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Final Year Project I
Dissertation Report

Design and Fabrication of Three dimensional Periodic Table Display

by

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CERTIFICATION OF APPROVAL

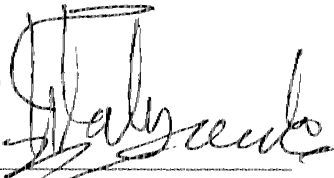
DESIGN AND FABRICATION OF 3D PERIODIC TABLE DISPLAY

by

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Approved by,



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SEPTEMBER 2011

CERTIFICATION OF ORIGINALITY

This is to certify that I am responsible for the work submitted in this project, that the original work is my own except as specified in the references and acknowledgements, and that the original work contained herein have not been undertaken or done by unspecified sources or persons.

FARIS AKMAL BIN MOHAMAD ASRI

Abstract

The subject of engineering materials is vast where it involves hundred of elements thus relate it with the concept of periodic table. This project is mainly about design and fabricating an improvised version of three dimensional periodic table displays. There are too many elements in there world, thus the idea of the Periodic Table is to arrange the elements in a way that enables chemists to understand patterns in the properties of elements. Unfortunately, current two dimensional periodic table displays has some flaws in it & less attractive thus resulting the periodic table is not well appreciated among Engineering Students. This project will be focusing on modeling and understanding of a three dimensional periodic table. Methods that will be used is by doing research on the current two dimensional and three dimensional periodic table and discuss about an improvise version of three dimensional periodic table. Then, a survey is done to selected student about the improvised version of three dimensional periodic table displays. This report will represent in details on the introduction about the project, the problem statement, the objectives and methodology used to solve the problem.

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CHAPTER 1: INTRODUCTION

1.1 Background of Study

Engineering materials subject involve a lot of things. There are thousands of different plastics, thousands of metal alloys and countless ceramic compounds and composite possibilities that comprise this area of study. However, all of these engineering materials are made from the hundred or so stable elements that have been discovered.

The discovery of the chemical elements has been an ongoing process since ancient times. Certain elements, such as gold, appear in nature in elemental form and were thus discovered thousands of years ago. Our ancestor at 1000BC has discovered at least ten elements. These were the elements that were known to the ancients which were carbon, sulfur, iron, copper, silver, tin, platinum, gold, mercury and lead. Carbon and iron were known in the Iron Age, copper and tin in the Bronze Age and platinum was known in Aztec culture.

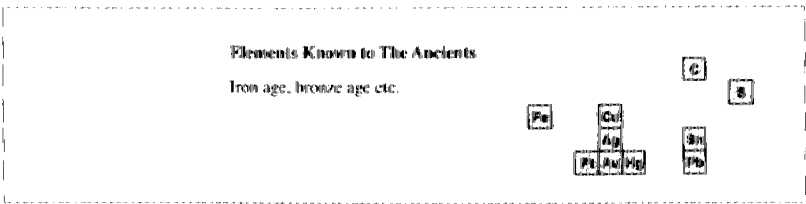


Figure 1.1: Elements Known to the Ancients

Initially, before the periodic table was made, there is actually another table called Affinity Table. An affinity table is an arrangement of chemical species ordered such that the species at the head of each column had a chemical attraction for each species below with each potential reactant listed in order of decreasing force of affinity to the header species, enabling the chemist to predict the course of react. In the history of chemistry, Étienne François Geoffroy (1672-1731) was a French physician and chemist noted for the construction of the world's first affinity table, 1718. This is often considered to have been the seed of the chemical revolution.

into numerous compounds. Therefore, scientists were unaware of their existence. In the early nineteenth century, advances in chemistry made it easier to isolate elements from their compounds. Dalton’s atomic theory set the stage for a vigorous growth in chemical experimentation during the early 1800s. As a result, the number of known elements more than doubled from 31 in 1800 to 63 by 1865.

As the number of known elements increased, scientists began to investigate the possibilities of classifying them in useful ways. In 1869, Dmitri Mendeleev in Russia and Lothar Meyer in Germany published nearly identical classification schemes. Both scientists noted that similar chemical and physical properties recur periodically when the elements are arranged in order of increasing atomic weight. Scientists at that time had no knowledge of atomic numbers. Atomic weights, however, generally increase with increasing atomic number, so both of them fortuitously arranged the elements in proper sequence. The tables of elements advanced by them were forerunners of the modern periodic table.

The arrangement of elements in order of increasing atomic number, with elements having similar properties placed in vertical columns, is known as the periodic table. The horizontal rows of the periodic table are called periods. The vertical columns of the periodic table are called groups. Elements that belong to the same group often exhibit similarities in physical and chemical properties and it is actually because of the same arrangement of electrons at the periphery of their atoms.

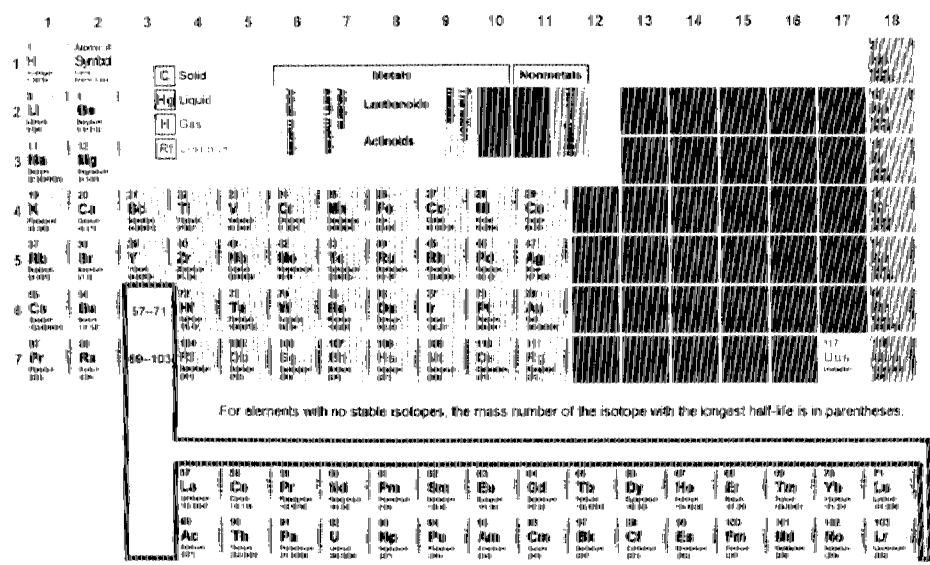


Figure 1.3: Two Dimensional Periodic Table Display

1.2 Problem Statement

Current two dimensional periodic table displays is actually not accurate and not precise enough. The flaws from the two dimensional periodic table are:-

- Sixth and seventh period are not properly constructed
- Not all groups(in columns) have the same properties
- Approximately only 10 information per element

When doing research or projects, university students needs more information from certain elements. Because two dimensional periodic tables have approximately 10 information per element, they have to do more research for that particular element. Thus it is hard for university students to use & understand the whole periodic table display in 2 dimensional forms. Furthermore, current two dimensional periodic tables display is not attractive enough to attract student study and understand it. Because of this, most of the university student does not appreciate the importance of the periodic table.

1.3 Objectives

The main objective of this project is to design and create an improvise version of 3 dimensional periodic table display that is more attractive and user friendly. By creating a three dimensional periodic table, our second objective is to create awareness among Engineering Students toward the importance of the periodic table towards Materials Science Education.

1.4 Scope of the study

This project focuses on modelling a three dimensional periodic table that is attractive and user friendly. The project also covers to get an understanding of the working principle both of the two dimensional periodic table display and three dimensional periodic table display and model the three dimensional periodic display. There are actually many rendition of the periodic table in 3 dimensions of the chemical elements. In parallel with this project, an analysis will be conducted on some of the elements in the periodic table to get more information on it.

1.5 Relevancy of the study

The project undertaken is relevant to me as a Mechanical student that learns about materials & elements. This will definitely help to apply knowledge from the subject that have been studied throughout the previous semester that is Engineering Materials and Introduction to Materials Science and Engineering (IMSE). This will provides a good learning medium for me to learn in details about material & elements. The new three dimensional periodic table will be further improved from the current three dimensional periodic table.

CHAPTER 2: LITERATURE REVIEW

Engineering materials are the materials that make up the products, structures, devices, and mechanisms that we use to maintain life and to improve living conditions and it is based largely on the pure sciences of chemistry and physics. All materials obey the law of physics and chemistry in their formation, reactions, and combinations. The smallest part of an element that retains the properties of that element is the atom. Atoms are the building blocks for engineering materials. All matter composed of atoms bonded together in different patterns and with different types of bonds. This leads to the discovery of element, which is a pure substance that cannot be broken down by chemical means to a simpler substance.

All of the elements derive their atomic number from a comparison of their subatomic makeup. The atomic number is really the number of protons in the nucleus of an atom. Atoms are far more complicated than we probably even know, but, current knowledge characterizes atoms as being composed of protons (positively charged particles), neutrons (neutral particles), and electrons, which orbit the nucleus, or core, of an atom^[13] as in figure 2.1:

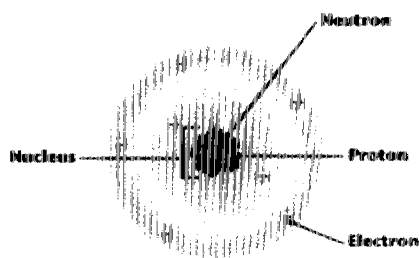


Figure 2.1: Atomic Structure

These relate to the properties of elements and it tends to be a periodic function thus a periodic table is made.

2.1 Two Dimensional Periodic Table

The 2D Periodic Table can be found in every chemistry lab and classroom in the world. It is the first thing we are taught when school's students study chemistry and it is in two dimensional. Until now, the 2D Periodic Table display are still being improvised by the chemist and scientist, by adding new elements that has been found or created.

2.1.1 Flaws in Two Dimensional Periodic Table

Some of things that have been learn are elements that belong to the same group often exhibit similarities in physical and chemical properties. For example, the “coinage metals” which consist of copper (Cu), silver (Ag), and gold (Au) all belong to group 1B ^[1]. As their name suggests, the coinage metals are used throughout the world to make coins. Many other groups in the periodic table also have names, as listed in Table 2.1:

Group	Name	Elements
1	Alkali metals	Li, Na, K, Rb, Cs, Fr
2	Alkaline earth metals	Be, Mg, Ca, Sr, Ba, Ra
16	Chalcogens	O, S, Se, Te, Po
17	Halogens	F, Cl, Br, I, At
18	Noble gases (or rare gases)	He, Ne, Ar, Kr, Xe, Rn

Table 2.1: Names of Some Group in the Periodic Table

But as we all know, not all groups have the same properties. This is the first flaw of the two dimensional periodic table. As an example, hydrogen is at the same column from the alkali metals but it does not have the same properties with other elements within the same group ^[1]. All the elements on the left side and in the middle of the periodic table are metallic elements, or metals.

