | Love | Underworld Dead | Wisdom Knowledge Arts/Science | Crafts Invention | Culture Hero Schemer |
|---|-----------------------------|---------------------------|---------------------------|-------------------------|---------------------------------|--|---|---------------------------|----------------------------------|-------------------------------------|----------------------|-------------------------------|
| Egyptian | Amon-Re | Hathor Isis | Amon-Re Horus | Thoth Hathor Isis | Mont | Osiris | Hathor Isis Osiris | Hathor | Anubis Osiris | Thoth Isis | Ptah | Osiris |
| Sumerian/ Babylonian | An Anu Marduk | Innini | Babbar Shamash | Nanna Sin | Enlil Marduk Adad | Enki Ea | Nanna Ishtar | Nanna Ishtar Tammuz | Ereshkigal | Nabu Ea | Ea | Ea |
| Greece | Zeus | Hera | Apollo | Artemis | Ares | Poseidon | Demeter Persephone Dionysus | Aphrodite Eros | Hades (Dis) | Athena Apollo | Hephaestus Athena | Prometheus Hermes |
| Roman | Jupiter (Jove) | Juno | Apollo | Diana | Mars | Neptune | Ceres Proserpine Bacchus | Venus Cupid | Pluto | Minerva | Vulcan Minerva | Mercury |
| Norse | Odin | Frigg | Balder | -- | Thor | Aegir Frey | Frey Freya | Freya Frigg | Hel | Odin Bragi Mimir | Volund Frigg | Loki |
| Celtic | Dagda | Danu | Lug | Branwen | Morrigan Macha Taranis | Manannan | Danu Macha Brigit | Branwen | Bran Urien | Lug Brigit Bran | Goibniu Lug | -- |
| Chinese (Taoist/Buddhist) | Yu-huang (lao t'ien-yeh) | T'ien Hou | Yi | Ch'ang-o (Heng-o) | Huang-ti Kuan-ti Lei-kung | Lung-wang (dragon king) Yu-ch'iang | Sheng-mu (Pi-hia yuan kun) Kuan-yin | -- | Yen-wang Ts'in-kuang- wang | Wen-ch'ang | Lu Pan Huang-ti | Shen-nung Fu-hsi |
| Indian (Vedic/Hindu) | Indra Vishnu Shiva | Lakshmi Parvati (Kali) | Surya Mitra Savitar | Soma Yaruna | Indra Skanda Rudra | Varuna Parjanya | Parvati | Kama Krishna | Yama | Rudra Sarasvati | -- | -- |
| West African (Ashanti/Fon/ Yaruba) | Nyame Mahu Olorun | Asase Yaa | Lisa | -- | Tano Xevioso Schango | Nyame Aylekete Olokun | Asase Yaa Mahu Odudua | -- | -- | Orunmila | Gun Ogun | Ananse Gun. Legba Eschu |
| Mayan | Hun-Ahpu | Ixazaluoh | Hun-Ahpu Itzamna | -- | Hurakan | Chac | Itzamna | -- | Humahau | Itzamna Kukulcan | Ixazaluoh | Itzamna Kukulcan |
| Aztec | Tonacate- cutli | Tonacaci- huatl | Tezcatlipoca | Meztli | Huitzilo- pochtli | Tlaloc | Tzinteotl | Tlazolteotl Coatlicue | Michtlante- cutli | Quetzalcoatl | Quetzalcoatl | Quetzalcoatl |

TOPOGRAPHIC TALLY

Table 5 lists some of the major continents and countries around the world. In fact, see if you can locate some of these on your world map.

Table 5 Topographic Tally

Major Continents and Countries

| Africa | Asia | Europe | North America | South America |
|--------------|--------------|----------------|---------------|---------------|
| Morocco | China | Norway | Canada | Argentina |
| Tunisia | India | Sweden | U.S.A. | Chile |
| Algeria | Mongolia | Finland | Mexico | Brazil |
| Libya | Burma | Poland | Guatemala | Venezuela |
| Egypt | Laos | Germany | El Salvador | Colombia |
| Sudan | Vietnam | France | Cuba | Ecuador |
| Chad | Japan | Austria | Panama | Peru |
| Niger | North Korea | Spain | Nicaragua | Bolivia |
| Nigeria | South Korea | Switzerland | Honduras | Paraguay |
| Ghana | Philippines | Italy | Costa Rica | Uruguay |
| Ivory Coast | Cambodia | Portugal | Belize | |
| Zaire | Malaysia | Hungary | | |
| Angola | Sri Lanka | Yugoslavia | | |
| Zambia | Nepal | United Kingdom | | |
| Uganda | Iran | Ireland | | |
| Ethiopia | Iraq | Denmark | | |
| Botswana | Afghanistan | Russia | | |
| South Africa | Turkey | Bulgaria | | |
| Zimbabwe | Lebanon | Czechoslovakia | | |
| | Israel | Netherlands | | |
| | Saudi Arabia | | | |
| | Thailand | | | |

Major Landmarks

| Deserts | Lakes | Mountains | Rivers |
|--------------|-------------|--------------|-------------|
| Death Valley | Ontario | Aconcagua | Amazon |
| Gobi | Caspian Sea | Everest | Danube |
| Great Basin | Superior | Kilimanjaro | Nile |
| Kalahari | Victoria | Matterhorn | Congo |
| Kara Kum | Aral Sea | Fuji | Ganges |
| Kyzyl Kum | Titicaca | McKinley | Hudson |
| Mojave | Huron | Rainier | Jordan |
| Negev | Michigan | Saint Helens | Mississippi |

Table 5 Topographic Tally (concluded)

| Deserts | Lakes | Mountains | Rivers |
|-------------|------------|--------------|--------------|
| Sahara | Tanganyika | Shasta | Niger |
| Sahel | Baikal | Whitney | Potomac |
| Takli Makan | Nyasa | Olympus | Rhine |
| Thar | Albert | Vesuvius | Rio Grande |
| Atacama | Balkhash | Popocatepetl | St. Lawrence |
| Arabian | Bangweulu | Orizaba | Seine |
| | Chad | Kenya | Thames |
| | Erie | Logan | Volga |
| | Geneva | Cotopaxi | Yangtze |
| | Mead | Jungfrau | Zambezi |
| | Tahoe | Mauna Loa | |
| | | Mauna Kea | |
| | | Etna | |

LOCATING LANDMARKS ON THE CONTINENTS

Studying maps can help you learn of places all around the world. In Africa, look for these important landmarks: Nile River, Mt. Kilimanjaro, Victoria Falls, Cape of Good Hope, Great Rift Valley, Suez Canal, Sahara Desert, Congo River, and the Canary Islands.

In Antarctica are the Horlick Mountains, Whitmore Mountains, Filchner Ice Shelf, Berkner Island, Ross Sea, Prydz Bay, Ross Ice Shelf, and Mertz Glacier.

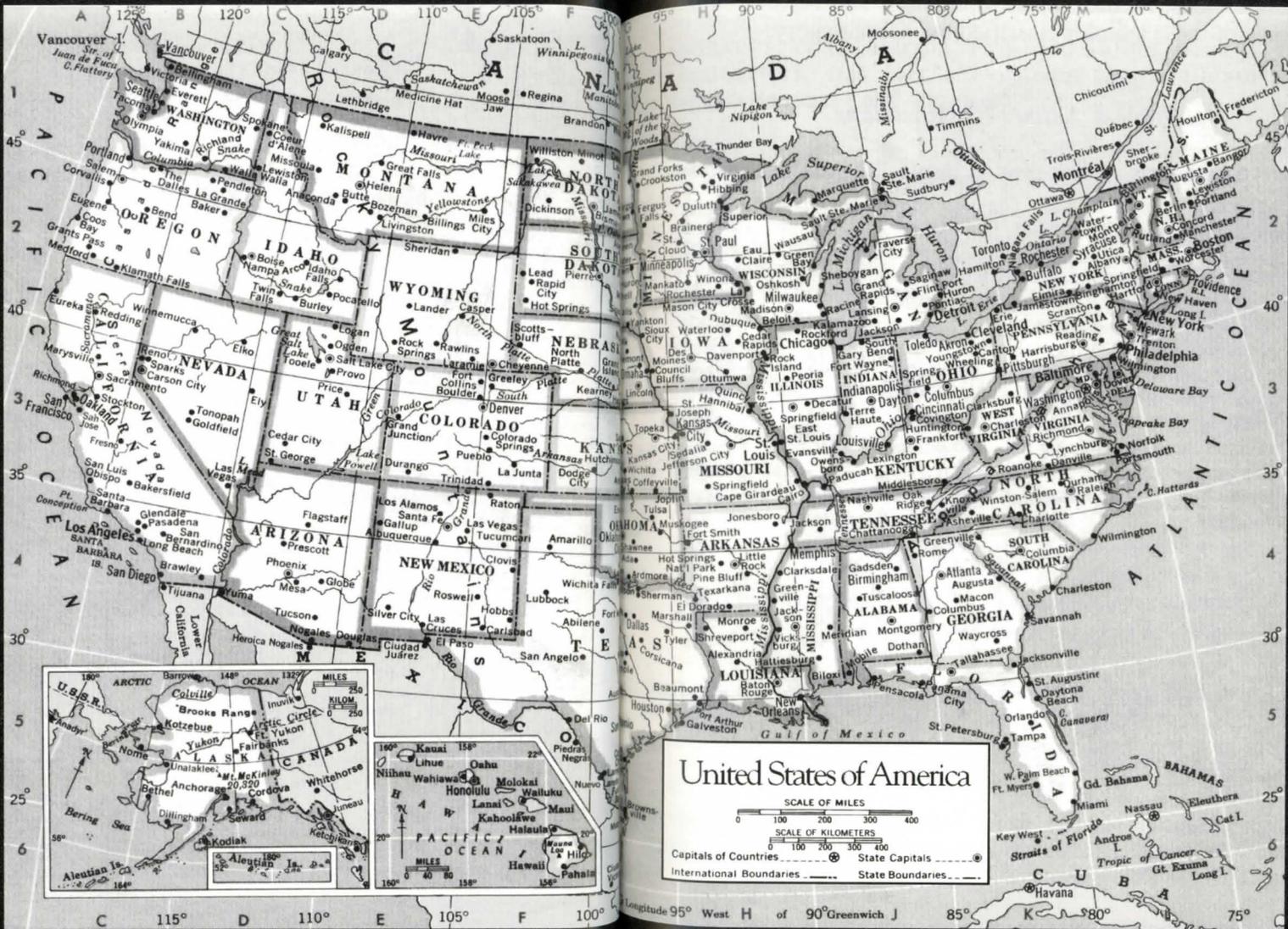
Discover Mt. Everest, Pamir Knot, Altai Mountains, Tigris River, Euphrates River, Taklimakan Desert, Gobi Desert, and the River Jordan in Asia.

