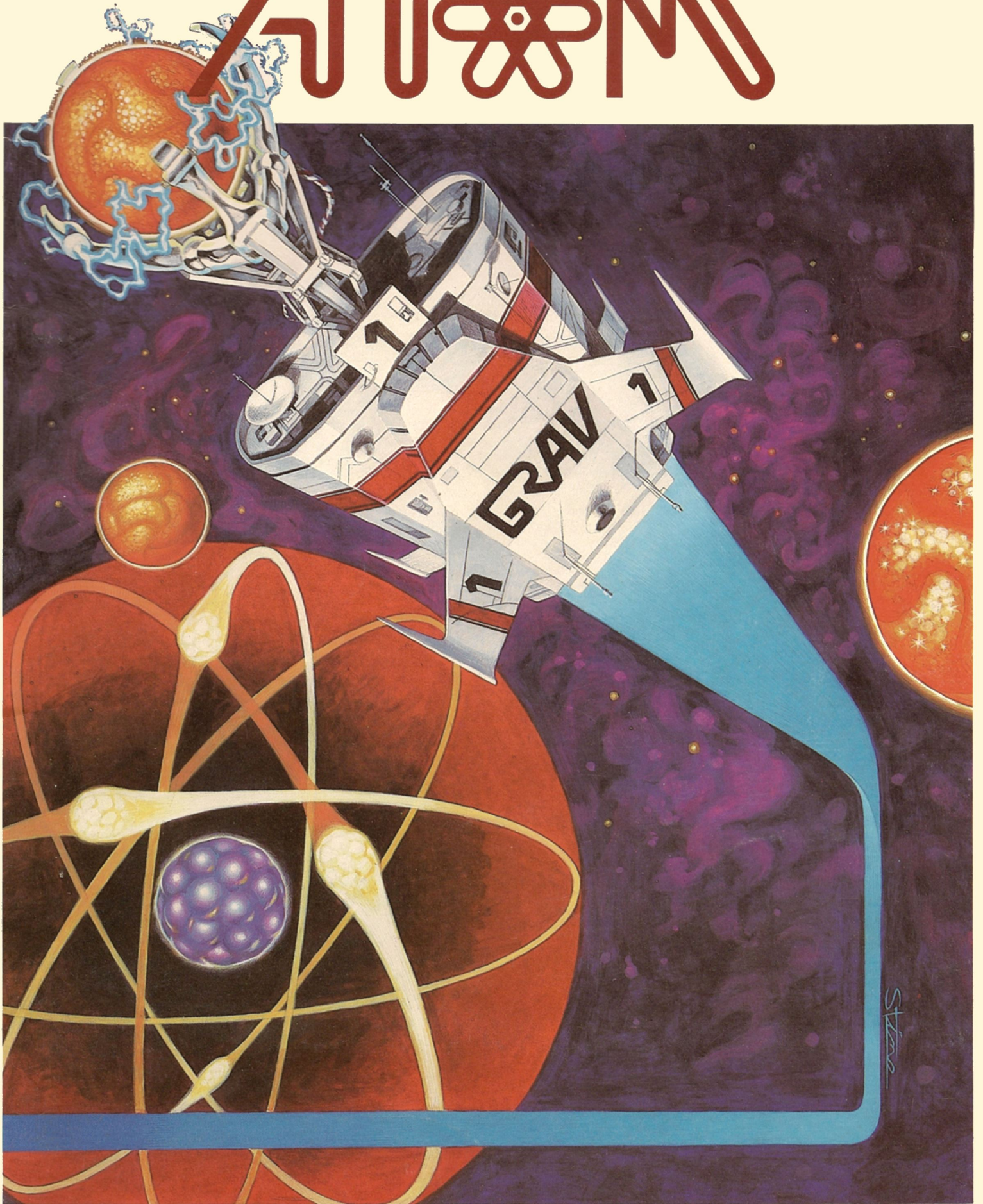


ATOM



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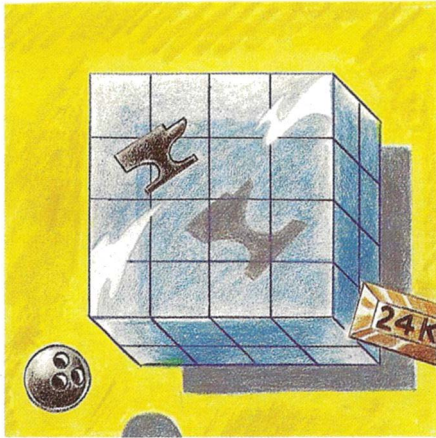
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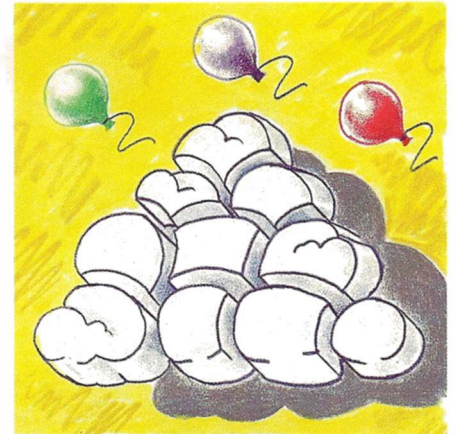
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The universe consists of matter and energy. Matter is anything which occupies space and has mass, and can be in one of four forms: solid, liquid, gas, or plasma. All matter can be broken down into units called "atoms."



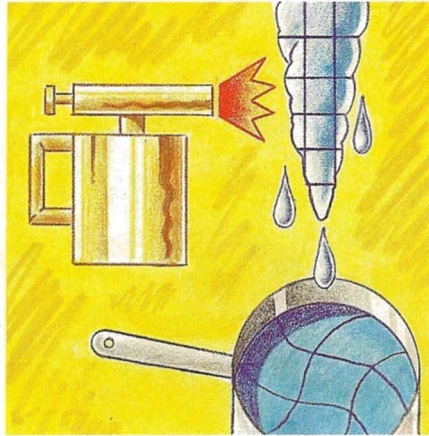
In a solid, atoms are packed tightly together. The atoms of a liquid move and flow but are packed together almost as tightly as in solid matter. In a gas, the atoms can move and float freely around because the magnetic forces are weak.

INTRODUCTION

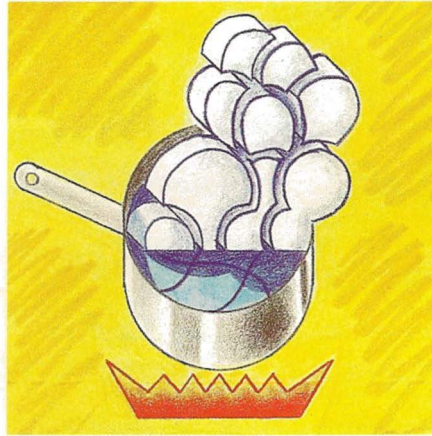
Atom is a game designed to introduce your child to the exciting subatomic world of elements. The object is to build an atom of each of the 54 elements available in the game as quickly as possible. At the same time, your child will be learning the name of each new element, its atomic number and