From the periodic table, the majority of elements are metallic and they all share many characteristic properties such as high electrical and heat conductivity. All metals, with the exception of mercury (Hg), are solids at room temperature. Another flaw on the two dimensional periodic table is that the metals are separated from the non-metallic elements, or non-metals by a diagonal steplike line that runs from boron (B) to astatine (At) as shown in figure 2.2:

	3A	4A	5A	6A	7A	8A
1	Li	Be	B	C	N	O
2	Na	Mg	Al	Si	P	S
3	K	Ca	Sc	Ti	V	Cr
4	Rb	Sr	Y	Zr	Nb	Mo
5	Cs	Ba	La	Hf	Ta	W
6	Fr	Ra	Ac	Rf	Db	Sg

Figure 2.2: Steplike line

Another flaw on the current two dimensional periodic table is that not all the elements on the 6th and 7th row can fit in the two dimensional periodic table, they need to be listed below the main table as shown in figure 2.3:

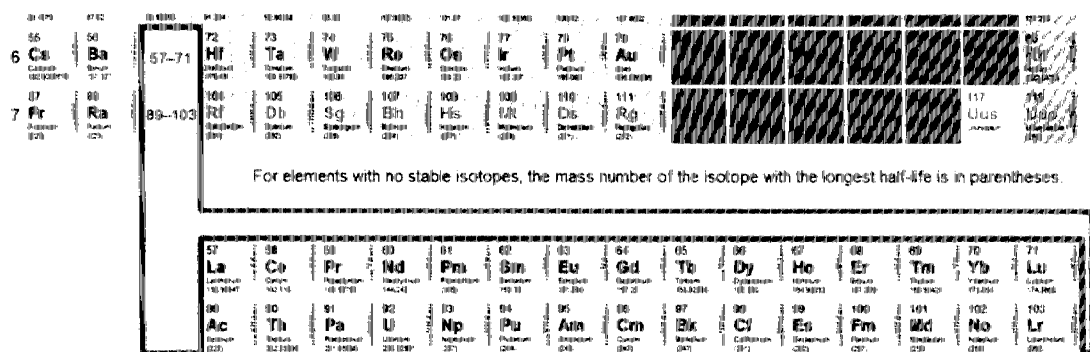


Figure 2.3: Elements that can't fit in the Main Table

2.1.2 Two Dimensional Periodic Table Updates

The latest discovery on **June 2011** from the chemist about the two dimensional periodic table are the rejection of some elements in it. Two years after copernicium became the heaviest element, the scales have tipped in favour of newcomers that temporarily called ununquadium and ununhexium. These claims for the discovery of elements 113, 115 and 118 have so far been rejected.

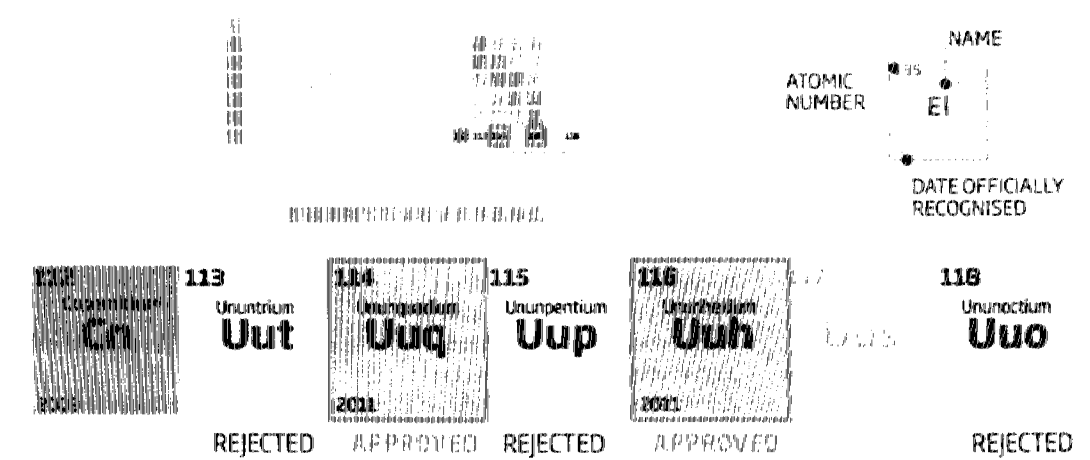


Figure 2.4: Rejected and Approved Elements

Evidence for ununquadium and ununhexium existence has been mounting for years and they were finally given official status at June 2011 after a three-year review by the Joint Working Party on Discovery of Elements, made up of scientists from the International Union of Pure and Applied Chemistry (IUPAC) and the International Union of Pure and Applied Physics (IUPAP) ^[2].

The researchers forged the elements by slamming together the nuclei of lighter atoms in an accelerator at JINR. They made ununhexium by bombarding the radioactive element curium, which has 96 protons in its nucleus, with calcium nuclei, which have 20 protons ^[2]. These newest members are the heaviest elements yet confirmed, with 114 and 116 protons a piece^[2].

2.2 Three Dimensional Periodic Table

There are actually many rendition of the periodic table in 3 dimensions that are available right now that are created by chemist. The main purpose of any periodic table of the elements is to help us understand the relationships among the various elements. We want to construct a “periodic table” that is a reasonably faithful representation of the observed relationships. We shall see that there are many advantages to thinking of the periodic table as a three-dimensional object (rather than as a flat, two-dimensional object). The idea of a 3D periodic table is not new: in 1862 Alexandre Beguyer de Chancourtois published a description of his method for arranging the elements in a helix, on the surface of a cylinder ^[4]. This is several years before Mendeleev got create a two dimensional periodic table.

2.2.1 Present Example of Three Dimensional Periodic Table

i) Telluric Helix or Screw, 1862

Alexandre-Émile Béguyer de Chancourtois was the first person to make use of atomic weights to produce a classification of periodicity. He drew the elements as a continuous spiral around a metal cylinder divided into 16 parts. The atomic weight of oxygen was taken as 16 and was used as the standard against which all the other elements were compared^[5]. Tellurium was situated at the centre, prompting *vis tellurique*, or telluric screw.

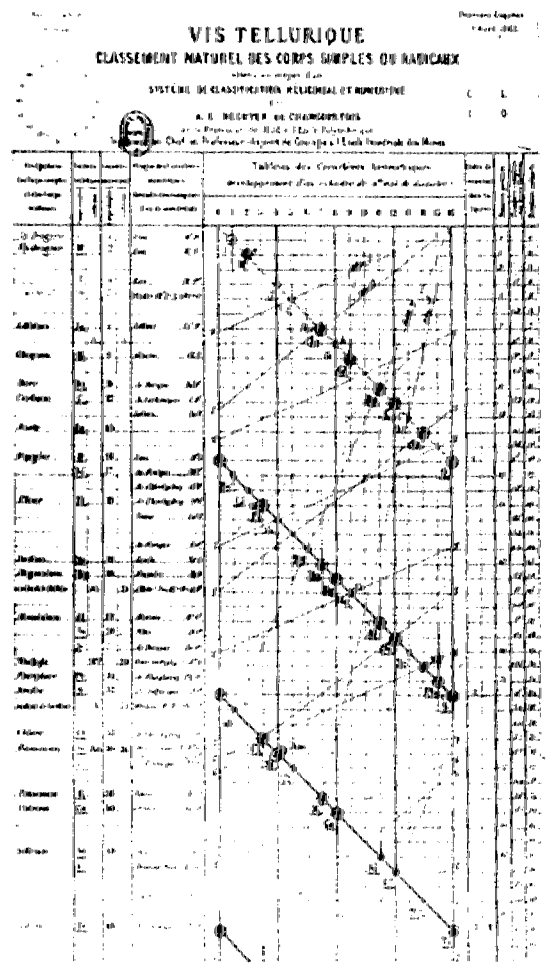


Figure 2.5: Original Telluric Helix @ Screw

The helix was an important advance in that it introduced the concept of periodicity, but it was flawed^[5]. The formulation was rediscovered in the 1889 and since then it has appeared most often in a simplified form that emphasizes the virtues and eliminates its flaws.

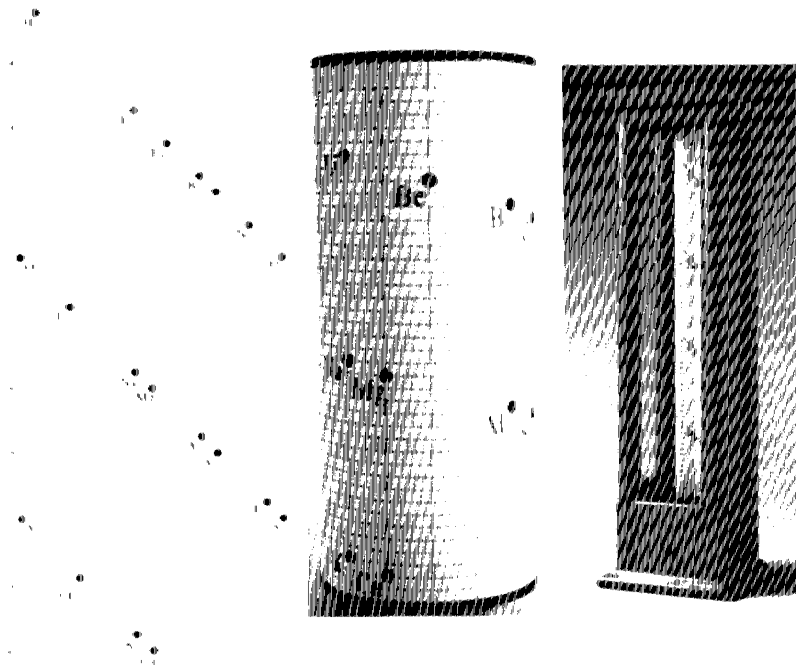


Figure 2.6: Modern Telluric Helix

ii) Dufour's Periodic Tree, 1996

Fernando Dufour, has been fascinated and obsessed by the idea of developing a 3-D color model table of his own. He said that "A third dimension [for the periodic table] is not an option but a necessity". Fernando Dufour is conceivably the world's leading authority on the three dimensional periodic table^[6]. Fernando has created scores of variations on his three dimensional periodic table. Some of them are larger than Fernando as shown in Figure 2.7:

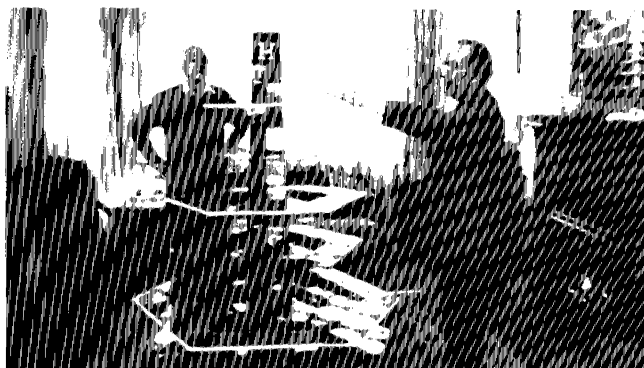


Figure 2.7: 3D Periodic Table larger than Fernando

The 10.5" 3-D commercial model of Dufour's *ElementTree* uses the horizontal and vertical symmetry inherent in the periodic table to relate the electron configurations of the elements to their chemical and physical properties.

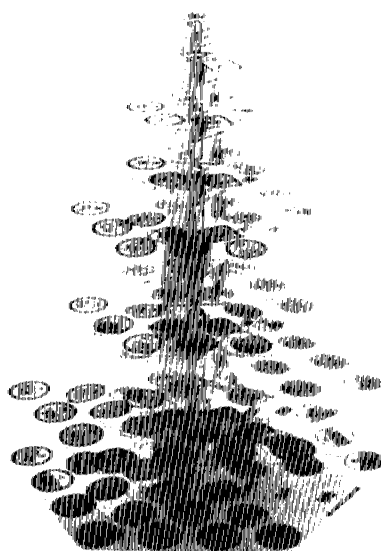


Figure 2.8: Dufour's Periodic Tree

With both vertical and horizontal axes, ElemenTree expands the visual access from 3 to 42 periodic features. Its main advantage is the way it highlights secondary periodicity. In the ElemenTree, a slide or plane through the 3D system serves to align elements with similar properties across multiple dimensions. For example, one slide groups many elements showing a maximum valence of +4, such as carbon (C), silicon (Si), germanium (Ge), tin (Sn), titanium (Ti) and zirconium (Zr). The next slide along aligns elements that display a +5 maximum valence, such as phosphorus (P), arsenic (As), antimony (Sb), bismuth (Bi), vanadium (V) and niobium (Nb). These are patterns hidden within the traditional 2-D periodic table.