In Australia, look for Botany Bay, Coral Sea, Darling River, Great Barrier Reef, Great Victoria Desert, Lake Eyre, Lake Torrens, Mount Kosciusko, and Murray River.

In Europe, you'll find these landmarks: Volga River, Danube River, Rhine River, Dardanelles, English Channel, Alps, Baltic Sea, Bay of Biscay, and Aegean Sea.

In North America, see if you can find the Rocky Mountains, Death Valley, Everglades, Grand Canyon National Park, Great Lakes, Great Salt Lake, Klondike, Mississippi River, Niagara Falls, Painted Desert, Rio Grande, Yosemite National Park, and the Yukon River.

In South America are the following landmarks: Amazon River, Lake Titicaca, Andes Mountains, Cape Horn, Galapagos Islands, Angel Falls, Atacama Desert, Lake Maracaibo, and the Tropical Rain Forest.



ANIMAL CLASSIFICATIONS

The animal kingdom is one of the largest groups of living things. To classify them, scientists divide them into categories. Six of these are fishes, amphibians, reptiles, birds, mammals, and insects. Table 6 shows some of these animals classified by their category.

Table 6 *Animal Classifications*

| Fishes | Amphibians | Reptiles | Birds | Mammals | Insects |
|----------|--------------------|--------------|----------|------------|------------|
| pike | frog | iguana | robin | tiger | ant |
| trout | toad | gecko | crow | rabbit | aphid |
| perch | salamander | gila monster | jay | cow | bee |
| carp | tailed frog | thorn devil | raven | armadillo | butterfly |
| catfish | tree frog | tortoise | eagle | camel | cicada |
| bass | spadefoot toad | turtle | ostrich | dog | cricket |
| marlin | spring peeper | crocodile | emu | whale | earwig |
| halibut | narrowmouth toad | snake | owl | rat | flea |
| seahorse | bullfrog | chameleon | duck | monkey | katydid |
| salmon | spotted salamander | alligator | goose | kangaroo | wasp |
| tuna | mudpuppy | tuataras | vulture | bat | termite |
| turbot | newt | lizard | macaw | seal | silverfish |
| eel | caecilian | caiman | flamingo | rhinoceros | louse |

LEARNING THE ANIMAL KINGDOM

Did you know that many different kinds of animals have made their homes in different regions around the world? Next time you're traveling in new territory, see if you can find some of the following (from a safe distance of course).

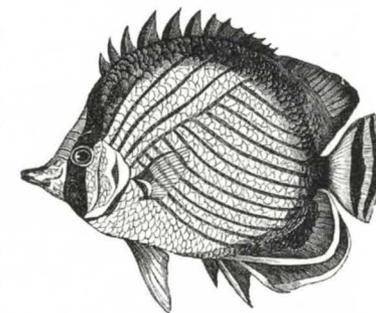
In the high mountain regions some animals include yaks, bighorn sheep, snow leopards, Himalayan ibexes, chinchillas, vicunas, giant pandas, and Marco Polo sheep.

In the grasslands look for ostriches, giraffes, aardvarks, zebras, gnus, pronghorns, kudus, blackbucks, hippopotamuses, kangaroos, prairie dogs, and elephants.

In the temperate forest, you'll find moose, wood frogs, otters, beavers, muskrats, raccoons, skunks, porcupines, opossums, woodchucks, chipmunks, white-tailed deer, snapping turtles, wild boars, koalas, echidnas, flying squirrels, and garter snakes.

In tropical forests, expect to see black howler monkeys, spider monkeys, coati, iguana, two-toed sloths, ocelots, tree boa constrictors, axis deer, chevrotains, tapirs, gibbons, bongos, jaguars, leopards, and orangutans.

If you happen to be in the desert, you'll find dingoes, scorpions, camels, dromedaries, saigas, gila monsters, kit foxes, bobcats, coyotes, muledeer, pocket mice, kangaroo rats, cacomistles, sidewinders, and chuckwallas.



Put on your parka at the polar regions. Some of the animals you'll find in these ice-capped places are musk oxen, arctic hares, polar bears, emperor penguins, caribou, walruses, collared lemmings, and ermine.

When you're swimming in the ocean look for these aquatic creatures: octopuses, whales, manatees, sharks, copepods, starfishes, limpets, jellyfishes, and saltwater crocodiles.

DR. BRAIN'S FAVORITE SONG WRITERS AND COMPOSERS

Look up Irving Berlin, George Cohan, Jerome Kern, Cole Porter, Richard Rodgers, Franz Schubert, and Paul Simon in your Glossary.

SECTION
THREE
REFERENCE

Glossary of General Terms

Abstract expressionism - Abstract expressionist artists shared a common outlook characterized by a spirit of revolt against tradition and a demand for spontaneous freedom of expression. One form of abstract expressionism is action painting.

Accidental - Music term meaning a sign (#, *b*) not in the key signature.

Acronym - Acronyms are words and abbreviations made up of the initials of other words. For example, BASIC stands for Beginners All-Purpose Symbolic Instruction Code, ROY G. BIV stands for the colors of the rainbow (Red, Orange, Yellow, Green, Blue, Indigo, and Violet), and FDIC stands for Federal Deposit Insured Corporation.

Action painting - A technique and style of painting made famous by Jackson Pollock. The artist using this style drips, dribbles, splashes, and pours paint over the canvas, which is often laid on the floor rather than placed upright.

Adjective - An adjective describes a noun or pronoun. For example, "She had *blue* hair. That elephant was *huge*."

Adverb - An adverb modifies a verb, an adjective, or another adverb. It tells when, how, where, why, how much, and how often. For example, "She talks *quietly*. (*Quietly* modifies the verb *talks*.) You're *really* funny. (*Really* modifies the adjective *funny*.)"

Algae - The slimy scum you see on the surface of a stagnant pond is blue-green algae. Blue-green algae were among the first forms of life to appear on Earth more than 3,000 years ago.

Allegro - Musical term meaning to play quickly and lively.

Amoeba - The amoeba is a single-celled animal called a protozoan. It lives in ponds and puddles. The amoeba moves by stretching out a part of its body known as a pseudopod, or "false foot."

Alcohol - One of the liquids you can measure in Dr. Brain's elevator puzzle.

Amphibians - Any of a class of cold-blooded vertebrates (such as frogs, toads, or newts) intermediate in many stages between fishes and reptiles and having gilled aquatic larvae and air-breathing adults.

Andante - Musical term meaning play slowly.



Glossary of General Terms

Antonym - A word that is opposite in meaning to another word. Hot and cold; dark and bright; etc.

Applying - The scientific thinking process by which we use knowledge.

Archimedes - Greek scientist who explained how levers and pulleys work and discovered how things float.

Atomic Weight - This is the weight of one atom of an element compared to the weight of an atom of carbon. You can discover the atomic weights of all known elements on the Periodic Table of the Elements (in your reference section of the EncycloAlmanacTionaryOgraphy).

Berlin, Irving - One of Dr. Brain's favorite song writers. Created such memorable hits as *Easter Parade*, *God Bless America*, *White Christmas*, *Alexander's Ragtime Band*, *All Alone*, *Blue Skies*, and *Always*.

Brahmin - A Hindu of the highest caste traditionally assigned to the priesthood.

Brass - Some of the most exciting sounds in music come from brass instruments. Some of the instruments in this group are the French horn, the trumpet, and the tuba.

Capacitor - A device for storing electrical charge.

Categorizing - The scientific thinking process that deals with patterns of groups and classes.

Cerebral - Of or relating to the brain or the intellect.

Cerebellum - A large dorsally projecting part of the brain concerned especially with the coordination of muscles and the maintenance of bodily equilibrium.

Charts - An outline map exhibiting something (as climatic or magnetic variations) in its geographical aspects; a map for the use of navigators.

Chord - A music term meaning a combination of three or more tones.

Chromosome - Chromosomes are in the nucleus of the cell. They carry genetic information and give a unique mixture of genetic material to each person. Chromosomes contain DNA which is the main carrier of genetic information in almost all living things.

Cilia - A minute short hairlike growth of a cell that is capable of lashing movement and serves to produce locomotion.

Cipher - A cipher converts plain text into a scrambled message by substituting another letter, number, or symbol for each letter of plain text or by mixing up the letters.

Circuit - The complete path of an electric current usually including the source of electric current.

Circulatory system - The system of blood, blood vessels, lymphatics, and heart concerned with the circulation of the blood and lymph.

Coding - To put in the form or symbols of a code forming a system of communication; also, to specify the genetic code.

Cohan, George M. - One of Dr. Brain's favorite song writers. He wrote the following songs: *I'm a Yankee Doodle Dandy*, *Give My Regards to Broadway*, *You're a Grand Old Flag*, *Mary's a Grand Old Name*, *Harrigan*, and *Over There*.

Common time - A musical term denoted by a time signature (C) indicating 4/4 time.

Communicating - The scientific thinking process that conveys ideas through social interchanges.

Glossary of General Terms

Comparing - The scientific thinking process that deals with concepts of similarities and differences.

Conjunction - A conjunction connects two individual words or groups of words. Some coordinate conjunctions are as follows: and, or, but, nor, for, yet, and so.

Contraction - A contraction is a word that is shortened by the omission of one or more letters, often combining two words into one word, with the insertion of an apostrophe. For example, *do not* becomes *don't*, *would not* becomes *wouldn't*, and *who is* becomes *who's*.