configuration, and its main property. As a player improves and completes the structures of the atoms, the atoms become more complex and less time is given to construct the next atom.

REQUIRED EQUIPMENT

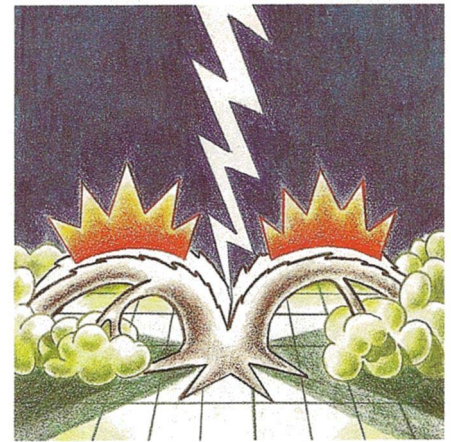
- Standard Television (Color recommended)
- Color Computer equipped with at least 16K memory
- Joysticks



The atoms of a solid are constantly moving despite the tight arrangement of atoms. If enough heat is applied to a solid, the atoms move so much that the arrangement becomes



loose and the solid melts to liquid. If more heat is applied, the atoms move even more and after the liquid reaches its boiling point, it turns into a gas.



The fourth state of matter, plasma, was not discovered until this century. In this state, so much heat is applied to a substance, that its atoms and molecules smash into each other and swap electrons (becoming "ions" in the process). The substance is transformed into plasma, a wild mass of heated, negatively-charged electrons and positively-charged ions. Plasma is the state of matter closest to pure energy. A lightning bolt is an example of plasma.