It also have an unbroken numerical sequence from 1 to 118 allows the learner to stay on track while tracing trends, similarities, or differences for any element. Blocks s, p, d, and f are integrated as a bisymmetrical motif for the tree structure.

A revamped version of the periodic table design by an Oxford plant scientist is finding favour with chemists and non-chemists alike. In his spare time, Philip Stewart, a University Lecturer in Plant Science, create a design that would both represent the continuity of the sequence of elements and be visually exciting^[7]. Inspired by a mural of the periodic table created by the artist Edgar Longman for the South Kensington Science Exhibition, part of the Festival of Britain held in 1951, he created an image in which the elements are set against a galaxy of stars.

This table was created in a spiral design which uses a starry pathway to link the elements and to express the astronomical reach of chemistry. The elements are arranged by their atomic number, starting with the galactic centre and circle outwards. This design can also be read as the approximate sequence of formation of the elements in the history of the universe. Instead of figuring in adjacent boxes, each element is represented by a colour-coded circle and all are connected in a spiral, at the centre of which is the neutron.

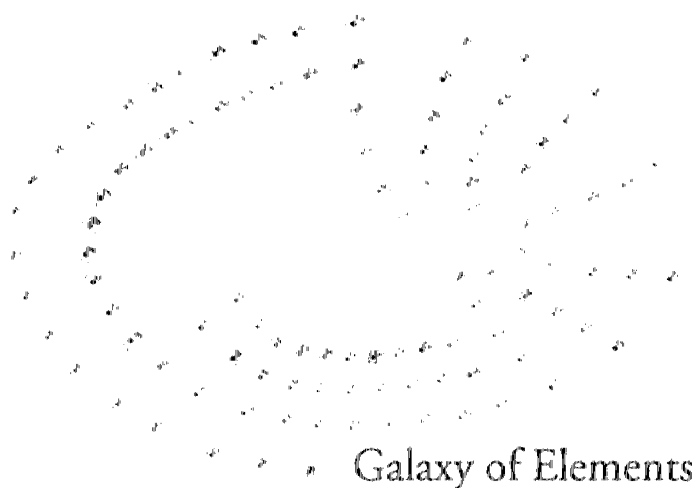


Figure 2.9: Galaxy of Elements

It took thirty years for Dr. Hinsdale Bernard to achieve his goal of creating a three-dimensional Periodic Spiral for chemical elements that represent the buildup of the Periodic Table. This creative professor was recently rewarded with a U.S. patent. “Teaching chemistry with a three-dimensional model is just like teaching about the human body. We needed something more attractive, a little more exciting than flat boxes.” Bernard said.

He also said that besides being very aesthetically pleasant to the eyes, this three dimensional rendition of the Periodic Table of the Elements could provide a hands-on teaching/learning model that can facilitate an understanding of the basics of the chemical elements, in particular, and stimulate interest in science, in general. This invention can be used by students and their instructors from school through college/university levels. As such, it can be produced as an individual teaching/learning kit for use in the classroom or at home, and even in the form of an exciting toy/game for younger children to play with at home and learn about the elements vicariously.

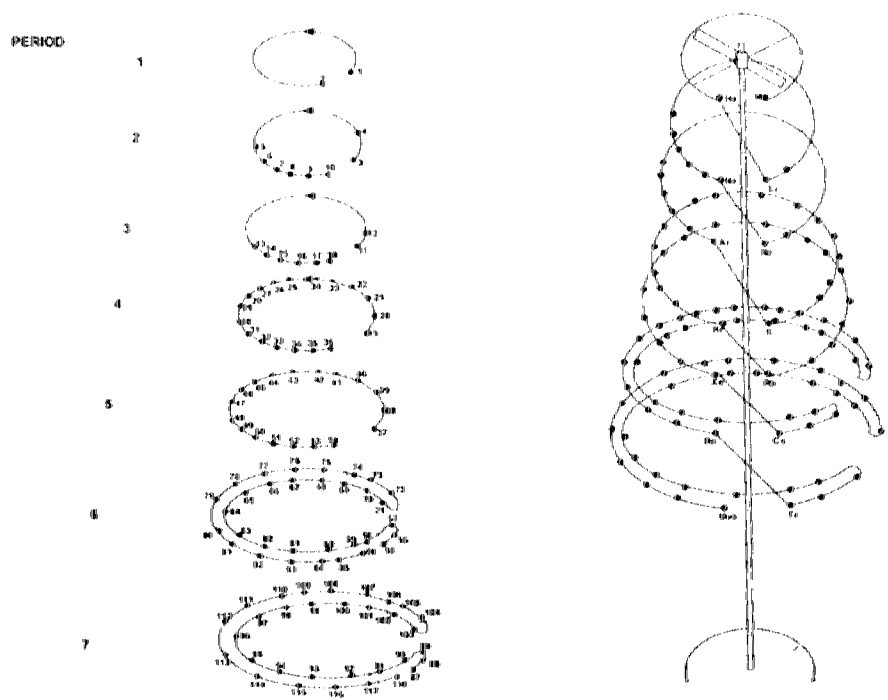


Figure 2.10: Periodic Spiral

CHAPTER 3: METHODOLOGY

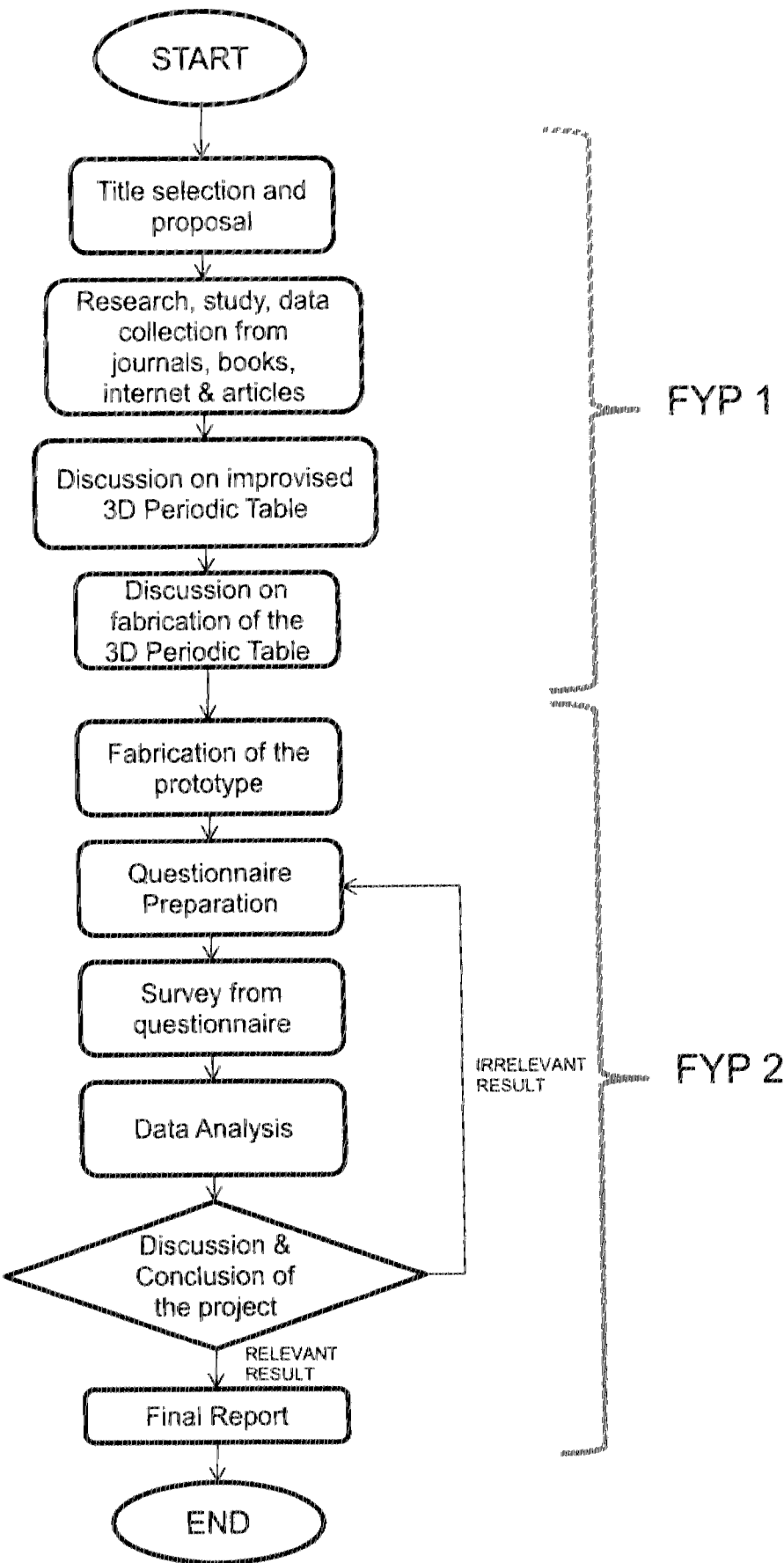
3.1 Research Methodology

This project starts with background of research, survey and understanding of current two dimensional periodic table & three dimensional periodic table elements, its usage. Background study plays an important role. Extended proposal report and interim report has been prepared and highlighted the findings of the research. This is important in determining the workflow to be done during the study, designing and fabricating the three dimensional periodic table displays. The discussion about safety issues when fabricating the three dimensional periodic table display has been done with laboratory technician. Any problems that may occur regarding the fabrication of the three dimensional periodic table in the future can be eliminated and discussed in this stage. If there is any problem, steps taken should be revised again.

For the completion of the project, the work done will generally be distributed in four phases which are:

- i) Research, survey and understanding of current two dimensional periodic table & three dimensional periodic table elements, its usage. The information related to these is collected from books, journals, internet, articles and lecturers. All the information is compiled for future references.
- ii) Discussion on an improvised three dimensional periodic table. This discussion is done between student and supervisor.
- iii) Prototyping on an improvised three dimensional periodic table, the material that is used to display the periodic table. The fabrication of the three dimensional periodic table will be done at Mechanical Engineering lab.
- iv) Data analysis and data collection by using questionnaire will be distributed to the selected student regarding the new fabricated three dimensional periodic table displays. The purpose is to get their feedback on it. The result and data are collected and compiled.

3.2 Flow Chart



3.3 Project Scheduling

The following Table 1 and Table 2 will list out all the work done and proposed dateline throughout Final Year Project 1 (FYP1) and Final Year Project 2 (FYP2).

Week	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Research on current two dimensional periodic table & three dimensional periodic table elements, its usage.														
Extended Proposal submission														
Proposal Defence														
Understanding and discussion on an improvised version of three dimensional periodic table														
Discussion about the material used to build the three dimensional periodic table														
Interim Report submission														

Table 3.1 : Tabulation of work and dateline proposed in FYP1 semester

During FYP1, the author will familiarize with the current two dimensional periodic displays and three dimensional periodic displays. Discussion on an improvised three dimensional periodic display will be done with the help of the supervisor. At the end of the semester, a case study will be given by the supervisor to test the author knowledge on the improvised version of the three dimensional periodic table.

Week	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Fabrication of the prototype three dimensional periodic table														
Survey by using questionnaire about the new three dimensional periodic table														
Data collection from questionnaire														
Data Analysis														
Progress Report submission														
Pre-EDX														
Dissertation writing														
Draft Report Submission														
Dissertation Submission (Soft bound)														
Technical Paper Submission														
Oral Presentation														
Dissertation Submission (Hard bound)														

Table 3.2: Tabulation of work and dateline proposed in FYP2 semester

In FYP2, fabrication of the 3D periodic table takes place and data from the questionnaire about the current periodic table and the improvised periodic table will be collected. The data will be collected from the students both from nearby school and UTP. From the data collected, analysis will be conducted to determine the effectiveness of the periodic table display. Based on the analysis, action can be taken to improve students understanding of the periodic table.

3.4 Procedure

The procedure of this project are designing and fabricating the 3D periodic table based on the data gathered & details discussion between student and supervisor.