Constellation - Groups of stars often forming recognizable forms and shapes.

Cortex - The outer layer of gray matter of the cerebrum and cerebellum of the brain.

Cubism - Movement in painting developed by Picasso and Braque in the early 1900s. It is recognized as one of the great turning points in Western art. Cubists broke down their subject so that rather than showing them from a single, fixed viewpoint, many different aspects of the same object could be seen simultaneously. Picasso's works in cubism were generally called Analytical Cubism because forms were analyzed into predominantly geometrical structures and color was extremely subdued.

Cup - A cup is 8 ounces. You can experiment with a cup in Dr. Brain's elevator.

Cryptography - Writing and understanding secret messages. A person who engages in this activity is known as a cryptographer.

Dali, Salvador (1904-1989) - Painter on display in Dr. Brain's Art Gallery. He became a leader of surrealism. With a precise style, he created nightmare effects in his works, such as in *The Persistence of Memory*.

Da Vinci, Leonardo - The great Italian artist and inventor designed many machines, including a parachute and a helicopter, which were never built in his time. Leonardo was well ahead of his time.

Decipher - Converting a scrambled message into intelligible language or plain text.

Diagonal - A straight line in an oblique direction.

Digestion - The process of making food absorbable by dissolving it and breaking it down into simpler chemical compounds.

Dominant characters - Factors that are transmitted or inherited from one generation to the next and are clearly visible.

Domino - A polyomino made of two units. See *polyominoes*.

Duration - A continuance of time or the time during which something exists or lasts.

Dürer, Albrecht (1471-1528) - Dürer was one of the most influential German painters, engravers, and theoreticians of all time. He created such works as "Passion of Christ," "Melancholia," and "Apocalypse." His many self-portraits reveal a self-awareness rare for his time. He produced some important altarpieces, many sensitive watercolors of wildlife and landscapes, several



Glossary of General Terms

decorative projects, and treatises on human proportions, applied geometry, and fortifications.

Easter Island - Island in the South Pacific Ocean containing many unusual polynesian hieroglyphs and gigantic carved heads, some weighing over 50 tons!

Egyptian - A native or inhabitant of Egypt.

Element - A substance composed of atoms having the same atomic number. For more information on elements, see the Periodic Table of Elements in your reference section.

Encipher - Technique used by cryptographers to convert plain text into scrambled form.

EncycloAlmanacTionaryOgraphy - Dr. Brain's all-encompassing reference manual combining an encyclopedia, an almanac, a dictionary, a bibliography and game playing instructions.

Ensure - To make sure, certain, or safe: guarantee.

Expressionism - Term used to describe works of art and literature in which the representation of reality is distorted to communicate an artist's inner vision, transforming nature rather than imitating it.

Fibonacci, Leonardo (1170-1240) - Italian mathematician who invented the fibonacci sequence of numbers; 1, 1, 2, 3, 5, 8, 13, etc.

Fine - Musical term meaning *the end*.

Flagellum - A long hairlike locomotory organelle on the surface of a cell.

Flat - Musical term for a sign (*b*) which indicates a pitch one-half step lower.

Forte - Musical term meaning to play loudly (*f*).

Gallon - A gallon is 64 ounces or 16 cups. You can experiment with a gallon container in Dr. Brain's elevator.

Gershwin, George - One of Dr. Brain's favorite song writers. This famous American composer created songs such as *Swanee*, *I Got Rhythm*, *Love Walked In*, and *Embraceable You*.

Gene - The unit of heredity.

Genetics - The scientific study of heredity or chromosomal inheritance. The science arose in 1900, with the rediscovery of Gregor Mendel's work on traits that are inherited as if each were a separate, independent unit. Geneticists call the unit of inheritance the gene. Genes are located on the chromosomes in the nucleus, are passed on from generation to generation, and exert control over the characteristics of organisms.

Greek - A native or inhabitant of Greece.

Half step - A musical term meaning the distance from one key on the piano to the next in either direction.

Hindu - The dominant cultic religion of India emphasizing dharma with its resulting ritual and social observances and often mystical contemplation and ascetic practices.

Hippopotomonstrosesquipedalian - A word pertaining to a very long word.

Homonym - A word that is pronounced the same as another word, but has a different meaning and spelling. *Won* and *one*. *Maize* and *maze*.

Hydra - A many-headed serpent or monster in Greek mythology, slain by Hercules, each head of which when cut off was replaced by two others. A small tubular microscopic lifeform having at one end a mouth surrounded by tentacles.

Glossary of General Terms

Hypothalamus - Part of the posterior portion of the vertebrate forebrain, containing important centers of the autonomic nervous system and centers of emotion.

Icon - A pictorial representation for something else, i.e. the Icon Bar in *the Island of Dr. Brain* represents the actions a Player may make during the game.

Inductor - A coil which stores electrical current (such as a magnetic field) which also releases energy on the change of a current.

Impressionism - Late 19th century movement in art generally characterized by the attempt to depict transitory visual impressions, often painted directly from nature, and by the use of broken color to achieve brilliance and luminosity.

Inferring - The scientific thinking process that deals with principles concerning interactions.

Interjection - A word or phrase expressing strong emotion. For example, "All right! Good job! Congratulations!"

Interval - A musical term meaning the difference in pitch between two sounds.

Inversion - A musical term for a chord having a note other than the root in the bass.

Kandinsky, Wassily (1866-1944) - Russian abstract painter and theorist. He developed his ideas concerning the power of pure color and nonrepresentational painting in Paris. He examined the psychological effects of color in such works as *Spiritual in Art* (1912). In the 1920's his style evolved from pure bursts of color to more precise geometric compositions.

Karnaugh Map (K-Map) - A reorganized truth table used to minimize the complexity of a logical structure.

Kern, Jerome - One of Dr. Brain's favorite song writers. Created hits such as *Bill, All the Things You Are, Make Believe, Ol' Man River, and Smoke Gets in Your Eyes.*

Key signature - A musical term for flats or sharps placed after the clef sign to indicate which notes to play flat or sharp.

Kinetic energy - Energy associated with motion.

Kinetic theory - Either of two theories in physics based on the fact that the minute particles of a substance are in vigorous motion.

Kitchen sink - The usual place where household dishes are washed.

Legato - A musical term meaning to play in a manner that is smooth and connected.

Lines of Latitude - The imaginary lines that go from east to west around the Earth.

Lines of Longitude - The imaginary lines that go from north to south around the Earth.

Magic Number - In magic square puzzles, the magic number is generally the number which all columns, rows, and diagonals equal.

Magic square - A square containing a number of integers arranged so that the sum of the numbers in each row, column, and diagonal is the same.

Mass - The property of a body that is a measure of its inertia, that is commonly taken as a measure of the amount of material it contains and causes it to have weight in a gravitational field, and that along with length and time constitutes one of the fundamental quantities on which all physical measurements are based.

Glossary of General Terms

Mass Spectrum - An instrumental method for identifying the chemical constitution of a substance by means of the separation of gaseous ions according to their differing mass and charge.

Mechanical Advantage - The advantage gained by the use of a simple machine (lever, pulley, wheel and axle, inclined plane and wedge, and screw) in using force. Mechanical advantage is also the ratio of the force that performs the useful work of a machine to the force that is applied to the machine.

Mendel, Gregor - An Austrian Monk, who conducted experiments chiefly on garden peas. With his controlled pollination technique and a careful statistical analysis of his results, he produced the first accurate and scientific explanation for chromosomal inheritance or *genetics*. In his experiment with garden peas, he found that factors (which he termed hereditary characteristics) are transmitted from one generation to the next. Sometimes a given character did not show, but it was there nevertheless. For example, when red and white flowered peas were crossed, all the offspring bore red flowers. However, one-quarter of the red-flowered second generation had white flowers. The factor for white flowers had been there in the second-generation plants, but it was "recessive" and had been masked by the "dominant" red flowers. The scientific community of his day was unprepared for so radical a view of heredity that it paid little heed to Mendel's results or theories. His findings, published in 1866, were therefore generally ignored. It wasn't until 1900, when three botanists, working independently in their own countries, confirmed Mendel's conclusions. As a result, Mendel died well before the scientific community acknowledged him as the "Father of Genetics."

Mendeleev, Dmitri (1834-1907) - Mendeleev is credited with formulating periodic law and the Periodic Table of the Elements. In so doing, he invented a system of classifying the elements that allowed him to predict properties of unknown elements. Since that time over 100 elements have been classified. Will you be the next to discover a new element?

Mercury - One of the elements on your Periodic Table of the Elements with an atomic weight of 200.59. This is a very heavy viscous liquid which you can experiment with in Dr. Brain's elevator.

Michelangelo Buonarroti (1475-1564) - Florentine sculptor, painter, architect, draftsman, and poet. He was one of the greatest figures of the Renaissance.

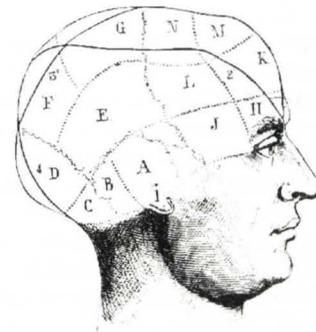
Mythology - The myths dealing with the gods, demigods, and legendary heroes of a particular people.

Natural - A musical term for a sign which cancels a previous flat or sharp.

Navigate - To operate or control the course of a boat or ship.

Nervous System - The bodily system that in vertebrates is made up of the brain and the spinal chord, nerves, ganglia, and parts of the receptor organs.

Newton, Sir Isaac - In 1666, Isaac Newton discovered that white light is really made up of a mixture of colors. In his darkened room, he placed a glass prism in a beam of



Glossary of General Terms

sunlight streaming through a small hole in the wall and saw white light split into the colors of the rainbow: Red, Orange, Yellow, Green, Blue, Indigo, and Violet, or ROY G. BIV. He also proposed the daring idea that gravity is a universal force, keeping planets and moons in their orbits as well as causing things to fall to the ground. Newton also put forward the famous laws of motion and invented calculus.