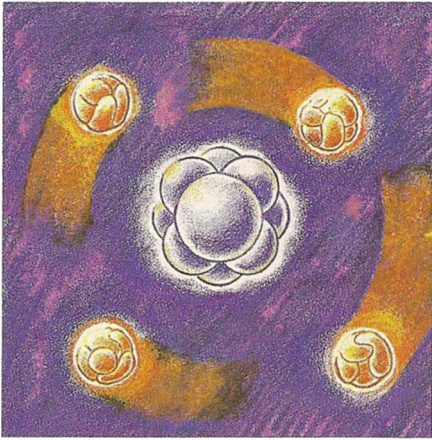
SETTING UP

First, make sure that the right joystick is properly connected to the computer. Turn on the TV and turn the volume up slightly. Make sure the Color Computer is turned off before you insert or remove the Program Pak. Insert the "Atom" Program Pak™ with the label side up on the right side of the computer. Next, when you turn on the computer, the copyright screen appears.

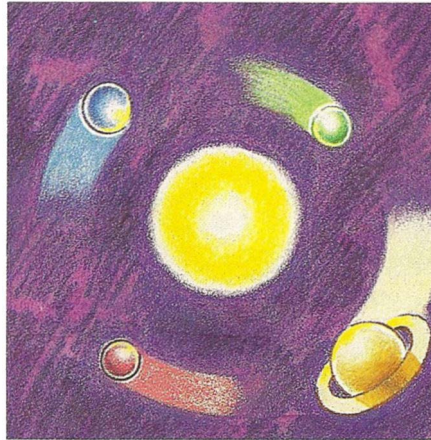
ATOM
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You have three choices of background colors. Press the **(CLEAR)** key for a green background. Hold down the **(SHIFT)** key and then press **(CLEAR)** for a buff background. Press any other key for a black background.

Note: The colors may vary slightly according to how you adjust your television's color and tint controls.



About 2,500 years ago (450 B.C.) the ancient Greeks believed that matter could be broken down until the smallest unit, atom (which comes from the Greek word atomos meaning "cannot be cut"), was reached. Atoms are so small that it would take millions of atoms just to make a single grain of seed.



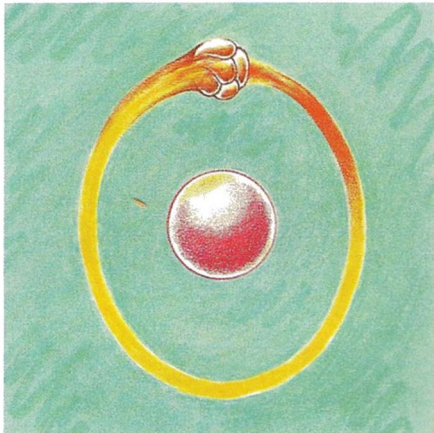
An atom is made up of protons, neutrons, and electrons. Protons and neutrons are in the center of the atom (the "nucleus") and the electrons orbit the nucleus in much the same way as planets orbit the sun in our solar system.

THE TITLE SCREEN

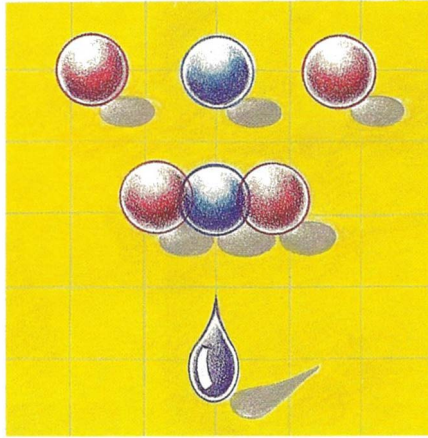
After you press a key(s) to select a background color, you are taken to an area of empty space in which a nucleus of an atom is shown in the center of the screen. (The nucleus is the "o" in the word "Atom.") In the lower right corner, you see a "graviton" behind a group of bunkers. You use this device as a magnet to attract floating electrons to build one atom of an element.

The bunkers serve as protection to hide the graviton from exploding atoms. The round number is shown in the upper left corner under which are two reserve gravitons. A reserve graviton appears behind the lower right bunkers if the graviton you are currently using is destroyed.

Note: One assumption which must be made for "Atom" to be scientifically correct is that the nucleus displayed on the screen always contains the appropriate number of protons and neutrons.