3.4.1 Design

In this part, details about designing the improvised 3D periodic table will be shown, including the dimension, picture using autocad and material selection.

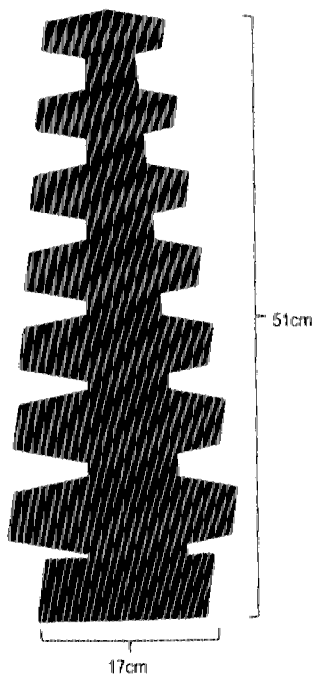


Figure 3.1: 3D Periodic Table

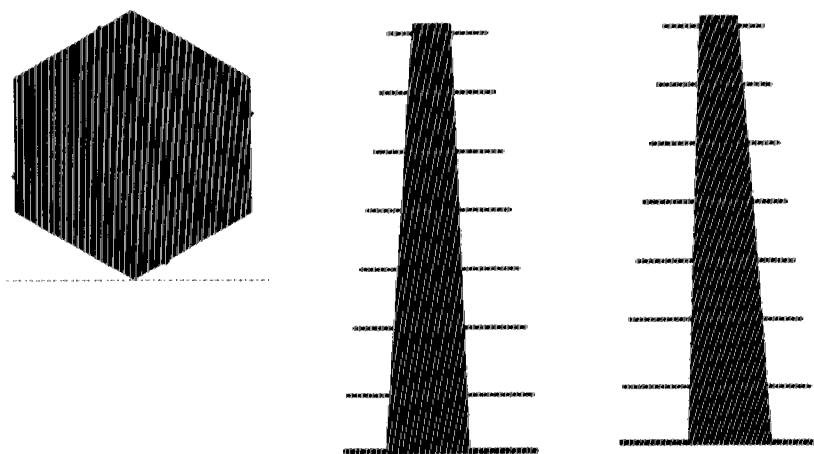


Figure 3.2: 3D Periodic Table top view, right side view & left side view

Materials Selection Table

Type	Price	Weight	Stiffness	Strength	Attractiveness	Score
Recycled box	3	2	1	1	1	8
Wood	1	1	3	3	1	9
Acrylic	2	2	3	3	2	12
Cardboard	3	3	2	2	3	13

Table 3.3: Material Selection

- Price = 1: Costly, 2: Normal, 3: Cheap
- Weight = 1: Heavy, 2: Normal, 3: Light
- Stiffness = 1: Less Stiff, 2: Normal, 3: Firm
- Strength = 1: Weak, 2: Normal, 3: Strong
- Attractiveness = 1: Less, 2: Normal, 3: More

Therefore, in fabricating the 3D Periodic Table, cardboard is selected to be the material used. Apart from the criteria above, cardboard is easy to shape/modified thus giving us an advantage to design the 3D periodic table accordingly.

3.4.2 Fabrication Steps

1. Prepare all these items to fabricate 3D periodic table:

- Ruler
- Protractor
- Knife
- Cardboard
- Sticker Paper
- UHU glue
- Pencil
- Compass

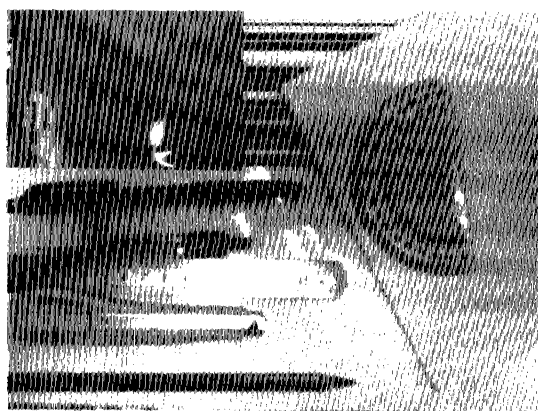


Figure 3.3: Items required

2. Draw hexagonal shape on the cardboard by trigonometry knowledge using the length and angle of the object:

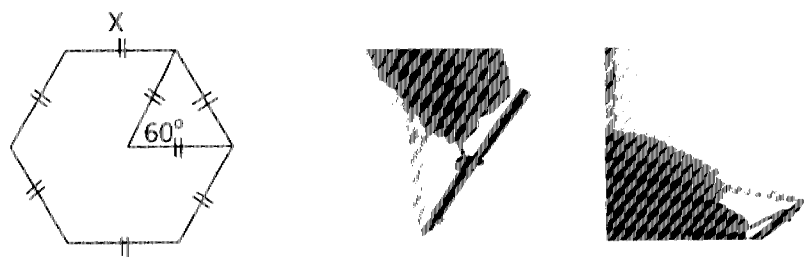


Figure 3.4: Drawing hexagonal shape

There are 7 hexagons to be made (each hexagon size has two sides) from top to bottom the size X are:

- 7cm, 8cm, 9cm, 10cm, 11cm, 12cm, 13cm

3. Draw 6 poles with these dimensions on the cardboard:

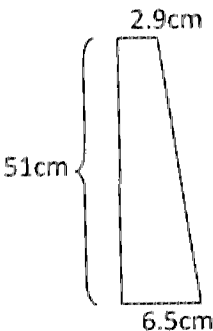


Figure 3.5: Pole dimensions

4. Draw 5 of a 17cmx17cm rectangular shape for the 3D Periodic table base.

5. Cut all the drawings that have been made (Hexagon, pole and base).

6. Joint the same size hexagon, 2 poles to make a pole (total 3 pole with double layer cardboard), and all 5 rectangular bases with UHU glue.

7. Draw and make a hole (as in figure 3.6) on the hexagons and rectangular base as size stated below:

Type	Hole
Hexagon 7cm	3cm
Hexagon 8cm	3.5cm
Hexagon 9cm	4cm
Hexagon 10cm	4.5cm
Hexagon 11cm	5cm
Hexagon 12cm	5.5cm
Hexagon 13cm	6cm
Rectangular Base	6.5cm

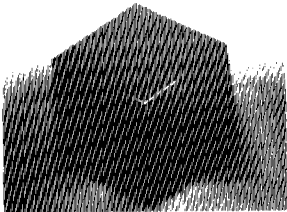


Figure 3.6: Hole

Table 3.4: Hole Size

8. For the elements to be placed on the hexagon according, a circle filled with elements nickname with dimension below is made with colour coded properties, printed on sticker paper, later was cut and paste on the hexagon periodically.

Type	Circle Diameter
Hexagon 7cm	4cm
Hexagon 8cm	3.5cm
Hexagon 9cm	3cm
Hexagon 10cm	2.5 cm
Hexagon 11cm	2cm
Hexagon 12cm	1.3cm
Hexagon 13cm	1cm

Table 3.5: Circle Diameter

9. Between each hexagon, put a rectangular shape that act as an “arrow” to show the sequence of the elements in the 3D periodic table display.

3.5 Project Activities

Based on current 2D periodic table and new improvised version of three dimensional periodic table made, a questionnaire that consist of 10 question mainly on the comparison, difference, advantage and disadvantage of the new 3D periodic table fabricated will be distributed to 50 selected university students. Then data collection will be made analysis will be done based on the questionnaire.

3.6 Tools/ Equipment

For this project, the tools and equipment are used to fabricate the three dimensional periodic table. Those are:

1. Protractor

A protractor is used to determine the angle of hexagon that is 60° .

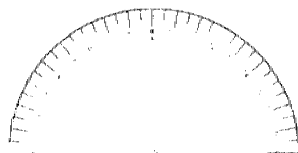


Figure 3.7: Protractor

2. Compass

A compass is used to draw the hexagon by using trigonometric knowledge.



Figure 3.8: Compass

3. Ruler

A ruler is used to determine the length of hexagon, pole and base.

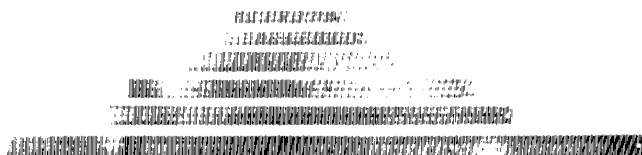


Figure 3.9: Ruler

Survey forms will be distributed to selected student and the main objective of this form is to get their feedback on the new fabricated three dimensional periodic table displays.

CHAPTER 4: RESULTS AND DISCUSSION

4.1 Results

Fabrication of the improvised version of 3D periodic table display has been done with colour coded elements as in figure 4.1 below:



Colour	Legend
	Other Nonmetals
	Noble Gases
	Alkali Metals
	Alkaline Earth Metals
	Poor Metals
	Transition Metals
	Lanthanoids
	Actinoids

Figure 4.1: Actual 3D Periodic Table

Table 4.1: Colour code

Period	Hexagon Figure	Elements
1		H, He
2		Li, Be, B, C, N, O, F, Ne
3		Na, Mg, Al, Si, P, S, Cl, Ar
4		K, Ca, Sc, Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, Ga, Ge, As, Se, Br, Kr
5		Rb, Sr, Y, Zr, Nb, Mo, Tc, Ru, Rh, Pd, Ag, Cd, In, Sn, Sb, Te, I, Xe
6		Cs, Ba, La, Ce, Pr, Nd, Pm, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu, Hf, Ta, W, Re, Os, Ir, Pt, Au, Hg, Ti, Pb, Bi, Po, At, Rn
7		Fr, Ra, Ac, Th, Pa, U, Np, Pu, Am, Cm, Bk, Cf, Es, Fm, Md, No, Lr, Rf, Db, Sg, Bh, Hs, Mt, Ds, Rg, Uub, Uuq, Uuh, Uus

Table 4.2: Period in details

From the questionnaire distributed to 50 students, these are the responses from the students:

1. Do you know what is periodic table of the elements?

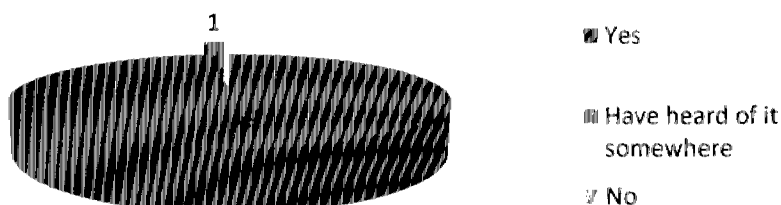


Figure 4.2: Pie Chart for Question 1

2. Do you understand the common 2D periodic table of the elements?

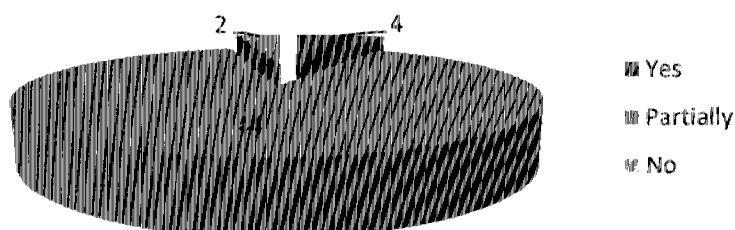


Figure 4.3: Pie Chart for Question 2

3. What do you want in 2D periodic table of the elements?

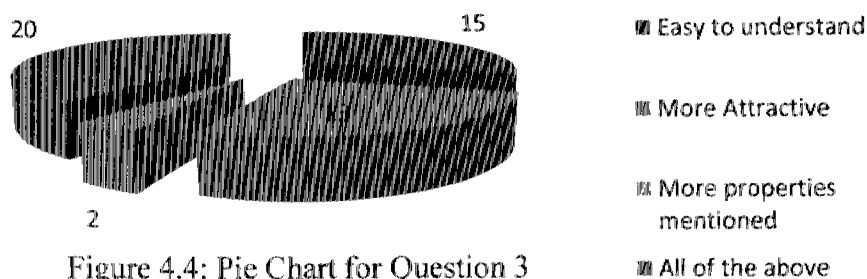


Figure 4.4: Pie Chart for Question 3

4. Are you aware that scientists are still trying to develop/synthesize new elements?

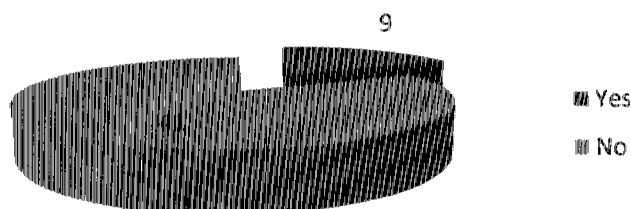


Figure 4.5: Pie Chart for Question 4

5. Have you ever heard of 3D periodic table of the elements?

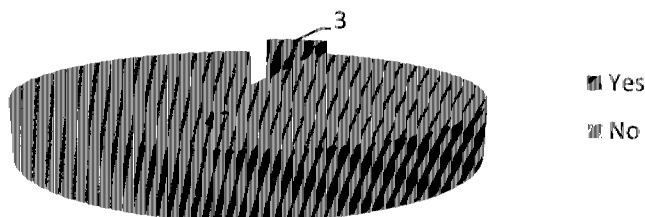


Figure 4.6: Pie Chart for Question 5

6. There are more than 100 types of 3D periodic table of the elements. Impressed?

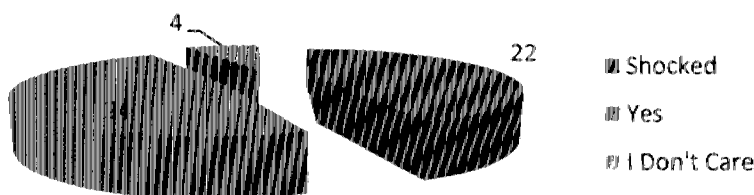


Figure 4.7: Pie Chart for Question 6

7. What do you want in 3D periodic table of the elements?

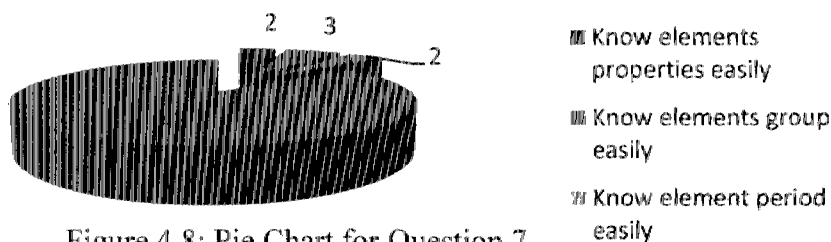


Figure 4.8: Pie Chart for Question 7

8. Which one is more attractive?

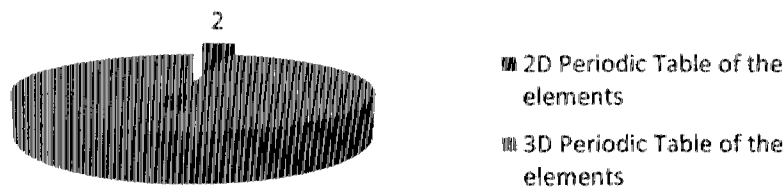


Figure 4.9: Pie Chart for Question 8

9. Do you want to look closely on the 3D periodic table of elements or touch it?

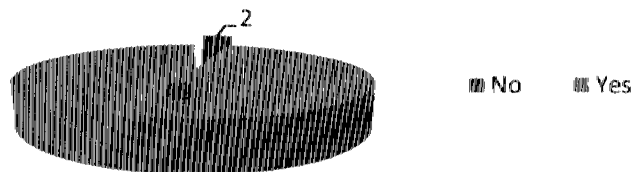


Figure 4.10: Pie Chart for Question 9

10. What is your general comment after witnessing this 3D periodic table of elements?

- Interesting
- Could act as a study reference in school
- Looks like a Christmas Tree
- Nice & okay
- Attractive
- Need further explanation for better understanding

11. Any further suggestion so that we could improvise the 3D periodic table of elements that you see?

- Make the circle of elements bigger to make it easier to see
- Put the legend on the top
- Modified the colour to make it more interesting
- Use material that have water resistance properties
- Organize the elements properly
- Make it small & portable
- Put full name of elements instead of symbols
- Show the sequence of the element in each period by putting arrow as indicator of the arrangement
- Make it more unique, instead of we can only read the improvised version of 3D periodic table of elements from top view, change it a bit so that it can also be viewed from side by making the circle a sphere.

4.2 Discussion

Design & Fabrication

The fabrication of the prototype 3D periodic table is design based on reason and motive. Those are:

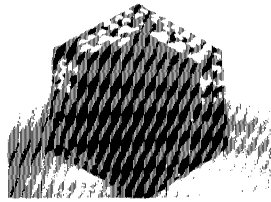


Figure 4.11: Stacked 3D Periodic Table

- Hexagon shape from top to bottom getting larger. This is because the periods are getting larger and the atomic number of the elements from the 1st period until the 7th period is increasing thus making the elements larger through the period.

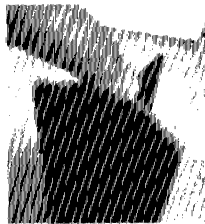


Figure 4.12: 3 Pole 120° distance

- 3 poles are made to support the hexagons with 120° distance from one another. This will help to hold the 3D structure and increase the stability of the model.

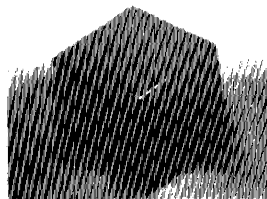


Figure 4.13: 50% Hole Length

- Hole made on the hexagon. A hole that approximately 50% of the hexagon length is made on the hexagon to increase stability and so that the pole can hold the structure efficiently. Friction force is applied between the pole and hexagon to hold the model.

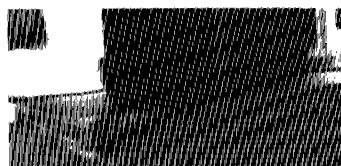


Figure 4.14: 5 layers base

- For the base, 5 stacks on cardboard are used for stability with thickness 6mm.

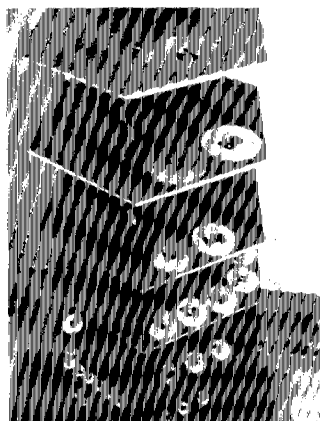


Figure 4.15: 3 colours cardboard

- 3 colours are used as cardboard that is light green, dark green and black to make it more attractive.



Figure 4.16: Counter Clockwise

- Counter clockwise arrangement of the elements is made on the hexagon so that it follows the atomic number.

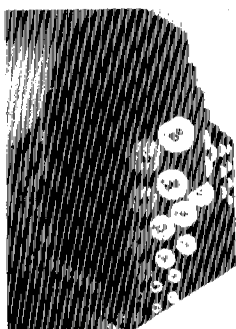


Figure 4.17: Decreasing circle size

- Circle size of the elements is decreasing from top to bottom of the model because the number of elements is increasing through the period.
- Colour coded elements been paste on the hexagon to make it more attractive and easy to understand.

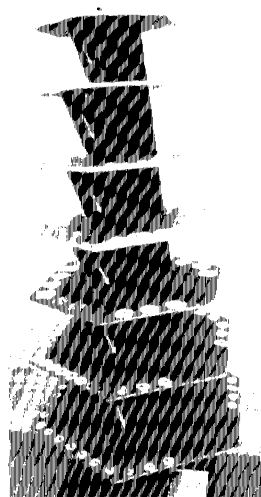


Figure 4.18: Arrow to show sequence

- Arrow between two plates to show the sequence of the 3D periodic table of the elements

On the other hand, there are some properties in this new 3D Periodic Table which are:

- Uninterrupted arrangement of elements periodically.
- Circle positioned so that chemical elements in a chemical group are in substantially the same vertical plane.
- Counter clockwise arrangement of the elements.
- Element 113, 115 and 118 are not included because it is rejected by the chemist.

For the survey part, the questionnaire is distributed to 50 selected undergraduate students. From this survey, 100% of the student knows about the 2D periodic table of elements but only 4% of them understand it as a whole, 88% of them understands only partially of it and 2% does not understand it at all. This happens because in school and universities, most of them learned only from the 1st period until the 4th period of the 2D periodic table of elements. They do not even know the properties of the 5th period until the 7th period of the periodic table.

Regarding their need, students want both 2D periodic table of elements and 3D periodic table of elements to be more users friendly where it can be understand easily. Improvement that they want in the common 2D periodic table is for it to become more attractive and more properties mentioned. This is based on our results where 26% of student want 2D periodic table to be more attractive, 4% of them want

more properties mentioned and 40% of them want it to be both. On the other hand, for their expectation on the 3D periodic table of elements they, 86% of them want it to be users friendly in terms of elements properties, groups and periods.

Student's awareness towards material science is very low. This is proven from our survey that only 18% of the students knew that scientists are still trying to develop/synthesize new elements and sadly another 82% of the students do not even know about this. It gets worse when 94% of the students have not even heard about the 3D periodic table of elements, only 6% of the students have heard of it. Most of them said that they do not aware of the material science education mostly because they do not know its importance and value towards engineering.

From the survey, 44% of student are shocked that there are actually more than 100 types of 3D periodic table of elements exists and 48% of them are impress with it. But there are 8% of the students do not even cares about it because they do not know the importance of it.

When this 50 student see the improvised version of 3D periodic table of elements, almost all of them are impress about it because it is attractive, colourful and unique. This is proven by the result where 96% of the student agreed that 3D periodic table of elements is more attractive than 2D periodic table of elements, and it is strengthen by 96% of them tends to touch it and took a closer look towards the improvised version of 3D periodic table of elements. Only 4% of the students still think that 2D periodic table is more suitable for studying. They said that 3D periodic table will be hard to carry around and more difficult to analyze.

CHAPTER 5: CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

As a conclusion, the present invention of 3D periodic table provides attractiveness, facilitates a better understanding of chemical elements and stimulates interest in science based on the result collected from the questionnaire. This is because 3D arrangements for the periodic table of the elements are based on a hexagon rather than rectangular arrangement represented in conventional charts & 3D arrangement contains a continuous uninterrupted arrangement of elements periodically where in every period, each circle representing a different chemical element. Furthermore, this improvised version of 3D periodic table of elements helps to increase the awareness about the importance of material science education.

5.2 Recommendations

The 3D periodic arrangement may be motorized so that it can rotate whereby an observer can view the entire device from a single position. It may also be formed on a display device, such as a computer monitor. Computer generated graphics and appropriate software required to form such an image in a display device are included within the scope of this invention.

Furthermore, the 3D periodic table may also be stored in a handy case for housing all the part of the kit so that an individual can transport the device with ease and assemble and disassemble the 3D periodic table at will.

More detailed study should be done especially in the discussion of the improvise version on 3D periodic table and its fabrication. This is because there are too many renditions of three dimensional periodic tables and each of them has their own ways in arranging the elements in their own ways where most of them arrange it by the elements properties.