Noun - A noun is a person, place, thing, or idea. Some examples are as follows: Uncle George, grandpa, Lake Millerton, stream, Ford Taurus, wheels, Christmas, happiness.

Number Patterns - Look for patterns in numbers and you will greatly enhance your problem-solving skills. For example, 12, 0, -12, -24, -36; this pattern decreases by 12 each time.

Observing - The scientific thinking process from which fundamental patterns of the world are constructed.

Octave - A musical term for the interval from one letter name to the next note of the same name, either up or down.

O'Keeffe, Georgia (1887-1986) - An American painter whose works are marked by organic, abstract forms painted in clear, strong colors. O'Keeffe lived much of her life in New Mexico and frequently employed motifs from the Southwest in her paintings.

Olfactory - Of, relating to, or connected with the sense of smell.

Ordering - The scientific thinking process that deals with patterns of sequence and seriation.

Paramecium - These one-celled cilia covered organisms have a permanent structure, an organelle, that functions in feeding. Some of them are among the most incredibly complex cells known.

Parts of Speech - There are eight different parts of speech: noun, pronoun, verb, adjective, adverb, preposition, conjunction, and interjection. For more information, you may wish to look up each in this glossary.

Percussion - Bells, gongs, drums. These instruments are beaten or shaken to make sound.

Periodic Table - An arrangement of the chemical elements based on the periodic law which states: the elements when arranged in the order of their atomic numbers show a periodic variation in most of their properties.

Perseverance - What you need to complete *the Island of Dr. Brain*. It's the continuation of something usually to an exceptional degree or beyond a desired point: steadfastness.

Pianissimo - A musical term meaning play very softly (*pp*).

Piano - A musical term meaning play softly (*p*).

Picasso, Pablo (1881-1973) - A Spanish painter, sculptor, graphic artist, and ceramist who worked in France. Leader of the School of Paris, he was remarkable for his technical virtuosity, incredible originality, and being prolific. In his later years, Picasso turned to creations of fantasy and comic invention. Working consistently in sculpture, ceramics, and the graphic arts, he continued to explore his personal vision until his death at 91.

Pitch - The property of a sound and especially a musical tone that is determined by the frequency of the waves producing it: highness or lowness of sound.

Glossary of General Terms

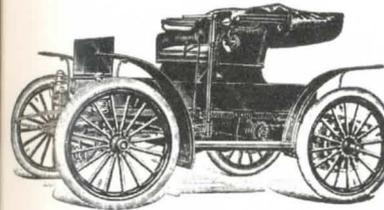
Pituitary Gland - An endocrine gland located near the brain of vertebrates; known as the master gland because it secretes hormones that regulate the action of the other endocrine glands.

Plain text - In ciphers, plain text is the message to be written secretly.

Planaria - These free-living aquatic organisms, also known as flatworms, have distinct front and rear ends, as well as distinct upper and lower surfaces. Their bodies are composed of three well-formed tissue layers.

Polar - Of, or relating to, a geographical pole or the region around it.

Pollock, Jackson (1912-1989) - An American painter who was a pioneer of abstract expressionism. He was influenced by Picasso and surrealism in his attempt to express, rather than illustrate, feeling. Pollock developed an abstract art in which he vigorously drew or "dripped" complicated linear rhythms onto enormous canvases.



Polyominoes ("poly" means many) - This is a large set of shapes formed by joining together identical square units, making special subsets according to the number of units involved. Solomon Golomb (the great American mathematician) is credited with their invention, when he first introduced them to the Harvard Mathematics Club in 1953. Polyomino patterns are examples of combinatorial (or computational) geometry. This type of mathematics deals with the ways in which geometrical shapes can be combined. Combinatorial geometry seems to

have few general methods, and in it systematic rules have not replaced ingenuity as the key to discovery. Therefore, many of the design problems in practical engineering are combinatorial in nature, especially when standard components or shapes are to be fitted together in some optimal fashion.

Pons - A broad mass of nerve fibers on the ventral surface of the brain of man and on lower mammals at the anterior end of the medulla oblongata.

Porter, Cole - One of Dr. Brain's favorite song writers. He wrote such great hits as *Begin the Beguine*, *Night and Day*, *I've Got You Under My Skin*, *You're the Top*, and *Anything Goes*.

Postimpressionism - Term referring to the work of some late 19th-century painters, in particular: Georges Seurat (1859-1891), Paul Cézanne (1839-1906), Vincent Van Gogh (1853-1890), and Paul Gauguin (1843-1903). The ways in which Postimpressionist artists rejected the naturalism and preoccupation with momentary effects used by impressionists varied greatly. Seurat concentrated on a scientific analysis of color. Cézanne was concerned with pictorial structure. Gauguin explored the symbolic use of color and line. And Van Gogh created a foundation for expressionism. A sound understanding of their individual styles and achievements is necessary if one is to fully comprehend twentieth-century art.

Potential energy - The energy that a piece of matter has because of its position or because of the arrangement of its parts.

Prefix - A word "part" added to the front of a word to enhance its meaning.

Glossary of General Terms

Preposition - A word (or group of words) which shows how two words or ideas are related to each other. For example, about, around, because of, down, on, since, under, and upon.

Probe - A scientific vehicle that travels through space and sends information back to earth.

Pronoun - A pronoun is a word used in place of a noun. Some examples are as follows: (Personal Pronouns) I, you, he, she, it, we, you, and they; (Relative Pronouns) who, whose, whom, which, what, that; (Demonstrative Pronouns) this, that, these, those; (Intensive and Reflexive Pronouns) myself, himself, herself, themselves, ourselves; (Indefinite Pronouns) all, both, everything, nobody, and someone.

Pronunciation - The way a word is sounded or spoken.

Pulleys - A pulley is a simple machine which consists of a wheel over which a rope, belt, chain, or cable runs. See mechanical advantage.

Push-pull force - A push-pull force is just what it sounds like: a force which pushes or pulls things.

Quart - A quart is 32 ounces or 4 cups. You can experiment with a quart container in Dr. Brain's elevator.

Recessive characters - In genetics, these are factors that are transmitted or inherited from one generation to the next but are not always visible.

Relating - The scientific thinking process that deals with principles concerning interactions.

Reptiles - Scaly-skinned animals such as alligators, turtles, and snakes are called reptiles. Some reptiles live in water and some on land; most are found in warmer parts of the world. The ancestors of today's reptiles were the dinosaurs.

Resistor - A resistor reduces the amount of current flowing in a circuit.

Respiratory System - The lungs, the airways, the throat, and the nasal passage make up the respiratory system. The lungs absorb vital oxygen from the air.

Rhythm - A music term which refers to all the elements, such as accent, meter, and tempo that relate to forward movement. Also the instruments in the band supplying the rhythm (the rhythm section).

Rodgers, Richard - Famous American composer who created famous tunes (often in collaboration with other composers). One of Dr. Brain's favorite song writers. Some of his works include: *The Lady is a Tramp*, *Falling in Love With Love*, *People Will Say We're in Love*, *Some Enchanted Evening*, and *Hello, Young Lovers*.

Roman - Two thousand years ago a single government and way of life united most of western Europe, the Middle East, and the north coast of Africa called the Roman Empire. The Roman Empire was based on good organization and centralized control. Strong border defenses manned by the Roman army protected the empire, while a skilled civil service governed it. The empire reached its height of power in about A.D. 200 and then began to decline slowly.

Rotational speed - A fancy way of describing how a gear or wheel spins around.

Scale - A musical term for a scale of tones arranged in a sequential order of ascending and descending pitches.

Glossary of General Terms

Schubert, Franz Peter - One of Dr. Brain's favorite song writers. This famous composer created such symphonies as *Ave Maria*, *Death and the Maiden*, *Serenade*, *the Trout*, and *Who is Sylvia?* to name a few.

Shakespeare, William (1564-1616) - Considered the greatest of all playwrights, this English dramatist and poet wrote such works as "The Rape of Lucrece" and "Hamlet."

Sharp - A musical term for a sign (#) which indicates a pitch one-half step higher.

Simon, Paul - One of Dr. Brain's favorite song writers. Some of the songs he wrote are as follows: *The Sounds of Silence*, *Homeward Bound*, *Mrs. Robinson*, *Bridge Over Troubled Water*, and *Loves Me Like a Rock*.

Skeleton - A rigid supportive framework (bones) of the body.

Spectrum - A series of images formed when a beam of radiant energy is subjected to dispersion and brought to focus so that the component waves are arranged in the order of their wavelengths (as when a beam of sunlight that is refracted and dispersed by a prism forms a display of colors).

Strings - The string section of a band is made up of instruments with the vibrating strings stretched across them to make music. The finer the string and shorter its length, the higher the note. Two string instruments are the violin and the cello.

Suffix - A word "part" added to the back of a word to enhance its meaning.

Surrealism - A movement in art and literature which flourished in the 1920s and 30s, characterized by a fascination with the bizarre, the incongruous, and the irrational. Andre Breton said its primary purpose was "to resolve the previously contradictory conditions of dream and reality into an absolute reality, a super-reality." The poet Lautreamont wrote, "Beautiful as the chance encounter of a sewing machine and an umbrella on an operating table."

Synonym - A word that has the same meaning as another word. *Hairy* and *furry*. *Angry* and *mad*.

Temperate - Having a moderate climate.

Tempo - The rate of speed of a musical piece or passage indicated by one of a series of directions, i.e. *largo*, *allegro*, *legato*.

Tetramino - A polyomino shape consisting of four units. See polyominoes.

Teutonic - Germanic.

Thalamus - Part of the rear portion of the vertebrate forebrain.

Thesaurus - A book of words and their synonyms.

Tonic - A music term meaning the keynote of a scale.

Tower of Hanoi - Ancient Brahmin puzzle using gold disks placed on three poles. You can see Dr. Brain's version of the Tower of Hanoi in the cave on the island.

Transpose - A musical term meaning to change the key of a composition to a higher or lower one.



Treble Clef - Shows the pitch at which to play the music.

Triad - A music term for a chord of three tones consisting of a root, third, and fifth.