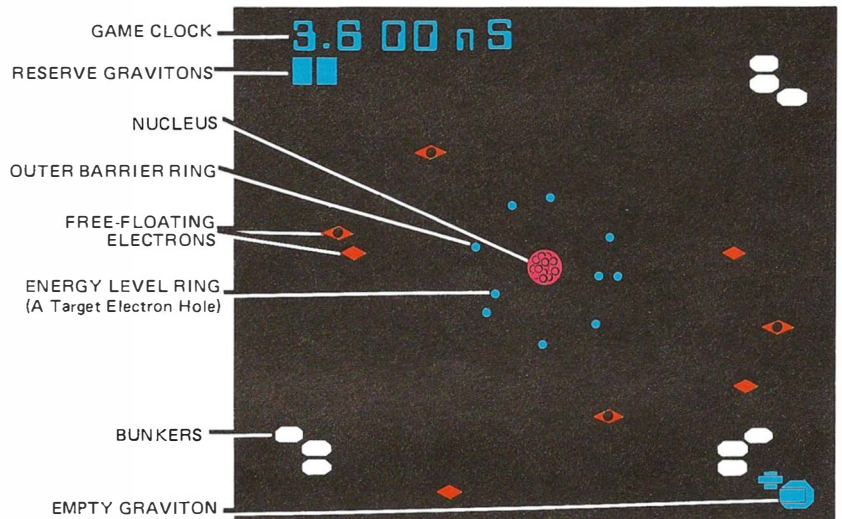
The word hydrogen comes from two words: hydor and gen which mean "water-forming." Hydrogen, the lightest element, was discovered in 1766.

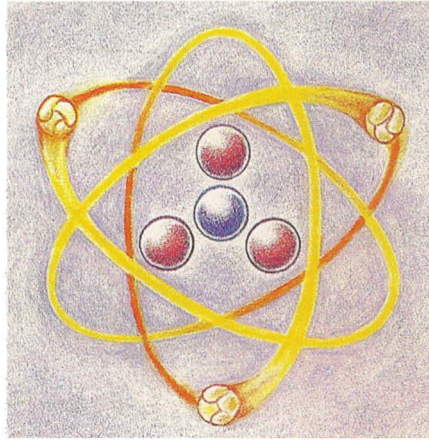
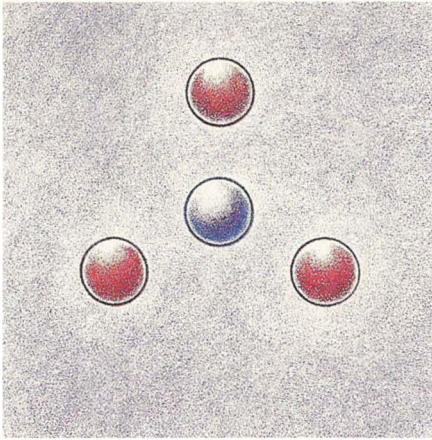


If all matter is made of atoms, what makes everything different? The answer is that not all atoms are exactly alike. An element is something which is made up of only one kind of atom. For example, gold (#79 - Au) and oxygen (#8 - O) are elements. Other things are made of two, three, or even more different kinds of atoms. For example, water is a compound of hydrogen and oxygen. A water molecule is made of two hydrogen atoms linked to one oxygen atom.

THE GAME SCREEN

Press the fire button on the joystick control to see the game screen. Your screen should look similar to this:

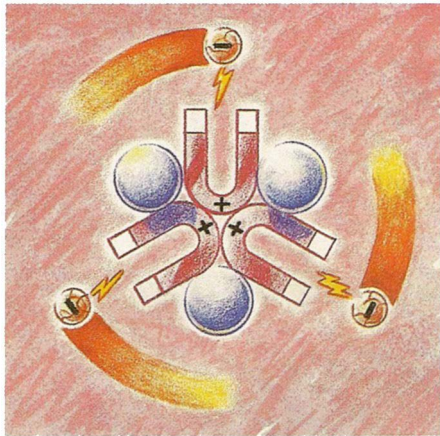




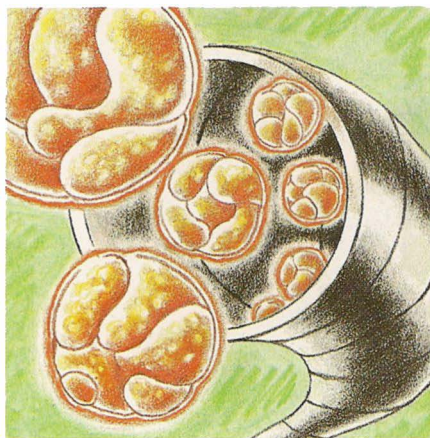
Although the ancient Greeks thought that an atom was the smallest particle, we now know that an atom contains three "subatomic" particles: protons and neutrons, which are in the nucleus, and electrons orbiting outside the nucleus. (Nucleus comes from a Latin word meaning "the pit inside a piece of fruit.") The nucleus is in the middle of the atom, and its protons and neutrons contain almost the whole weight of the atom. There is one proton for each electron orbiting the nucleus. However, the number of neutrons inside the nucleus may be less or greater than the number of orbiting electrons.