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Questionnaire

1. Do you know what is periodic table of the elements?
 - a) ☒ Yes
 - b) ☐ Have heard of it somewhere
 - c) ☐ No
2. Do you understand the common 2D periodic table of the elements?
 - a) ☐ Yes, from the 1st element until the 118th elements
 - b) ☒ I understand it partially
 - c) ☐ Not at all
3. What do you want in 2D periodic table of the elements?
 - a) ☐ Easy to understand
 - b) ☐ More attractive
 - c) ☒ More properties mentioned
 - d) ☐ All of the above
4. Are you aware that scientists are still trying to develop/synthesize new elements?
 - a) ☒ Yes
 - b) ☐ No
5. Have you ever heard of 3D periodic table of the elements?
 - a) ☒ Yes
 - b) ☐ No
6. There are more than 100 types of 3D periodic table of the elements. Impressed?
 - a) ☐ Wow!!! (Shocked)
 - b) ☒ Yes
 - c) ☐ I don't care
7. What do you want in 3D periodic table of the elements?
 - a) ☐ Know element properties easily
 - b) ☐ Know element groups easily
 - c) ☒ Know element period easily
 - d) ☐ All of the above
8. Which one is more attractive?
 - a) ☐ 2D Periodic Table of the elements
 - b) ☒ 3D Periodic Table of the elements
9. Do you want to look closely on the 3D periodic table of elements or touch it? Yes
10. What is your general comment after witnessing this 3D periodic table of elements?
Okay.
11. Any further suggestion so that we could improvise the 3D periodic table of elements that you see?
Modified the colour.

Questionnaire

1. Do you know what is periodic table of the elements?
☒ a) Yes
b) Have heard of it somewhere
c) No
2. Do you understand the common 2D periodic table of the elements?
a) Yes, from the 1st element until the 118th elements
☒ b) I understand it partially
c) Not at all
3. What do you want in 2D periodic table of the elements?
a) Easy to understand
☒ b) More attractive
c) More properties mentioned
d) All of the above
4. Are you aware that scientists are still trying to develop/synthesize new elements?
☒ a) Yes
b) No
5. Have you ever heard of 3D periodic table of the elements?
a) Yes
☒ b) No
6. There are more than 100 types of 3D periodic table of the elements. Impressed?
a) Wow!!! (Shocked)
☒ b) Yes
c) I don't care
7. What do you want in 3D periodic table of the elements?
a) Know element properties easily
☒ b) Know element groups easily
c) Know element period easily
d) All of the above
8. Which one is more attractive?
a) 2D Periodic Table of the elements
☒ b) 3D Periodic Table of the elements
9. Do you want to look closely on the 3D periodic table of elements or touch it? *Yes*
10. What is your general comment after witnessing this 3D periodic table of elements?

ok

11. Any further suggestion so that we could improvise the 3D periodic table of elements that you see?

—

Questionnaire

- 1. Do you know what is periodic table of the elements?
 - ☒ a) Yes
 - b) Have heard of it somewhere
 - c) No
- 2. Do you understand the common 2D periodic table of the elements?
 - a) Yes, from the 1st element until the 118th elements
 - ☒ b) I understand it partially
 - c) Not at all
- 3. What do you want in 2D periodic table of the elements?
 - a) Easy to understand
 - ☒ b) More attractive
 - c) More properties mentioned
 - d) All of the above
- 4. Are you aware that scientists are still trying to develop/synthesize new elements?
 - ☒ a) Yes
 - b) No
- 5. Have you ever heard of 3D periodic table of the elements?
 - ☒ a) Yes
 - b) No
- 6. There are more than 100 types of 3D periodic table of the elements. Impressed?
 - a) Wow!!! (Shocked)
 - ☒ b) Yes
 - c) I don't care
- 7. What do you want in 3D periodic table of the elements?
 - a) Know element properties easily
 - b) Know element groups easily
 - ☒ c) Know element period easily
 - d) All of the above
- 8. Which one is more attractive?
 - a) 2D Periodic Table of the elements
 - ☒ b) 3D Periodic Table of the elements
- 9. Do you want to look closely on the 3D periodic table of elements or touch it? ☒ Yes

10. What is your general comment after witnessing this 3D periodic table of elements?

Nice

11. Any further suggestion so that we could improvise the 3D periodic table of elements that you see?

Portable

Questionnaire

1. Do you know what is periodic table of the elements?
☒ a) Yes
b) Have heard of it somewhere
c) No
2. Do you understand the common 2D periodic table of the elements?
a) Yes, from the 1st element until the 118th elements
☒ b) I understand it partially
c) Not at all
3. What do you want in 2D periodic table of the elements?
a) Easy to understand
b) More attractive
☒ c) More properties mentioned
d) All of the above
4. Are you aware that scientists are still trying to develop/synthesize new elements?
☒ a) Yes
b) No
5. Have you ever heard of 3D periodic table of the elements?
☒ a) Yes
b) No
6. There are more than 100 types of 3D periodic table of the elements. Impressed?
a) Wow!!! (Shocked)
☒ b) Yes
c) I don't care
7. What do you want in 3D periodic table of the elements?
a) Know element properties easily
b) Know element groups easily
☒ c) Know element period easily
d) All of the above
8. Which one is more attractive?
☒ a) 2D Periodic Table of the elements
b) 3D Periodic Table of the elements
9. Do you want to look closely on the 3D periodic table of elements or touch it? ☒
10. What is your general comment after witnessing this 3D periodic table of elements?
good
11. Any further suggestion so that we could improvise the 3D periodic table of elements that you see?
nothing

Questionnaire

1. Do you know what is periodic table of the elements?
a) ☒ Yes
b) Have heard of it somewhere
c) No
2. Do you understand the common 2D periodic table of the elements?
a) Yes, from the 1st element until the 118th elements
b) ☒ I understand it partially
c) Not at all
3. What do you want in 2D periodic table of the elements?
a) Easy to understand
b) More attractive
c) More properties mentioned
d) ☒ All of the above
4. Are you aware that scientists are still trying to develop/synthesize new elements?
a) Yes
b) ☒ No
5. Have you ever heard of 3D periodic table of the elements?
a) Yes
b) ☒ No
6. There are more than 100 types of 3D periodic table of the elements. Impressed?
a) Wow!!! (Shocked)
b) ☒ Yes
c) I don't care
7. What do you want in 3D periodic table of the elements?
a) Know element properties easily
b) Know element groups easily
c) Know element period easily
d) ☒ All of the above
8. Which one is more attractive?
a) 2D Periodic Table of the elements
b) ☒ 3D Periodic Table of the elements
9. Do you want to look closely on the 3D periodic table of elements or touch it? Yes
10. What is your general comment after witnessing this 3D periodic table of elements?

Explanation.

11. Any further suggestion so that we could improvise the 3D periodic table of elements that you see?

Organize.

Questionnaire

1. Do you know what is periodic table of the elements?
☒ a) Yes
b) Have heard of it somewhere
c) No
2. Do you understand the common 2D periodic table of the elements?
a) Yes, from the 1st element until the 118th elements
☒ b) I understand it partially
c) Not at all
3. What do you want in 2D periodic table of the elements?
a) Easy to understand
b) More attractive
c) More properties mentioned
☒ d) All of the above
4. Are you aware that scientists are still trying to develop/synthesize new elements?
☒ a) Yes
b) No
5. Have you ever heard of 3D periodic table of the elements?
a) Yes
☒ b) No
6. There are more than 100 types of 3D periodic table of the elements. Impressed?
a) Wow!!! (Shocked)
b) Yes
☒ c) I don't care
7. What do you want in 3D periodic table of the elements?
a) Know element properties easily
b) Know element groups easily
c) Know element period easily
☒ d) All of the above
8. Which one is more attractive?
a) 2D Periodic Table of the elements
☒ b) 3D Periodic Table of the elements
9. Do you want to look closely on the 3D periodic table of elements or touch it? ☒ Yes
10. What is your general comment after witnessing this 3D periodic table of elements?
Attractive
11. Any further suggestion so that we could improvise the 3D periodic table of elements that you see?
FULL NAME

Questionnaire

1. Do you know what is periodic table of the elements?
☒ a) Yes
b) Have heard of it somewhere
c) No
2. Do you understand the common 2D periodic table of the elements?
a) Yes, from the 1st element until the 118th elements
☒ b) I understand it partially
c) Not at all
3. What do you want in 2D periodic table of the elements?
a) Easy to understand
b) More attractive
c) More properties mentioned
☒ d) All of the above
4. Are you aware that scientists are still trying to develop/synthesize new elements?
☒ a) Yes
b) No
5. Have you ever heard of 3D periodic table of the elements?
a) Yes
☒ b) No
6. There are more than 100 types of 3D periodic table of the elements. Impressed?
a) Wow!!! (Shocked)
b) Yes
☒ c) I don't care
7. What do you want in 3D periodic table of the elements?
a) Know element properties easily
b) Know element groups easily
c) Know element period easily
☒ d) All of the above
8. Which one is more attractive?
a) 2D Periodic Table of the elements
☒ b) 3D Periodic Table of the elements
9. Do you want to look closely on the 3D periodic table of elements or touch it? ☒ Yes
10. What is your general comment after witnessing this 3D periodic table of elements?

Nke

11. Any further suggestion so that we could improvise the 3D periodic table of elements that you see?

Unique it.

Questionnaire

1. Do you know what is periodic table of the elements?
☒ a) Yes
☐ b) Have heard of it somewhere
☐ c) No
2. Do you understand the common 2D periodic table of the elements?
☒ a) Yes, from the 1st element until the 118th elements
☐ b) I understand it partially
☐ c) Not at all
3. What do you want in 2D periodic table of the elements?
☐ a) Easy to understand
☐ b) More attractive
☒ c) More properties mentioned
☐ d) All of the above
4. Are you aware that scientists are still trying to develop/synthesize new elements?
☒ a) Yes
☐ b) No
5. Have you ever heard of 3D periodic table of the elements?
☐ a) Yes
☐ b) No
6. There are more than 100 types of 3D periodic table of the elements. Impressed?
☒ a) Wow!!! (Shocked)
☐ b) Yes
☐ c) I don't care
7. What do you want in 3D periodic table of the elements?
☐ a) Know element properties easily
☒ b) Know element groups easily
☐ c) Know element period easily
☐ d) All of the above
8. Which one is more attractive?
☐ a) 2D Periodic Table of the elements
☒ b) 3D Periodic Table of the elements
9. Do you want to look closely on the 3D periodic table of elements or touch it? *Yes*
10. What is your general comment after witnessing this 3D periodic table of elements?

Eye catching.

11. Any further suggestion so that we could improvise the 3D periodic table of elements that you see?

No, suggestion.

Questionnaire

1. Do you know what is periodic table of the elements?
☒ a) Yes
☐ b) Have heard of it somewhere
☐ c) No
2. Do you understand the common 2D periodic table of the elements?
☐ a) Yes, from the 1st element until the 118th elements
☒ b) I understand it partially
☐ c) Not at all
3. What do you want in 2D periodic table of the elements?
☐ a) Easy to understand
☒ b) More attractive
☐ c) More properties mentioned
☐ d) All of the above
4. Are you aware that scientists are still trying to develop/synthesize new elements?
☐ a) Yes
☒ b) No
5. Have you ever heard of 3D periodic table of the elements?
☒ a) Yes
☐ b) No
6. There are more than 100 types of 3D periodic table of the elements. Impressed?
☐ a) Wow!!! (Shocked)
☒ b) Yes
☐ c) I don't care
7. What do you want in 3D periodic table of the elements?
☐ a) Know element properties easily
☐ b) Know element groups easily
☒ c) Know element period easily
☐ d) All of the above
8. Which one is more attractive?
☐ a) 2D Periodic Table of the elements
☒ b) 3D Periodic Table of the elements
9. Do you want to look closely on the 3D periodic table of elements or touch it? *Yes*
10. What is your general comment after witnessing this 3D periodic table of elements?

Interesting. Hard to understand without explanation.

11. Any further suggestion so that we could improvise the 3D periodic table of elements that you see?

The legend should be easy to view.

Questionnaire

Do you know what is periodic table of the elements?