Trivial - Commonplace, ordinary.

Tromino - A polyomino shape consisting of three units. See polyominoes.

Truth table - A listing of all possible states of a boolean function.

Van Gogh, Vincent (1853-1890) - Dutch postimpressionist painter. The great majority of his works were produced in 29 months of frenzied activity interspersed with epileptic seizures, his cutting off his ear, and despair that finally ended in suicide. His story has been captured in the movie *Vincent and Theo* (available on videocassette).

Ventricle - A chamber of the heart which receives blood from a corresponding atrium and from which blood is forced into the arteries.

Verb - A verb is a word which expresses action or existence. For example, "He ran to the store. (action) They played basketball yesterday afternoon. (action) We were in the stands to watch. (existence)"

Vivo - A musical term meaning to play lively; briskly.

Vocabulary - A list or collection of words and phrases employed by a language, group, individual, work, or field of knowledge.

Water - One of the liquids in Dr. Brain's measurement puzzle. Water has a molecular structure of H₂O.

Whole step - A music term meaning twice the distance of a half step.

Woodwind - Flutes, oboes, saxophones. Woodwind instruments are characterized by a cylindrical or conical tube of wood or metal usually ending in a slightly flared bell, that produces tones by the vibration of one or two reeds in the mouthpiece or by the passing of air over a mouth hole. These instruments usually also have finger holes or keys to allow the player to produce all the tones within the instrument's range.

BIBLIOGRAPHY

- Albee, Edward. *A Delicate Balance*. New York, Atheneum Press, 1966.
Albee, Edward. *All Over*. New York, Atheneum Press, 1971.
Albee, Edward. *Seascape*. New York, Atheneum Press, 1963.
Albee, Edward. *The American Dream*. New York, Coward-McCann, 1961.
Albee, Edward. *The Death of Bessie Smith*. New York, Coward-McCann, 1961.
Albee, Edward. *The Zoo Story*. New York, Coward-McCann, 1960.
Albee, Edward. *Tiny Alice*. New York, Atheneum Press, 1963.
Albee, Edward. *Who's Afraid of Virginia Woolf?* New York, Atheneum Press, 1963.
Alcott, Louisa May. *An Old-Fashioned Girl*. Boston, Little, Brown Publishing, 1911.
Alcott, Louisa May. *Eight Cousins*. Boston, Little, Brown Publishing, 1934.
Alcott, Louisa May. *Jo's Boys*. Boston, Little, Brown Publishing, 1950.
Alcott, Louisa May. *Little Men*. Boston, Little, Brown Publishing, 1913.
Alcott, Louisa May. *Little Women*. Garden City, New York, Garden City

Bibliography

- Publishing Company, Inc., 1932.
Auden, W. H. "In Praise of Limestone." *The New Pocket Anthology of American Verse*. New York, The Pocket Library, 1958.
Auden, W. H. "The Labyrinth." *The New Pocket Anthology of American Verse*. New York, The Pocket Library, 1958.
Auden, W. H. "Lakes." *The New Pocket Anthology of American Verse*. New York, The Pocket Library, 1958.
Auden, W. H. "Perhaps." *The New Pocket Anthology of American Verse*. New York, The Pocket Library, 1958.
Auden, W. H. "The Trial." *The New Pocket Anthology of American Verse*. New York, The Pocket Library, 1958.
Auden, W. H. "The Shield of Achilles." *The New Pocket Anthology of American Verse*. New York, The Pocket Library, 1958.
Auden, W. H. "The Unknown Citizen." *The New Pocket Anthology of American Verse*. New York, The Pocket Library, 1958.
Auden, W. H. "Under Sirius." *The New Pocket Anthology of American Verse*. New York, The Pocket Library, 1958.
Auden, W. H. "Woods." *The New Pocket Anthology of American Verse*. New York, The Pocket Library, 1958.
Austin, Jane. *Emma*. London, J.M. Dent; E.P. Dutton, 1926.
Austin, Jane. *Mansfield Park*. London, Collins Publishing, 1962.
Austin, Jane. *Northanger Abbey*. London, Oxford University Press, 1963.
Austin, Jane. *Pride and Prejudice*. New York, Knopf Publishing, 1991.
Austin, Jane. *Sense and Sensibility*. London, Oxford University Press, 1990.
Blume, Judy. *Are you there God? It's Me, Margaret*. Scarsdale, New York, Bradbury Press, 1970.
Blume, Judy. *Blubber*. New York, Dell Publishing Company, 1974.
Blume, Judy. *Otherwise Known as Sheila the Great*. Scarsdale, New York, Bradbury Press, 1972.
Blume, Judy. *Superfudge*. New York, Dutton Publishing Company, 1980.
Blume, Judy. *Tales of a Fourth Grade Nothing*. New York, Dutton Publishing, 1980.
Blume, Judy. *Then Again, Maybe I Won't*. Scarsdale, New York, Bradbury Press, 1977.
Buck, Pearl S. *The Good Earth*. New York, The John Day Company, 1973.
Buck, Pearl S. *Dragon Seed*. New York, The John Day Company, 1977.
Buck, Pearl S. *Imperial Woman*. New York, The John Day Company, 1978.
Buck, Pearl S. *The Living Reed*. New York, The John Day Company, 1979.
Buck, Pearl S. *East Wind: West Wind*. New York, The John Day Company, 1979.
Buck, Pearl S. *My Several Worlds*. New York, The John Day Company, 1981.
Buck, Pearl S. *A House Divided*. New York, The John Day Company, 1982.
Buck, Pearl S. *A Bridge for Passing*. New York, The John Day Company, 1984.
Chekhov, Anton. *The Cherry Orchard*. Minneapolis, Indiana, University of Minnesota Press, 1965.
Chekhov, Anton. *Ivanov*. New York, Theater Arts Books, 1966.

Bibliography

- Chekhov, Anton. The Seagull. Melville, New York, Belwin-Mills Publishing, 1975.
- Chekhov, Anton. Three Sisters. London, Methuen Publishing, 1983.
- Chekhov, Anton. Uncle Vanya. New York, Covici, Friede Publishing, 1930.
- Cleary, Beverly. Beezus and Ramona. New York, Morrow Publishing, 1955.
- Cleary, Beverly. Dear Mr. Henshaw. New York, Morrow Publishing, 1955.
- Cleary, Beverly. Henry Huggins. New York, Morrow Publishing, 1955.
- Cleary, Beverly. Runaway Ralph. New York, Morrow Publishing, 1970.
- Cleary, Beverly. The Mouse and the Motorcycle. New York, Morrow Publishing, 1955.
- Crane, Steven. "A Learned Man." The New Pocket Anthology of American Verse. New York, The Pocket Library, 1958.
- Crane, Steven. "A Man Saw a Ball of Gold in the Sky." The New Pocket Anthology of American Verse. New York, The Pocket Library, 1958.
- Crane, Steven. "A Youth in Apparel That Glittered." The New Pocket Anthology of American Verse. New York, The Pocket Library, 1958.
- Crane, Steven. "I Saw a Man Pursuing the Horizon." The New Pocket Anthology of American Verse. New York, The Pocket Library, 1958.
- Crane, Steven. "I Stood Upon a High Place." The New Pocket Anthology of American Verse. New York, The Pocket Library, 1958.
- Crane, Steven. "There was a Man with a Tongue of Wood." The New Pocket Anthology of American Verse. New York, The Pocket Library, 1958.
- Crane, Steven. "The Wayfarer." The New Pocket Anthology of American Verse. New York, The Pocket Library, 1958.
- Cummings, E. E. "All in Green Went My Love Riding." The New Pocket Anthology of American Verse. New York, The Pocket Library, 1958.
- Cummings, E. E. "Always Before Your Voice My Soul." The New Pocket Anthology of American Verse. New York, The Pocket Library, 1958.
- Cummings, E. E. "My Sweet Old Etcetera." The New Pocket Anthology of American Verse. New York, The Pocket Library, 1958.
- Cummings, E. E. "No Man, if Men are Gods." The New Pocket Anthology of American Verse. New York, The Pocket Library, 1958.
- Cummings, E. E. "Pity This Busy Monster, Manunkind." The New Pocket Anthology of American Verse. New York, The Pocket Library, 1958.
- Cummings, E. E. "Spring is Like a Perhaps Hand." The New Pocket Anthology of American Verse. New York, The Pocket Library, 1958.
- Cummings, E. E. "What if a Much of a Which of a Wind." The New Pocket Anthology of American Verse. New York, The Pocket Library, 1958.
- Dickens, Charles. A Christmas Carol. New York, Columbia University Press, 1956.
- Dickens, Charles. A Tale of Two Cities. New York, The Heritage Club, 1938.
- Dickens, Charles. Bleak House. New York, Heritage Press, 1942.
- Dickens, Charles. David Copperfield. Berkeley, California, Porter, 1947.
- Dickens, Charles. Great Expectations. London, Oxford University Press, 1953.
- Dickens, Charles. Oliver Twist. London, Clarendon Press, 1966.
- Dickens, Charles. The Old Curiosity Shop. London, Oxford University Press, 1951.