The nucleus is surrounded by two rings of moving dots. The ring closest to the nucleus is an energy level, and your immediate goal is to build the first atom by picking up an electron and shooting it into one of the holes in this energy-level ring. The electrons you pick up to create an element are floating outside the rings. After you fire an electron into one hole of the inner ring, you create the simplest element, Hydrogen.

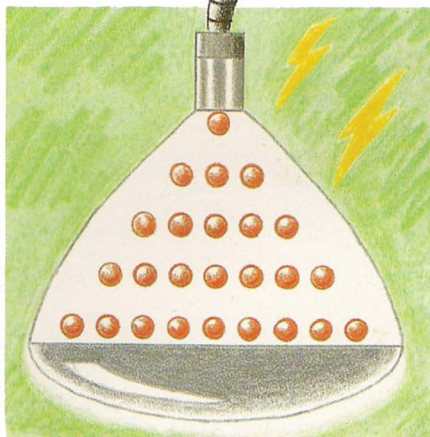
The outer ring is a barrier ring — it is not an atomic energy level for electrons. If you hit a dot in the outer ring or an incorrect energy level, the entire atom explodes and destroys the graviton **unless** you quickly hide it behind a bunker. Be careful when you move the graviton towards a bunker because it can be destroyed by crashing against a bunker.



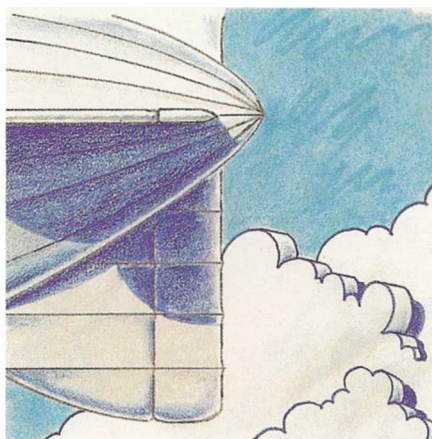
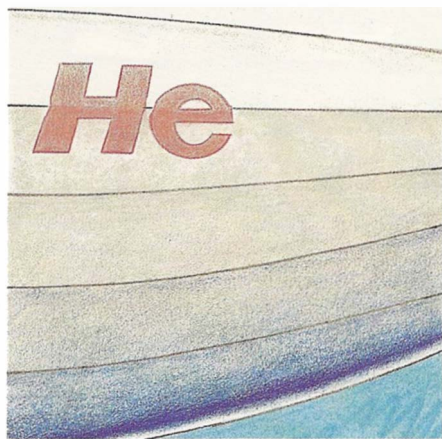
A proton with its positive electric charge is like a magnet which keeps an electron with its negative charge close to the nucleus. A neutron has no electric charge at all but is about the same mass as a proton. Each element has a different number of protons, and that's why elements are different from each other. For example, gold has 79 protons, while copper has 29 protons.



Electrons have a negative electric charge but are very light. The electric charge of free-floating electrons can be used to produce electricity for various machines. For example, on television sets, there is a device at the back of the picture tube which shoots electrons towards the TV screen. You see a dot of light when an electron strikes the front of the picture tube (which is coated with phosphor). An entire picture is produced when thousands of dots are on the screen.



You must race against the clock while building atoms. (Time is defined in nanoseconds.) For the first energy level, you have 3.6 nanoseconds and you must build both a Hydrogen and Helium atom before the time runs out. If you do not complete an energy level in the allotted time (or hit a dot in a ring other than the one next to the barrier ring), the unstable atom explodes. You start over with the first element of that energy level with the original amount of time to try to complete the ring again.