- ☒ a) Yes
- b) Have heard of it somewhere
- c) No

Do you understand the common 2D periodic table of the elements?

- ☒ a) Yes, from the 1st element until the 118th elements
- b) I understand it partially
- c) Not at all

What do you want in 2D periodic table of the elements?

- a) Easy to understand
- b) More attractive
- ☒ c) More properties mentioned
- d) All of the above

Are you aware that scientists are still trying to develop/synthesize new elements?

- ☒ a) Yes
- b) No

Have you ever heard of 3D periodic table of the elements?

- ☒ a) Yes
- b) No

There are more than 100 types of 3D periodic table of the elements. Impressed?

- a) Wow!!! (Shocked)
- ☒ b) Yes
- c) I don't care

What do you want in 3D periodic table of the elements?

- a) Know element properties easily
- b) Know element groups easily
- ☒ c) Know element period easily
- d) All of the above

Which one is more attractive?

- a) 2D Periodic Table of the elements
- ☒ b) 3D Periodic Table of the elements

Do you want to look closely on the 3D periodic table of elements or touch it?

0. What is your general comment after witnessing this 3D periodic table of elements? *Yes, interesting*

1. Any further suggestion so that we could improvise the 3D periodic table of elements that you see?

No

Questionnaire

- Do you know what is periodic table of the elements?
- ☒ a) Yes
 - b) Have heard of it somewhere
 - c) No
- Do you understand the common 2D periodic table of the elements?
- ☒ a) Yes, from the 1st element until the 118th elements
 - b) I understand it partially
 - c) Not at all
- What do you want in 2D periodic table of the elements?
- ☒ a) Easy to understand
 - b) More attractive
 - c) More properties mentioned
 - d) All of the above
- Are you aware that scientists are still trying to develop/synthesize new elements?
- ☒ a) Yes
 - b) No
- Have you ever heard of 3D periodic table of the elements?
- ☒ a) Yes
 - b) No
- There are more than 100 types of 3D periodic table of the elements. Impressed?
- ☒ a) Wow!!! (Shocked)
 - b) Yes
 - c) I don't care
- What do you want in 3D periodic table of the elements?
- ☒ a) Know element properties easily
 - b) Know element groups easily
 - c) Know element period easily
 - d) All of the above
- Which one is more attractive?
- ☒ a) 2D Periodic Table of the elements
 - b) 3D Periodic Table of the elements
- Do you want to look closely on the 3D periodic table of elements or touch it? *Yes*
0. What is your general comment after witnessing this 3D periodic table of elements?
more attractive than 2D
1. Any further suggestion so that we could improvise the 3D periodic table of elements that you see?

Questionnaire

Do you know what is periodic table of the elements?

- ☒ a) Yes
- ☐ b) Have heard of it somewhere
- ☐ c) No

Do you understand the common 2D periodic table of the elements?

- ☐ a) Yes, from the 1st element until the 118th elements
- ☒ b) I understand it partially
- ☐ c) Not at all

What do you want in 2D periodic table of the elements?

- ☐ a) Easy to understand
- ☐ b) More attractive
- ☒ c) More properties mentioned
- ☐ d) All of the above

Are you aware that scientists are still trying to develop/synthesize new elements?

- ☐ a) Yes
- ☐ b) No

Have you ever heard of 3D periodic table of the elements?

- ☒ a) Yes
- ☐ b) No

There are more than 100 types of 3D periodic table of the elements. Impressed?

- ☐ a) Wow!!! (Shocked)
- ☒ b) Yes
- ☐ c) I don't care

What do you want in 3D periodic table of the elements?

- ☐ a) Know element properties easily
- ☐ b) Know element groups easily
- ☒ c) Know element period easily
- ☐ d) All of the above

Which one is more attractive?

- ☐ a) 2D Periodic Table of the elements
- ☒ b) 3D Periodic Table of the elements

Do you want to look closely on the 3D periodic table of elements or touch it?

9. What is your general comment after witnessing this 3D periodic table of elements? *Yes*
good

10. Any further suggestion so that we could improvise the 3D periodic table of elements that you see? *No*

Questionnaire

Do you know what is periodic table of the elements?

- ☒ a) Yes
- b) Have heard of it somewhere
- c) No

Do you understand the common 2D periodic table of the elements?

- ☒ a) Yes, from the 1st element until the 118th elements
- b) I understand it partially
- c) Not at all

What do you want in 2D periodic table of the elements?

- ☒ a) Easy to understand
- b) More attractive
- c) More properties mentioned
- d) All of the above

Are you aware that scientists are still trying to develop/synthesize new elements?

- ☒ a) Yes
- b) No

Have you ever heard of 3D periodic table of the elements?

- ☒ a) Yes
- b) No

There are more than 100 types of 3D periodic table of the elements. Impressed?

- ☒ a) Wow!!! (Shocked)
- b) Yes
- c) I don't care

What do you want in 3D periodic table of the elements?

- ☒ a) Know element properties easily
- b) Know element groups easily
- c) Know element period easily
- d) All of the above

Which one is more attractive?

- ☒ a) 2D Periodic Table of the elements
- b) 3D Periodic Table of the elements

Do you want to look closely on the 3D periodic table of elements or touch it? *Yes*

What is your general comment after witnessing this 3D periodic table of elements?

interesting because i have never seen it

Any further suggestion so that we could improvise the 3D periodic table of elements that you see?

none. perfect.

Questionnaire

1. Do you know what is periodic table of the elements?
 - ☒ a) Yes
 - b) Have heard of it somewhere
 - c) No
2. Do you understand the common 2D periodic table of the elements?
 - a) Yes, from the 1st element until the 118th elements
 - ☒ b) I understand it partially
 - c) Not at all
3. What do you want in 2D periodic table of the elements?
 - a) Easy to understand
 - ☒ b) More attractive
 - c) More properties mentioned
 - d) All of the above
4. Are you aware that scientists are still trying to develop/synthesize new elements?
 - ☒ a) Yes
 - b) No
5. Have you ever heard of 3D periodic table of the elements?
 - ☒ a) Yes
 - b) No
6. There are more than 100 types of 3D periodic table of the elements. Impressed?
 - a) Wow!!! (Shocked)
 - ☒ b) Yes
 - c) I don't care
7. What do you want in 3D periodic table of the elements?
 - a) Know element properties easily
 - ☒ b) Know element groups easily
 - c) Know element period easily
 - d) All of the above
8. Which one is more attractive?
 - a) 2D Periodic Table of the elements
 - ☒ b) 3D Periodic Table of the elements
9. Do you want to look closely on the 3D periodic table of elements or touch it? *Yes*
10. What is your general comment after witnessing this 3D periodic table of elements?
Easy to understand
11. Any further suggestion so that we could improvise the 3D periodic table of elements that you see?
Make it more compact

Questionnaire

1. Do you know what is periodic table of the elements?
☒ a) Yes
b) Have heard of it somewhere
c) No
2. Do you understand the common 2D periodic table of the elements?
a) Yes, from the 1st element until the 118th elements
☒ b) I understand it partially
c) Not at all
3. What do you want in 2D periodic table of the elements?
a) Easy to understand
b) More attractive
☒ c) More properties mentioned
d) All of the above
4. Are you aware that scientists are still trying to develop/synthesize new elements?
☒ a) Yes
b) No
5. Have you ever heard of 3D periodic table of the elements?
a) Yes
☒ b) No
6. There are more than 100 types of 3D periodic table of the elements. Impressed?
a) Wow!!! (Shocked)
☒ b) Yes
c) I don't care
7. What do you want in 3D periodic table of the elements?
a) Know element properties easily
b) Know element groups easily
c) Know element period easily
☒ d) All of the above
8. Which one is more attractive?
a) 2D Periodic Table of the elements
☒ b) 3D Periodic Table of the elements
9. Do you want to look closely on the 3D periodic table of elements or touch it? *Yes*
10. What is your general comment after witnessing this 3D periodic table of elements?
Creative
11. Any further suggestion so that we could improvise the 3D periodic table of elements that you see?
Pocket size

Questionnaire

1. Do you know what is periodic table of the elements?
☒ a) Yes
b) Have heard of it somewhere
c) No
2. Do you understand the common 2D periodic table of the elements?
a) Yes, from the 1st element until the 118th elements
☒ b) I understand it partially
c) Not at all
3. What do you want in 2D periodic table of the elements?
a) Easy to understand
☒ b) More attractive
c) More properties mentioned
d) All of the above
4. Are you aware that scientists are still trying to develop/synthesize new elements?
a) Yes
☒ b) No
5. Have you ever heard of 3D periodic table of the elements?
☒ a) Yes
b) No
6. There are more than 100 types of 3D periodic table of the elements. Impressed?
a) Wow!!! (Shocked)
☒ b) Yes
c) I don't care
7. What do you want in 3D periodic table of the elements?
a) Know element properties easily
☒ b) Know element groups easily
c) Know element period easily
d) All of the above
8. Which one is more attractive?
a) 2D Periodic Table of the elements
☒ b) 3D Periodic Table of the elements
9. Do you want to look closely on the 3D periodic table of elements or touch it? *Yes*
10. What is your general comment after witnessing this 3D periodic table of elements?
Can be commercial
11. Any further suggestion so that we could improvise the 3D periodic table of elements that you see?
need to create a mobile periodic table, so that easier to bring to anyway.

Questionnaire

1. Do you know what is periodic table of the elements?
 - a) Yes
 - ☒ b) Have heard of it somewhere
 - c) No
2. Do you understand the common 2D periodic table of the elements?
 - a) Yes, from the 1st element until the 118th elements
 - b) I understand it partially
 - ☒ c) Not at all
3. What do you want in 2D periodic table of the elements?
 - a) Easy to understand
 - b) More attractive
 - ☒ c) More properties mentioned
 - d) All of the above
4. Are you aware that scientists are still trying to develop/synthesize new elements?
 - ☒ a) Yes
 - b) No
5. Have you ever heard of 3D periodic table of the elements?
 - ☒ a) Yes
 - b) No
6. There are more than 100 types of 3D periodic table of the elements. Impressed?
 - a) Wow!!! (Shocked)
 - b) Yes
 - ☒ c) I don't care
7. What do you want in 3D periodic table of the elements?
 - ☒ a) Know element properties easily
 - b) Know element groups easily
 - c) Know element period easily
 - d) All of the above
8. Which one is more attractive?
 - ☒ a) 2D Periodic Table of the elements
 - b) 3D Periodic Table of the elements
9. Do you want to look closely on the 3D periodic table of elements or touch it? *No*
10. What is your general comment after witnessing this 3D periodic table of elements?
Nice

1. Any further suggestion so that we could improvise the 3D periodic table of elements that you see?

No

Questionnaire

1. Do you know what is periodic table of the elements?
☒ a) Yes
b) Have heard of it somewhere
c) No
2. Do you understand the common 2D periodic table of the elements?
a) Yes, from the 1st element until the 118th elements
☒ b) I understand it partially
c) Not at all
3. What do you want in 2D periodic table of the elements?
a) Easy to understand
☒ b) More attractive
c) More properties mentioned
d) All of the above
4. Are you aware that scientists are still trying to develop/synthesize new elements?
☒ a) Yes
b) No
5. Have you ever heard of 3D periodic table of the elements?
☒ a) Yes
b) No
6. There are more than 100 types of 3D periodic table of the elements. Impressed?
☒ a) Wow!!! (Shocked)
b) Yes
c) I don't care
7. What do you want in 3D periodic table of the elements?
a) Know element properties easily
☒ b) Know element groups easily
c) Know element period easily
d) All of the above
8. Which one is more attractive?
a) 2D Periodic Table of the elements
☒ b) 3D Periodic Table of the elements
9. Do you want to look closely on the 3D periodic table of elements or touch it? *Yes*
10. What is your general comment after witnessing this 3D periodic table of elements?