Bibliography

- Dickenson, Emily. "A Shady Friend for Torrid Days." The New Pocket Anthology of American Verse. New York, The Pocket Library, 1958.
- Dickenson, Emily. "After Great Pain a Formal Feeling Comes." The New Pocket Anthology of American Verse. New York, The Pocket Library, 1958.
- Dickenson, Emily. "Because I Could Not Stop for Death." The New Pocket Anthology of American Verse. New York, The Pocket Library, 1958.
- Dickenson, Emily. "I Heard a Fly Buzz When I Died." The New Pocket Anthology of American Verse. New York, The Pocket Library, 1958.
- Dickenson, Emily. "I Taste a Liqueur Never Brewed." The New Pocket Anthology of American Verse. New York, The Pocket Library, 1958.
- Dickenson, Emily. "I Took My Power in My Hand." The New Pocket Anthology of American Verse. New York, The Pocket Library, 1958.
- Dickenson, Emily. "My Life Closed Twice Before Its Close." The New Pocket Anthology of American Verse. New York, The Pocket Library, 1958.
- Dickenson, Emily. "Step Lightly on This Narrow Spot." The New Pocket Anthology of American Verse. New York, The Pocket Library, 1958.
- Dickenson, Emily. "The Soul Selects Her Own Society." The New Pocket Anthology of American Verse. New York, The Pocket Library, 1958.
- Dickenson, Emily. "The Wind Tapped Like a Tired Man." The New Pocket Anthology of American Verse. New York, The Pocket Library, 1958.
- Faulkner, William. A Fable. New York, Random House, 1954.
- Faulkner, William. A Rose for Emily. Columbus, Ohio, Merrill Publishing, 1970.
- Faulkner, William. Absalom, Absalom! New York, Random House, 1977.
- Faulkner, William. Go Down, Moses. New York, Random House, 1980.
- Faulkner, William. Requiem for a Nun. New York, Random House, 1951.
- Faulkner, William. The Reivers. New York, Random House, 1962.
- Faulkner, William. The Sound and the Fury. New York, Random House, 1984.
- Faulkner, William. The Unvanquished. New York, Random House, 1938.
- Frost, Robert. "Acquainted with the Night." The New Pocket Anthology of American Verse. New York, The Pocket Library, 1958.
- Frost, Robert. "Fire and Ice." The New Pocket Anthology of American Verse. New York, The Pocket Library, 1958.
- Frost, Robert. "The Hill Wife (The Impulse)." The New Pocket Anthology of American Verse. New York, The Pocket Library, 1958.
- Frost, Robert. "On Looking up by Chance at the Constellations." The New Pocket Anthology of American Verse. New York, The Pocket Library, 1958.
- Frost, Robert. "Stopping by Woods on a Snowy Evening." The New Pocket Anthology of American Verse. New York, The Pocket Library, 1958.
- Frost, Robert. "The Silken Tent." The New Pocket Anthology of American Verse. New York, The Pocket Library, 1958.
- Frost, Robert. "The Witch of Coos." The New Pocket Anthology of American Verse. New York, The Pocket Library, 1958.
- Frost, Robert. "To Earthward." The New Pocket Anthology of American Verse. New York, The Pocket Library, 1958.
- Hemingway, Ernest. Death in the Afternoon. New York, Charles Scribner and Sons, 1932.

Bibliography

- Hemingway, Ernest. A Farewell to Arms. New York, Charles Scribner and Sons, 1957.
- Hemingway, Ernest. For Whom the Bell Tolls. New York, Charles Scribner and Sons, 1940.
- Hemingway, Ernest. The Old Man and the Sea. New York, Charles Scribner and Sons, 1980.
- Hemingway, Ernest. The Snows of Kilimanjaro, and other stories. New York, Charles Scribner and Sons, 1961.
- Hemingway, Ernest. The Sun Also Rises. New York, Charles Scribner and Sons, 1954.
- Ibsen, Henrik. A Doll's House. Baltimore, Maryland, Penguin Books, 1963.
- Ibsen, Henrik. An Enemy of the People. London, Eyre Methuen, 1974.
- Ibsen, Henrik. Brand. Minneapolis, Minnesota, University of Minnesota Press, 1981.
- Ibsen, Henrik. Ghosts. Baltimore, Maryland, Penguin Books, 1963.
- Ibsen, Henrik. Hedda Gabler. Baltimore, Maryland, Penguin Books, 1963.
- Ibsen, Henrik. Peer Gynt. New York, New American Library, 1964.
- Ibsen, Henrik. The Wild Duck. New York, Norton Publishing, 1968.
- King, Stephen. Carrie. Garden City, New York, Doubleday Publishing, 1979.
- King, Stephen. Christine. New York, New American Library, 1983.
- King, Stephen. Cujo. New York, Viking Press, 1981.
- King, Stephen. The Dead Zone. New York, NAL Penguin Inc., 1979.
- King, Stephen. The Firestarter. Garden City, New York, Doubleday Publishing, 1982.
- King, Stephen. Pet Sematary. Garden City, New York, Doubleday Publishing, 1983.
- King, Stephen. The Stand. Garden City, New York, Doubleday Publishing, 1978.
- King, Stephen. The Tommyknockers. New York, New American Library, 1988.
- Kipling, Rudyard. Captain Courageous. Garden City, New York, Doubleday Publishing, 1964.
- Kipling, Rudyard. The Jungle Book. Garden City, New York, Doubleday Publishing, 1964.
- Kipling, Rudyard. Just So Stories. Garden City, New York, Doubleday Publishing, 1952.
- Kipling, Rudyard. Kim. Garden City, New York, Doubleday Publishing, 1931.
- Kipling, Rudyard. Wee Willie Winkie and Other Stories. New York, Doubleday and McClure, 1899.
- Longfellow, Henry Wadsworth. "The Cross of Snow." The New Pocket Anthology of American Verse. New York, The Pocket Library, 1958.
- Longfellow, Henry Wadsworth. "Evangeline." The New Pocket Anthology of American Verse. New York, The Pocket Library, 1958.
- Longfellow, Henry Wadsworth. "Tales of a Wayside Inn." The New Pocket Anthology of American Verse. New York, The Pocket Library, 1958.
- Longfellow, Henry Wadsworth. "The Courtship of Miles Standish." The New

Bibliography

- Pocket Anthology of American Verse. New York, The Pocket Library, 1958.
- Longfellow, Henry Wadsworth. "The Song of Hiawatha." The New Pocket Anthology of American Verse. New York, The Pocket Library, 1958.
- Michener, James A. Centennial. New York, Random House, 1974.
- Michener, James A. Chesapeake. New York, Random House, 1978.
- Michener, James A. Hawaii. New York, Random House, 1959.
- Michener, James A. Sayonara. New York, Random House, 1954.
- Michener, James A. Tales of the South Pacific. New York, The MacMillan Company, 1947.
- Michener, James A. Texas. New York, Random House, 1985.
- Michener, James A. Poland. New York, Random House, 1988.
- Michener, James A. The Covenant. New York, Random House, 1980.
- Michener, James A. The Source. London, Secker and Warburg, 1965.
- Miller, Arthur. A View from the Bridge. New York, Viking Press, 1955.
- Miller, Arthur. After the Fall. New York, Viking Press, 1964.
- Miller, Arthur. All My Sons. New York, Viking Press, 1981.
- Miller, Arthur. Death of a Salesman. New York, Viking Press, 1968.
- Miller, Arthur. Incident at Vichy. New York, Viking Press, 1965.
- Miller, Arthur. The Crucible. Harmondsworth, England, Penguin Books, 1981.
- Miller, Arthur. The Price. London, Secker and Warburg, 1968.
- Molière. Don Juan. San Diego, California, Harcourt-Brace Jovanovich, 1963.
- Molière. The Learned Ladies. San Diego, California, Harcourt-Brace Jovanovich, 1978.
- Molière. The Misanthrope. London, Faber and Faber, 1958.
- Molière. The Miser. Woodbury, New York, Barron's Educational Series, Inc., 1964.
- Molière. Tartuffe, or the Imposter. New York, Harcourt, Brace, and World, 1963.
- Molière. The School for Wives. San Diego, California, Harcourt-Brace Jovanovich, 1991.
- Molière. The Would-Be Gentleman. San Diego, California, Harcourt-Brace Jovanovich, 1963.
- Nash, Ogden. "A Caution to Everybody." The New Pocket Anthology of American Verse. New York, The Pocket Library, 1958.
- Nash, Ogden. "And Three Hundred and Sixty-Six in Leap Year." The New Pocket Anthology of American Verse. New York, The Pocket Library, 1958.
- Nash, Ogden. "Oh, Please Don't Get Up!" The New Pocket Anthology of American Verse. New York, The Pocket Library, 1958.
- Nash, Ogden. "Oh, Stop Being Thankful All Over the Place." The New Pocket Anthology of American Verse. New York, The Pocket Library, 1958.
- Nash, Ogden. "Portrait of the Artist as a Prematurely Old Man." The New Pocket Anthology of American Verse. New York, The Pocket Library, 1958.
- Nash, Ogden. "Reflections on Ice-Breaking." The New Pocket Anthology of American Verse. New York, The Pocket Library, 1958.
- Nash, Ogden. "The Terrible People." The New Pocket Anthology of American Verse. New York, The Pocket Library, 1958.

Bibliography

- Poe, Edgar Allen. "Annabel Lee." The New Pocket Anthology of American Verse. New York, The Pocket Library, 1958.
- Poe, Edgar Allen. "Eldorado." The New Pocket Anthology of American Verse. New York, The Pocket Library, 1958.
- Poe, Edgar Allen. "Israfel." The New Pocket Anthology of American Verse. New York, The Pocket Library, 1958.
- Poe, Edgar Allen. "Tales of the Grotesque and Arabesque." The Complete Works of Edgar Allen Poe. New York, Crowell, 1902.
- Poe, Edgar Allen. "The Fall of the House of Usher." The Complete Works of Edgar Allen Poe. New York, Crowell, 1902.
- Poe, Edgar Allen. "The Gold-Bug." The Complete Works of Edgar Allen Poe. New York, Crowell, 1902.
- Poe, Edgar Allen. "Ligeia." The Complete Works of Edgar Allen Poe. New York, Crowell, 1902.
- Poe, Edgar Allen. "Morella." The Complete Works of Edgar Allen Poe. New York, Crowell, 1902.
- Poe, Edgar Allen. "Shadow." The Complete Works of Edgar Allen Poe. New York, Crowell, 1902.
- Poe, Edgar Allen. "The City in the Sea." The New Pocket Anthology of American Verse. New York, The Pocket Library, 1958.
- Poe, Edgar Allen. "The Happiest Day, The Happiest Hour." The New Pocket Anthology of American Verse. New York, The Pocket Library, 1958.
- Poe, Edgar Allen. "The Haunted Place." The New Pocket Anthology of American Verse. New York, The Pocket Library, 1958.
- Poe, Edgar Allen. "The Masque of the Red Death." The Complete Works of Edgar Allen Poe. New York, Crowell, 1902.
- Poe, Edgar Allen. "The Pit and the Pendulum." The Complete Works of Edgar Allen Poe. New York, Crowell, 1902.
- Poe, Edgar Allen. "The Purloined Letter." The Complete Works of Edgar Allen Poe. New York, Crowell, 1902.
- Poe, Edgar Allen. "The Raven." The New Pocket Anthology of American Verse. New York, The Pocket Library, 1958.
- Poe, Edgar Allen. "The Tell-Tale Heart." The Complete Works of Edgar Allen Poe. New York, Crowell, 1902.
- Poe, Edgar Allen. "To My Mother." The New Pocket Anthology of American Verse. New York, The Pocket Library, 1958.
- Poe, Edgar Allen. "To One in Paradise." The New Pocket Anthology of American Verse. New York, The Pocket Library, 1958.
- Seuss, Dr. Hop on Pop. New York, Beginner Books, 1963.
- Seuss, Dr. How the Grinch Stole Christmas. New York, Random House, 1957.
- Seuss, Dr. Green Eggs and Ham. New York, Beginner Books, 1960.
- Seuss, Dr. Horton Hears a Who. New York, Random House, 1957.
- Seuss, Dr. The Cat in the Hat. New York, Random House, 1957.
- Seuss, Dr. The Lorax. New York, Random House, 1957.
- Seuss, Dr. The Sneetches. New York, Random House, 1957.
- Seuss, Dr. You're Only Old Once. New York, Random House, 1957.
- Shakespeare, William. "A Lover's Complaint." The Complete Works of