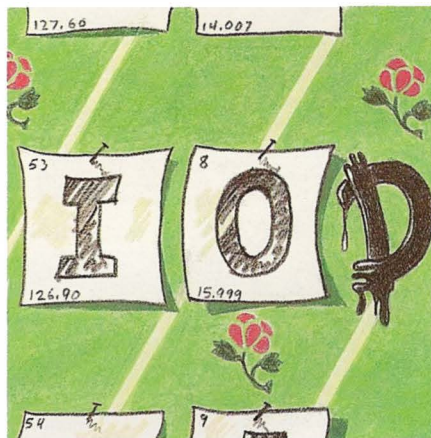
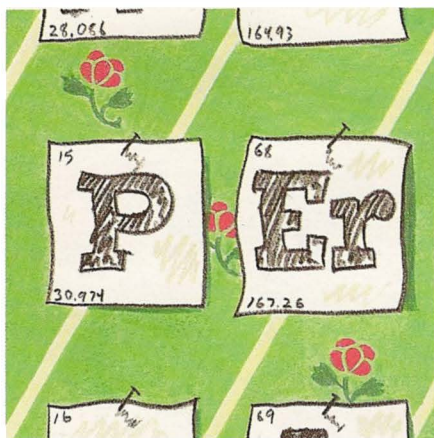


Helium comes from the word, "helios," meaning "sun." This gaseous element, which was discovered in 1868, is used in blimps and balloons.

MOVING THE GRAVITON

Use the joystick to move the graviton towards the electron you want to pick up. You can pick up only one electron at a time. After you fire an electron, you must pick up another. Before you start playing, you need to know how to operate the joystick. Hold the joystick with the red fire button farthest away from you. Move the joystick to the left to move the graviton clockwise, or to the right to move the graviton in a counter-clockwise direction. To move the graviton closer to the nucleus, move the joystick up. Move the joystick down to move the graviton away from the nucleus.

Tip: You may have to practice awhile before you become really good at using the joystick. The joystick is easier to use when the graviton is near the bottom of the screen.

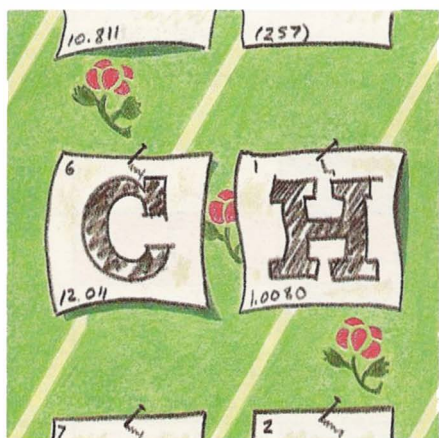


In the 1860's, Dimitri Ivanovich Mendeleev was the first scientist to try to arrange the elements according to properties. He started his work by writing down everything he knew about an element on one card. He then pinned the card up on the wall in his laboratory and proceeded to fill a card with information about another element.

BUILDING ATOMS

Now, you are ready to start. Press the fire button to start the game and activate the game clock. Move the graviton from behind the bunker towards an electron. (The tip of the graviton is white when there is no electron in it.) Hold down the fire button and move the graviton so that its tip almost touches one of the free electrons. You hear a swishing noise when an electron has been picked up, and the tip of the graviton turns colors. (Be very careful when approaching an electron because if it collides with the graviton, the graviton is instantly demolished.) After you have picked up an electron, release the fire button.

Now, move the graviton in the desired direction and aim the tip at a hole in the next-to-outer ring. When you're ready to shoot, press the fire button. After one hole is filled, the letter H for Hydrogen appears in the upper left corner and the clock stops. The screen clears and next you see the game's Periodic Chart of Elements. Note



After arranging the cards on the wall in rows according to atomic weight (starting with the lightest element, hydrogen), he studied the relationships and properties of the elements in his new arrangement. Mendeleev then realized that the chemical behavior of the elements of each vertical column were very similar. He even left places blank on a row when the next heaviest element did not match a particular column because of its different properties. Later, as new elements were discovered, they were easily inserted into his chart.

that Hydrogen is Element #1 since it has one electron. It is a non-metal element.

Use the joystick to scan the chart. (You can also check the poster or the Periodic Table of Elements in this manual.) Each time the blue scanning line stops on an element, its full name and main property are displayed. (There are four main properties which describe elements: Noble Gas, Metal, Metalloid, and Non-Metal.) Center the joystick to stop the scanning line.