Okay

11. Any further suggestion so that we could improvise the 3D periodic table of elements that you see?

Arrow indicator

Questionnaire

- Do you know what is periodic table of the elements?
- ☒ a) Yes
 - b) Have heard of it somewhere
 - c) No
- Do you understand the common 2D periodic table of the elements?
- a) Yes, from the 1st element until the 118th elements
 - b) I understand it partially
 - ☒ c) Not at all
- What do you want in 2D periodic table of the elements?
- a) Easy to understand
 - b) More attractive
 - ☒ c) More properties mentioned
 - d) All of the above
- Are you aware that scientists are still trying to develop/synthesize new elements?
- a) Yes
 - ☒ b) No
- Have you ever heard of 3D periodic table of the elements?
- ☒ a) Yes
 - b) No
- There are more than 100 types of 3D periodic table of the elements. Impressed?
- a) Wow!!! (Shocked)
 - b) Yes
 - ☒ c) I don't care
- What do you want in 3D periodic table of the elements?
- a) Know element properties easily
 - b) Know element groups easily
 - ☒ c) Know element period easily
 - d) All of the above
- Which one is more attractive?
- ☒ a) 2D Periodic Table of the elements
 - ☒ b) 3D Periodic Table of the elements
- Do you want to look closely on the 3D periodic table of elements or touch it? ☒ Yes
10. What is your general comment after witnessing this 3D periodic table of elements?
- None
11. Any further suggestion so that we could improvise the 3D periodic table of elements that you see?
- _____
- _____

Questionnaire

Do you know what is periodic table of the elements?

- ☒ a) Yes
- b) Have heard of it somewhere
- c) No

Do you understand the common 2D periodic table of the elements?

- a) Yes, from the 1st element until the 118th elements
- ☒ b) I understand it partially
- c) Not at all

What do you want in 2D periodic table of the elements?

- a) Easy to understand
- ☒ b) More attractive
- c) More properties mentioned
- d) All of the above

Are you aware that scientists are still trying to develop/synthesize new elements?

- a) Yes
- ☒ b) No

Have you ever heard of 3D periodic table of the elements?

- a) Yes
- ☒ b) No

There are more than 100 types of 3D periodic table of the elements. Impressed?

- ☒ a) Wow!!! (Shocked)
- b) Yes
- c) I don't care

What do you want in 3D periodic table of the elements?

- a) Know element properties easily
- b) Know element groups easily
- ☒ c) Know element period easily
- d) All of the above

Which one is more attractive?

- a) 2D Periodic Table of the elements
- ☒ b) 3D Periodic Table of the elements

Do you want to look closely on the 3D periodic table of elements or touch it? *Yes*

10. What is your general comment after witnessing this 3D periodic table of elements?

hard to read the element at the bottom

11. Any further suggestion so that we could improvise the 3D periodic table of elements that you see?

need to use a highly rotatable material, so that, it is not easily broken.

Questionnaire

1. Do you know what is periodic table of the elements?
 - ☐ a) Yes
 - b) Have heard of it somewhere
 - c) No
2. Do you understand the common 2D periodic table of the elements?
 - a) Yes, from the 1st element until the 118th elements
 - ☒ b) I understand it partially
 - c) Not at all
3. What do you want in 2D periodic table of the elements?
 - a) Easy to understand
 - b) More attractive
 - c) More properties mentioned
 - ☒ d) All of the above
4. Are you aware that scientists are still trying to develop/synthesize new elements?
 - a) Yes
 - ☒ b) No
5. Have you ever heard of 3D periodic table of the elements?
 - ☒ a) Yes
 - b) No
6. There are more than 100 types of 3D periodic table of the elements. Impressed?
 - a) Wow!!! (Shocked)
 - b) Yes
 - ☒ c) I don't care
7. What do you want in 3D periodic table of the elements?
 - a) Know element properties easily
 - b) Know element groups easily
 - ☒ c) Know element period easily
 - d) All of the above
8. Which one is more attractive?
 - ☒ a) 2D Periodic Table of the elements
 - ☒ b) 3D Periodic Table of the elements
9. Do you want to look closely on the 3D periodic table of elements or touch it? *Yes*
10. What is your general comment after witnessing this 3D periodic table of elements?
attractive
11. Any further suggestion so that we could improvise the 3D periodic table of elements that you see?
need to include explanation for each

Questionnaire

1. Do you know what is periodic table of the elements?
☒ a) Yes
b) Have heard of it somewhere
c) No
2. Do you understand the common 2D periodic table of the elements?
a) Yes, from the 1st element until the 118th elements
☒ b) I understand it partially
c) Not at all
3. What do you want in 2D periodic table of the elements?
a) Easy to understand
b) More attractive
c) More properties mentioned
☒ d) All of the above
4. Are you aware that scientists are still trying to develop/synthesize new elements?
a) Yes
b) No
5. Have you ever heard of 3D periodic table of the elements?
☒ a) Yes
b) No
6. There are more than 100 types of 3D periodic table of the elements. Impressed?
☒ a) Wow!!! (Shocked)
b) Yes
c) I don't care
7. What do you want in 3D periodic table of the elements?
a) Know element properties easily
☒ b) Know element groups easily
c) Know element period easily
d) All of the above
8. Which one is more attractive?
a) 2D Periodic Table of the elements
☒ b) 3D Periodic Table of the elements
9. Do you want to look closely on the 3D periodic table of elements or touch it? Yes
10. What is your general comment after witnessing this 3D periodic table of elements?
Okay
11. Any further suggestion so that we could improvise the 3D periodic table of elements that you see?
Small & Portable.

Questionnaire

1. Do you know what is periodic table of the elements?
☒ a) Yes
b) I have heard of it somewhere
c) No
2. Do you understand the common 2D periodic table of the elements?
a) Yes, from the 1st element until the 118th elements
☒ b) I understand it partially
c) Not at all
3. What do you want in 2D periodic table of the elements?
a) Easy to understand
☒ b) More attractive
c) More properties mentioned
d) All of the above
4. Are you aware that scientists are still trying to develop/synthesize new elements?
☒ a) Yes
b) No
5. Have you ever heard of 3D periodic table of the elements?
☒ a) Yes
b) No
6. There are more than 100 types of 3D periodic table of the elements. Impressed?
☒ a) Wow!!! (Shocked)
b) Yes
c) I don't care
7. What do you want in 3D periodic table of the elements?
a) Know element properties easily
☒ b) Know element groups easily
c) Know element period easily
d) All of the above
8. Which one is more attractive?
☒ a) 2D Periodic Table of the elements
☒ b) 3D Periodic Table of the elements
9. Do you want to look closely on the 3D periodic table of elements or touch it? *Yes*
10. What is your general comment after witnessing this 3D periodic table of elements?

Further Explanation.

11. Any further suggestion so that we could improvise the 3D periodic table of elements that you see?

Organize the elements.

Questionnaire

1. Do you know what is periodic table of the elements?
☒ a) Yes
b) Have heard of it somewhere
c) No
2. Do you understand the common 2D periodic table of the elements?
a) Yes, from the 1st element until the 118th elements
☒ b) I understand it partially
c) Not at all
3. What do you want in 2D periodic table of the elements?
a) Easy to understand
b) More attractive
c) More properties mentioned
☒ d) All of the above
4. Are you aware that scientists are still trying to develop/synthesize new elements?
☒ a) Yes
b) No
5. Have you ever heard of 3D periodic table of the elements?
☒ a) Yes
☒ b) No
6. There are more than 100 types of 3D periodic table of the elements. Impressed?
a) Wow!!! (Shocked)
☒ b) Yes
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7. What do you want in 3D periodic table of the elements?
a) Know element properties easily
b) Know element groups easily
c) Know element period easily
☒ d) All of the above
8. Which one is more attractive?
☒ a) 2D Periodic Table of the elements
☒ b) 3D Periodic Table of the elements
9. Do you want to look closely on the 3D periodic table of elements or touch it? *Yes*
10. What is your general comment after witnessing this 3D periodic table of elements?
christmas tree.
11. Any further suggestion so that we could improvise the 3D periodic table of elements that you see?
interesting colour.

Questionnaire

1. Do you know what is periodic table of the elements?
☒ a) Yes
b) Have heard of it somewhere
c) No
2. Do you understand the common 2D periodic table of the elements?
a) Yes, from the 1st element until the 118th elements
☒ b) I understand it partially
c) Not at all
3. What do you want in 2D periodic table of the elements?
a) Easy to understand
☒ b) More attractive
☒ c) More properties mentioned
d) All of the above
4. Are you aware that scientists are still trying to develop/synthesize new elements?
☒ a) Yes
b) No
5. Have you ever heard of 3D periodic table of the elements?
☒ a) Yes
b) No
6. There are more than 100 types of 3D periodic table of the elements. Impressed?
a) Wow!!! (Shocked)
☒ b) Yes
c) I don't care
7. What do you want in 3D periodic table of the elements?
a) Know element properties easily
b) Know element groups easily
☒ c) Know element period easily
d) All of the above
8. Which one is more attractive?
a) 2D Periodic Table of the elements
☒ b) 3D Periodic Table of the elements
9. Do you want to look closely on the 3D periodic table of elements or touch it? *Yes*
10. What is your general comment after witnessing this 3D periodic table of elements?
Study reference in School.
11. Any further suggestion so that we could improvise the 3D periodic table of elements that you see?
Legend on top.

Questionnaire

1. Do you know what is periodic table of the elements?
☒ a) Yes
b) Have heard of it somewhere
c) No
2. Do you understand the common 2D periodic table of the elements?
a) Yes, from the 1st element until the 118th elements
☒ b) I understand it partially
c) Not at all
3. What do you want in 2D periodic table of the elements?
a) Easy to understand
☒ b) More attractive
c) More properties mentioned
d) All of the above
4. Are you aware that scientists are still trying to develop/synthesize new elements?
☒ a) Yes
b) No
5. Have you ever heard of 3D periodic table of the elements?
☒ a) Yes
b) No
6. There are more than 100 types of 3D periodic table of the elements. Impressed?
a) Wow!!! (Shocked)
☒ b) Yes
c) I don't care
7. What do you want in 3D periodic table of the elements?
a) Know element properties easily
b) Know element groups easily
☒ c) Know element period easily
d) All of the above
8. Which one is more attractive?
a) 2D Periodic Table of the elements
☒ b) 3D Periodic Table of the elements
9. Do you want to look closely on the 3D periodic table of elements or touch it? *Yes*
10. What is your general comment after witnessing this 3D periodic table of elements?
Interesting
11. Any further suggestion so that we could improvise the 3D periodic table of elements that you see?
Bigger circle & easier to see.

Questionnaire

1. Do you know what is periodic table of the elements?
☒ a) Yes
b) Have heard of it somewhere
c) No
2. Do you understand the common 2D periodic table of the elements?
a) Yes, from the 1st element until the 118th elements
☒ b) I understand it partially
c) Not at all
3. What do you want in 2D periodic table of the elements?
a) Easy to understand
☒ b) More attractive
c) More properties mentioned
d) All of the above
4. Are you aware that scientists are still trying to develop/synthesize new elements?
☒ a) Yes
b) No
5. Have you ever heard of 3D periodic table of the elements?
☒ a) Yes
b) No
6. There are more than 100 types of 3D periodic table of the elements. Impressed?
a) Wow!!! (Shocked)
☒ b) Yes
c) I don't care
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a) Know element properties easily
b) Know element groups easily
c) Know element period easily
☒ d) All of the above
8. Which one is more attractive?
a) 2D Periodic Table of the elements
☒ b) 3D Periodic Table of the elements
9. Do you want to look closely on the 3D periodic table of elements or touch it? Yes
10. What is your general comment after witnessing this 3D periodic table of elements?
Attractive
11. Any further suggestion so that we could improvise the 3D periodic table of elements that you see?
Water Resistance