Bibliography

- Shakespeare. Glenview, Illinois, Scott, Foresman, and Company, 1980.
- Shakespeare, William. "A Midsummer Night's Dream." The Complete Works of Shakespeare. Glenview, Illinois, Scott, Foresman, and Company, 1980.
- Shakespeare, William. "All's Well That Ends Well." The Complete Works of Shakespeare. Glenview, Illinois, Scott, Foresman, and Company, 1980.
- Shakespeare, William. "Anthony and Cleopatra." The Complete Works of Shakespeare. Glenview, Illinois, Scott, Foresman, and Company, 1980.
- Shakespeare, William. "As You Like it." The Complete Works of Shakespeare. Glenview, Illinois, Scott, Foresman, and Company, 1980.
- Shakespeare, William. "Hamlet." The Complete Works of Shakespeare. Glenview, Illinois, Scott, Foresman, and Company, 1980.
- Shakespeare, William. "King Lear." The Complete Works of Shakespeare. Glenview, Illinois, Scott, Foresman, and Company, 1980.
- Shakespeare, William. "Macbeth." The Complete Works of Shakespeare. Glenview, Illinois, Scott, Foresman, and Company, 1980.
- Shakespeare, William. "The Merchant of Venice." The Complete Works of Shakespeare. Glenview, Illinois, Scott, Foresman, and Company, 1980.
- Shakespeare, William. "Much Ado About Nothing." The Complete Works of Shakespeare. Glenview, Illinois, Scott, Foresman, and Company, 1980.
- Shakespeare, William. "Othello." The Complete Works of Shakespeare. Glenview, Illinois, Scott, Foresman, and Company, 1980.
- Shakespeare, William. "Romeo and Juliet." The Complete Works of Shakespeare. Glenview, Illinois, Scott, Foresman, and Company, 1980.
- Shakespeare, William. "The Passionate Pilgrim." The Complete Works of Shakespeare. Glenview, Illinois, Scott, Foresman, and Company, 1980.
- Shakespeare, William. "The Phoenix and Turtle." The Complete Works of Shakespeare. Glenview, Illinois, Scott, Foresman, and Company, 1980.
- Shakespeare, William. "The Rape of Lucrece." The Complete Works of Shakespeare. Glenview, Illinois, Scott, Foresman, and Company, 1980.
- Shakespeare, William. "The Taming of the Shrew." The Complete Works of Shakespeare. Glenview, Illinois, Scott, Foresman, and Company, 1980.
- Shakespeare, William. "Venus and Adonis." The Complete Works of Shakespeare. Glenview, Illinois, Scott, Foresman, and Company, 1980.
- Shaw, Bernard. Pygmalion. Baltimore, Maryland, Penguin Books, 1951.
- Shaw, Bernard. Candida. Baltimore, Maryland, Penguin Books, 1954.
- Shaw, Bernard. The Devil's Disciple. Baltimore, Maryland, Penguin Books, 1956.
- Shaw, Bernard. Caesar and Cleopatra. Baltimore, Maryland, Penguin Books, 1959.
- Shaw, Bernard. Man and Superman. Baltimore, Maryland, Penguin Books, 1961.
- Shaw, Bernard. Major Barbara. Baltimore, Maryland, Penguin Books, 1963.
- Shaw, Bernard. Androcles and the Lion. Baltimore, Maryland, Penguin Books, 19563.
- Shaw, Bernard. Heartbreak House. Baltimore, Maryland, Penguin Books, 1965.
- Shaw, Bernard. The Doctor's Dilemma. Baltimore, Maryland, Penguin Books, 1967.

Bibliography

- Simon, Neil. Barefoot in the Park. New York, Random House, 1964.
- Simon, Neil. Biloxi Blues. New York, S. French, 1986.
- Simon, Neil. Brighton Beach Memoirs. New York, Random House, 1984.
- Simon, Neil. Chapter Two. New York, Random House, 1979.
- Simon, Neil. Come Blow Your Horn. Garden City, New York, Doubleday, 1963.
- Simon, Neil. Last of the Red Hot Lovers. New York, Random House, 1970.
- Simon, Neil. Plaza Suite. New York, Random House, 1969.
- Simon, Neil. The Goodbye Girl. New York, Random House, 1969.
- Simon, Neil. The Odd Couple. New York, Random House, 1966.
- Steinbeck, John. Cannery Row. New York, The Viking Press, 1963.
- Steinbeck, John. East of Eden. New York, The Viking Press, 1952.
- Steinbeck, John. In Dubious Battle. New York, The Viking Press, 1963.
- Steinbeck, John. Of Mice and Men. New York, Modern Library, 1965.
- Steinbeck, John. Sweet Thursday. New York, The Viking Press, 1954.
- Steinbeck, John. The Grapes of Wrath. New York, The Viking Press, 1939.
- Steinbeck, John. Tortilla Flat. New York, Covici, Friede Publishing, 1935.
- Steinbeck, John. Travels with Charley. New York, The Viking Press, 1962.
- Steinbeck, John. The Winter of our Discontent. New York, The Viking Press, 1961.
- Stevenson, Robert Louis. A Child's Garden of Verses. New York, U.S. Camera Publishing Corp., 1944.
- Stevenson, Robert Louis. "David Balbour." The Novels & Tales of Robert Louis Stevenson. New York, Charles Scribner's Sons, 1897.
- Stevenson, Robert Louis. Kidnapped. London, Oxford University Press, 1986.
- Stevenson, Robert Louis. "New Arabian Nights." The Novels & Tales of Robert Louis Stevenson. New York, Charles Scribner's Sons, 1897.
- Stevenson, Robert Louis. "The Master of Ballantrae." The Novels & Tales of Robert Louis Stevenson. New York, Charles Scribner's Sons, 1897.
- Stevenson, Robert Louis. The Strange Case of Dr. Jekyll and Mr. Hyde. New York, Putnam, 1963.
- Stevenson, Robert Louis. Treasure Island. New York, Charles Scribner's Sons, 1939.
- Twain, Mark. A Connecticut Yankee in King Arthur's Court. New York, Macmillan Press, 1962.
- Twain, Mark. Adventures of Huckleberry Finn. New York, Macmillan Press, 1962.
- Twain, Mark. Life on the Mississippi. New York, Heritage Press, 1944.
- Twain, Mark. The Adventures of Tom Sawyer. New York, Macmillan Press, 1962.
- Twain, Mark. The Prince and the Pauper. Chicago, Illinois, Children's Press, 1969.
- Uris, Leon. Battle Cry. New York, Putnam, 1953.
- Uris, Leon. Exodus. London, W. Kimber, 1973.
- Uris, Leon. Mila 18. Garden City, New York, Doubleday, 1961.
- Uris, Leon. QB VII. Garden City, New York, Doubleday, 1970.
- Uris, Leon. Topaz. New York, McGraw-Hill, 1967.
- Uris, Leon. The Angry Hills. New York, Bantam Books, 1973.
- Uris, Leon. The Haj. Garden City, New York, Doubleday, 1984.
- Uris, Leon. Trinity. Garden City, New York, Doubleday, 1970.
- Vern, Jules. Around the World in Eighty Days. New York, Mead, 1956.
- Vern, Jules. Five Weeks in a Balloon. London, Arco Publishing, 1962.
- Vern, Jules. From the Earth to the Moon. London, Arco Publishing, 1965.
- Vern, Jules. Journey to the Center of the Earth. London, Arco Publishing, 1967.
- Vern, Jules. Twenty Thousand Leagues Under the Sea. New York, MacMillan, 1962.
- Whitman, Walt. "A Noiseless Patient Spider." The New Pocket Anthology of American Verse. New York, The Pocket Library, 1958.
- Whitman, Walt. "After the Dazzle of Day." The New Pocket Anthology of American Verse. New York, The Pocket Library, 1958.
- Whitman, Walt. "Are You the New Person Drawn Toward Me?" The New Pocket Anthology of American Verse. New York, The Pocket Library, 1958.
- Whitman, Walt. "Earth, My Likeness." The New Pocket Anthology of American Verse. New York, The Pocket Library, 1958.
- Whitman, Walt. "I Celebrate." The New Pocket Anthology of American Verse. New York, The Pocket Library, 1958.
- Whitman, Walt. "Not Heat Flames Up and Consumes." The New Pocket Anthology of American Verse. New York, The Pocket Library, 1958.
- Whitman, Walt. "O Captain! My Captain!" The New Pocket Anthology of American Verse. New York, The Pocket Library, 1958.
- Whitman, Walt. "Out of the Cradle Endlessly Rocking." The New Pocket Anthology of American Verse. New York, The Pocket Library, 1958.
- Whitman, Walt. "Roots and Leaves Themselves Alone." The New Pocket Anthology of American Verse. New York, The Pocket Library, 1958.
- Whitman, Walt. "Song of the Open Road." The New Pocket Anthology of American Verse. New York, The Pocket Library, 1958.
- Wilder, Thornton. Our Town. New York, Coward-McCann, Inc., 1938.
- Wilder, Thornton. The Angel That Troubled the Waters. New York, Coward-McCann, Inc., 1928.
- Wilder, Thornton. The Bridge of San Luis Rey. New York, A&C Boni, 1928.
- Wilder, Thornton. The Long Christmas Dinner. New York, Coward-McCann, Inc., 1931.
- Wilder, Thornton. The Matchmaker. New York, Harper, 1957.
- Wilder, Thornton. The Skin of Our Teeth. New York, Harper, 1942.
- Williams, Tennessee. A Streetcar Named Desire. New York, New Directions, 1971.
- Williams, Tennessee. "Camino Real." The Theater of Tennessee Williams. New York, New Directions, 1971.
- Williams, Tennessee. "Cat on a Hot Tin Roof." The Theater of Tennessee Williams. New York, New Directions, 1955.
- Williams, Tennessee. Sweet Bird of Youth. New York, New Directions, 1959.
- Williams, Tennessee. The Glass Menagerie. New York, New Directions, 1971.
- Williams, Tennessee. "The Night of the Iguana." The Theater of Tennessee Williams. New York, New Directions, 1971.
- Williams, Tennessee. "The Rose Tattoo." The Theater of Tennessee Williams. New York, New Directions, 1951.