Note: Although there are 54 elements on the Periodic Chart of Game Elements, there are actually 103 elements. It would be very difficult to see all electrons of the heavier elements on your television screen. For example, the last element, Lawrencium (#103), contains 103 electrons. Check your Periodic Table of Elements poster to learn more about the elements after Xenon.

group		I	II	III	IV	V	VI	VII	VIII	0	
period	series										
1	1	1 H 1.00797								2 He 4.003	
2	2	3 Li 6.939	4 Be 9.012	5 B 10.81	6 C 12.011	7 N 14.007	8 O 15.9994	9 F 19.00		10 Ne 20.183	
3	3	11 Na 22.990	12 Mg 24.31	13 Al 26.98	14 Si 28.09	15 P 30.974	16 S 32.064	17 Cl 35.453		18 Ar 39.948	
4	4	19 K 39.102	20 Ca 40.08	21 Sc 44.96	22 Ti 47.90	23 V 50.94	24 Cr 52.00	25 Mn 54.94	26 Fe 55.85	27 Co 58.93	28 Ni 58.71
	5	29 Cu 63.54	30 Zn 65.37	31 Ga 69.72	32 Ge 72.59	33 As 74.92	34 Se 78.96	35 Br 79.909			36 Kr 83.80
5	6	37 Rb 85.47	38 Sr 87.62	39 Y 88.905	40 Zr 91.22	41 Nb 92.91	42 Mo 95.94	43 Tc [98]	44 Ru 101.1	45 Rh 102.905	46 Pd 106.4
	7	47 Ag 107.870	48 Cd 112.40	49 In 114.82	50 Sn 118.69	51 Sb 121.75	52 Te 127.60	53 I 126.90			54 Xe 131.30
6	8	55 Cs 132.905	56 Ba 137.34	57-71 Lanthanide series*	72 Hf 178.49	73 Ta 180.95	74 W 183.85	75 Re 186.2	76 Os 190.2	77 Ir 192.2	78 Pt 195.09
	9	79 Au 196.97	80 Hg 200.59	81 Tl 204.37	82 Pb 207.19	83 Bi 208.98	84 Po [210]	85 At [210]			86 Rn [222]
7	10	87 Fr [223]	88 Ra [226]	89-103 Actinide series†							

ENERGY LEVELS

After you build an atom of Helium (which completes the first energy level) and start the next level, another energy-level ring with eight holes appears between the first energy level and the barrier ring. Your goal now is to create Element #3 — Lithium by shooting an electron into a hole in the second energy level. After you complete the second energy level, a new energy-level ring appears.

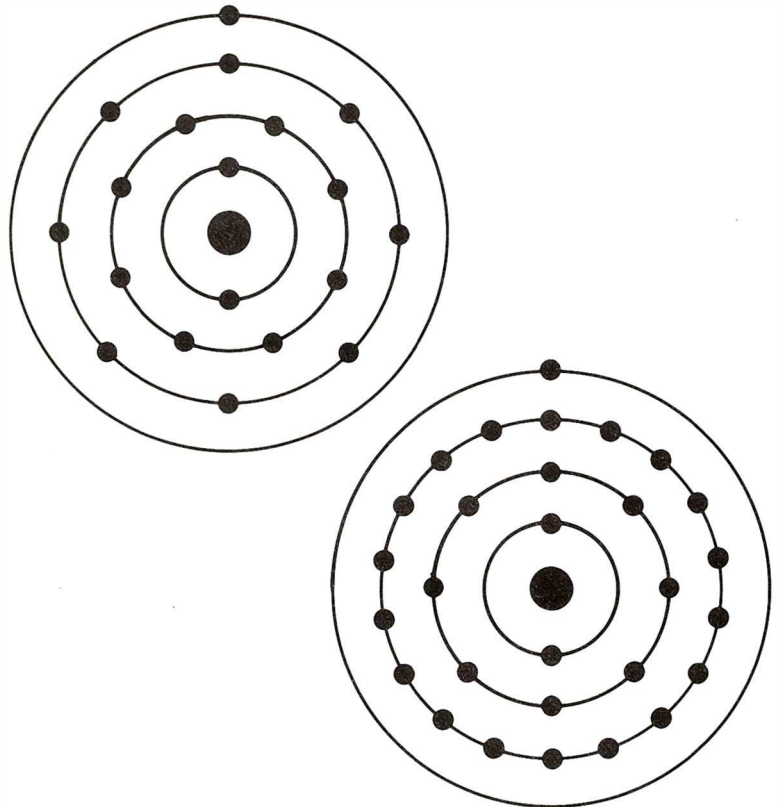
Altogether, there are five energy levels in the game. Each time you complete an energy level, the clock is reset but you have **less** time to build atoms to complete the new energy level. Each element you are about to create is shown with the proper number of electrons (in the proper arrangement) minus one which you must shoot in an available hole in the energy level next to the barrier ring.

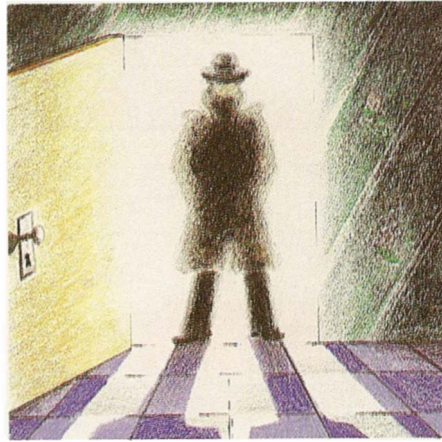
* Lanthanide series	57 La 138.91	58 Ce 140.12	59 Pr 140.91	60 Nd 144.24	61 Pm [147]	62 Sm 150.35	63 Eu 152.0	64 Gd 157.25	65 Tb 158.92	66 Dy 162.50	67 Ho 164.93	68 Er 167.26	69 Tm 168.93	70 Yb 173.04	71 Lu 174.97
† Actinide series	89 Ac [227]	90 Th 232.04	91 Pa [231]	92 U 238.03	93 Np [237]	94 Pu [242]	95 Am [243]	96 Cm [247]	97 Bk [247]	98 Cf [251]	99 E [254]	100 Fm [253]	101 Md [256]	102 No [254]	103 Lw [257]

The elements in any one column on the periodic chart constitute a group or family of elements that contain similar properties. For example, the elements of the rightmost column (from Helium to Radon) are all noble gases. These gases are the most stable of all elements because they are the least likely to change and form compounds with other elements.

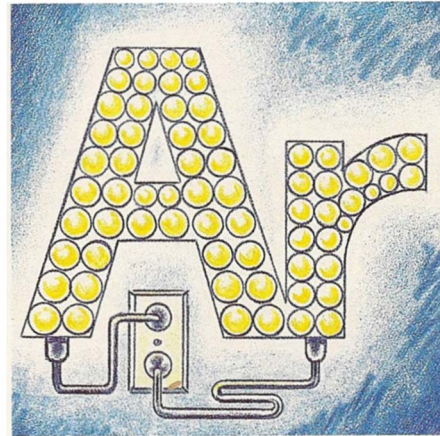
In the first two energy levels, an electron enters a vacant hole in the lowest energy level. After the second energy level, an element does not necessarily fill up an energy level before an electron enters a higher energy level. For example, through Argon (#18), each energy level is filled with the maximum number of possible electrons before the next energy level receives an electron. However, when you get to Potassium (#19), although the third energy level can contain up to 18 electrons, Potassium's nineteenth electron enters the fourth energy level. Compare an atom of Potassium with only 8 electrons in the third energy level with Copper which has 18 in the third level.

Note: Since Xenon is the last element you can construct, "Atom" displays a maximum of five energy levels, although there are actually seven.





Xenos whose name comes from “xenos,” meaning stranger, is the rarest gas and was not discovered until 1898. The high volatility of its electron structure produces an instant, intense light.



Argon (meaning inactive), the most abundant of all the noble gases, was discovered in 1894. This gas is used to fill ordinary incandescent light bulbs.

ROUNDS OF PLAY

When you build an atom for each of the 54 elements, Round 1 is finished. Round 2 starts over with Level 1, and you must create an atom of Hydrogen again. However, in Round 2 you have less time per level to complete the elements and the time decreases with each energy level.

At the beginning of the game, you have three gravitons — the one currently in use and the two reserve gravitons (which were shown in the upper left corner of the screen). If you lose all three gravitons, all atoms created on the present and previous energy level are destroyed. You start over at the beginning of the previous energy

level and play resumes with two gravitons — one active graviton and one remaining reserve graviton. Once again, if both of these gravitons are destroyed, you start over with the first atom of the previous energy level and only one graviton. If the last graviton is demolished, the current round is over, and the highest element created is displayed. The next round begins with the first energy level.

ENDING A GAME

When you are finished playing, turn off the television and the Color Computer. Remove the “Atom” cartridge and store it in a safe place.

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