SOME IMPORTANT INFORMATION

TABLE OF TIME MEASURE

60 seconds = 1 minute
 60 minutes = 1 hour
 24 hours = 1 day
 7 days = 1 week
 30 days = 1 month
 12 months = 1 year
 365 days = 1 common year
 366 days = 1 leap year
 100 years = 1 century

TABLE OF DRY MEASURE

2 pints (pt.) = 1 quart (qt.)
 8 quarts = 1 peck (pk.)
 4 pecks = 1 bushel (bu.)
 1 cord = 128 cu. ft.

TABLE OF LIQUID MEASURE

4 gills (gi.) = 1 pint (pt.)
 2 pints = 1 quart (qt.)
 4 quarts = 1 gallon (gal.)
 31.5 gallons = 1 barrel (bbl.)
 2 barrels = 1 hogshead (hhd.)

TABLE OF PAPER MEASURE

24 sheets = 1 quire
 20 quires = 1 ream
 10 reams = 1 bale

TABLE OF LINEAR MEASURE

12 inches = 1 foot
 3 feet = 1 yard
 16.5 feet (5.5 yds.) = 1 rod
 660 feet = 1 furlong
 320 rods (5280 ft.) = 1 mile

TABLE OF CUBIC MEASURE

1728 cubic inches = 1 cubic foot
 27 cubic feet = 1 cubic yard
 128 cubic feet = 1 cord of wood
 24.75 cubic feet = 1 perch of stone

NOTE- A chord of wood is a pile 8 feet long, 4 feet wide and 4 feet high.

A perch of stone or brick is 16.5 feet long, 1.5 ft. wide and 1 foot high.

TABLE OF CIRCULAR MEASURE

60 seconds (") = 1 minute (')
 60 minutes = 1 degree
 360 degrees = 1 circumference

TABLE OF APOTHECARIES' WEIGHT

20 grains (gr.) = 1 scruple
 3 scruples = 1 dram
 8 drams = 1 ounce
 12 ounces = 1 pound (lb.)

TABLE OF TROY WEIGHT

24 grains (gr.) = 1 pennyweight (dwt.)
 20 pennyweights = 1 ounce (oz.)
 12 ounces = 1 pound (lb.)

MISCELLANEOUS MEASURE

12 units = 1 dozen
 12 doz. = 1 gross
 12 gross = 1 great gross
 20 units = 1 score
 1 hand = 4 inches
 1 fathom = 6 feet
 1 knot = 6086 feet
 3 knots = 1 league
 1 bu. potatoes = 60 lbs.
 1 barrel flour = 196 lbs.
 1 cu. ft. of water = 7.48 liquid gals. and weighs 62.425 lbs

Diameter of circle X 3.1416 = circumference

Diameter of circle squared X .7854 = area

Atmospheric pressure is 14.7 lbs. per sq. inch at sea level.
 13.5 cu. ft. of air weighs 1lb.

TABLE OF SURFACE MEASURE

144 sq. in. = 1 sq. ft.
 9 sq. ft. = 1 sq. yd.
 30.25 sq. yds. = 1 sq. rod
 160 sq. rods = 1 acre
 640 acres = 1 sq. mile
 An acre measures 208.71ft. each side
 A section of land is 1 sq. mile
 A quarter section is 160 acres.
 A township is 36 sq. miles.

TABLE OF AVOIRDUPOIS WEIGHT

16 drams = 1 ounce (oz.)
 16 ounces = 1 pound (lb.)
 100 pounds = 1 hundredweight (cwt.)
 2000 pounds = 1 ton
 2240 pounds = 1 long ton (L.T.)

MULTIPLICATION TABLES

| | | | | | | | | | | | |
|----|----|----|----|----|----|----|----|-----|-----|-----|-----|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 2 | 4 | 6 | 8 | 10 | 12 | 14 | 16 | 18 | 20 | 22 | 24 |
| 3 | 6 | 9 | 12 | 15 | 18 | 21 | 24 | 27 | 30 | 33 | 36 |
| 4 | 8 | 12 | 16 | 20 | 24 | 28 | 32 | 36 | 40 | 44 | 48 |
| 5 | 10 | 15 | 20 | 25 | 30 | 35 | 40 | 45 | 50 | 55 | 60 |
| 6 | 12 | 18 | 24 | 30 | 36 | 42 | 48 | 54 | 60 | 66 | 72 |
| 7 | 14 | 21 | 28 | 35 | 42 | 49 | 56 | 63 | 70 | 77 | 84 |
| 8 | 16 | 24 | 32 | 40 | 48 | 56 | 64 | 72 | 80 | 88 | 96 |
| 9 | 18 | 27 | 36 | 45 | 54 | 63 | 72 | 81 | 90 | 99 | 108 |
| 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | 110 | 120 |
| 11 | 22 | 33 | 44 | 55 | 66 | 77 | 88 | 99 | 110 | 121 | 132 |
| 12 | 24 | 36 | 48 | 60 | 72 | 84 | 96 | 108 | 120 | 132 | 144 |

CONVERSION TABLES

| | | |
|--------|-------|--------|
| Meters | Yards | Inches |
| 1.000 | 1.093 | 39.37 |
| .914 | 1.000 | 36.00 |

| | | |
|-------------|--------|-------|
| Centimeters | Inches | Feet |
| 1.00 | .394 | .03 |
| 2.54 | 1.000 | 1/12 |
| 30.48 | 12.00 | 1.000 |

| | |
|------------|-------|
| Kilometers | Miles |
| 1.000 | .621 |
| 1.609 | 1.000 |

| | | |
|----------|--------|--------|
| Grams | Ounces | Pounds |
| 1.00 | .035 | .002 |
| 28.35 | 1.000 | 1/16 |
| 453.59 | 16.00 | 1.000 |
| 1,000.00 | 35.274 | 2.205 |

| | | |
|-----------|--------|--------|
| Kilograms | Ounces | Pounds |
| 1.000 | 35.274 | 2.205 |
| .028 | 1.000 | 1/16 |
| .454 | 16.000 | 1.000 |

| | | | |
|--------|-------|--------|-------|
| Liters | Pints | Quarts | Gal. |
| 1.000 | 2.113 | 1.057 | .264 |
| .473 | 1.000 | 1/2 | 1/8 |
| .946 | 2.000 | 1.000 | 1/4 |
| 3.785 | 8.000 | 4.000 | 1.000 |

CONVERSION TABLES

LENGTH

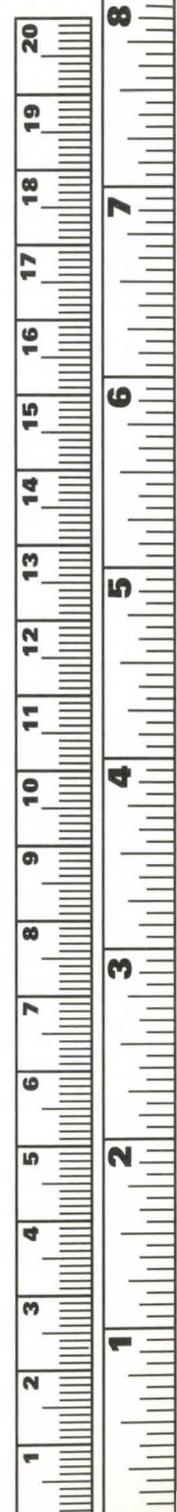
1 meter (m) = 100 cm = 1,000 mm
 1 millimeter (mm) = .001 m
 1 centimeter (cm) = .01 m
 1 decimeter (dm) = .1 m
 1 decameter (dkm) = 10 m
 1 hectometer (hm) = 100 m
 1 kilometer (km) = 1,000 m

CAPACITY

1 liter (l) = 100 cl = 1,000 ml
 1 milliliter (ml) = .001 l
 1 centiliter (cl) = .01 l
 1 deciliter (dl) = .1 l
 1 decaliter (dkl) = 10 l
 1 hectoliter (hl) = 100 l
 1 kiloliter (kl) = 1,000 l

WEIGHT

1 gram (g) = 100 cg = 1,000 mg
 1 milligram (mg) = .001 g
 1 centigram (cg) = .01 g
 1 decigram (dg) = .1 g
 1 decagram (dkg) = 10 g
 1 hectogram (hg) = 100 g
 1 kilogram (kg) = 1,000 g



| | | | |
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| | | 16. inversion | |



The *Island of Dr. Brain* was a collaborative design made possible only by the hard work from the

BRAINSTORMERS

“We play games with your future in mind.”

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