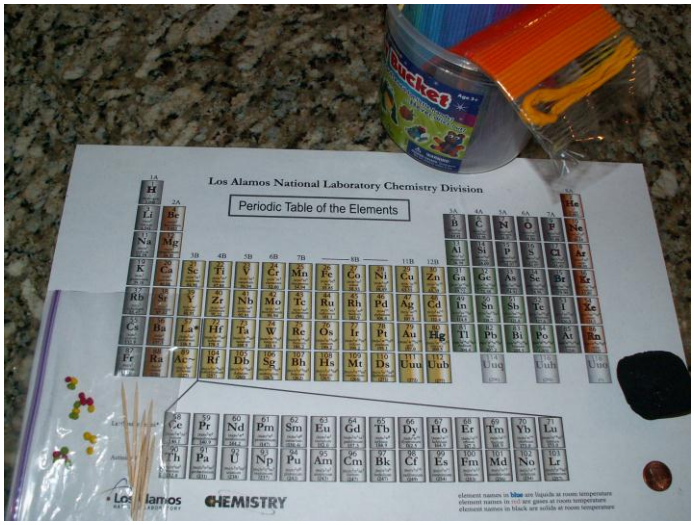
Table of Elements

Author: James R. Tonra, Ph.D.

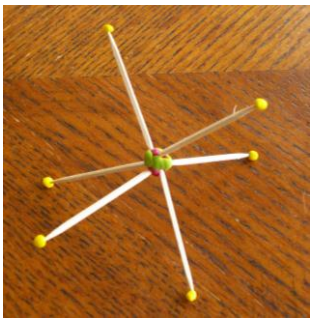
Materials:
Printouts of Table of Elements with Atomic Number, Atomic Weight and Name
Clay with 3 different colors
Toothpicks (about 5 cm long)
Small baggies
Piece of charcoal (50-90% carbon)
Recent penny (Approximately 97.5% zinc)
Whiteboard or other writing surface



Preparation before the lesson:
Prior to the lesson, print out a copy of the Table of Elements for each student and prepare the necessary number of baggies containing clay and toothpicks to model carbon. Each child or group of students (3-4 students) will need six small clay spheres for each of 3 colors and 6 toothpicks in a small baggie.

Key Words for use by children in discussion:
Electron, proton, neutron
Atomic Number, Atomic Weight, daltons

1) Point to different objects in the class and ask why things in the Universe look and feel different. Listen to a few of the hypotheses generated by the students. Walk around the class and show the students a piece of charcoal and a penny and ask why these two objects look and feel different. Discuss student generated hypotheses. End by discussing the idea that little things that make up these objects must be different. Note that scientists call these objects atoms or elements.
2) Hand out a copy of the Table of Elements to each child and inform them that it contains all the atoms that make up everything in the universe.
3) Draw a picture of an atom on the board, with nucleus containing protons and neutrons, and electrons spinning around the nucleus. Indicate that this is a model of what scientists believe the atoms of every element look like. Discuss the uses of models to help us think about things that we can only imagine. Inform the students that models predicting many things that are proven by experiments to be wrong are thrown out. But this model of the atom has worked pretty well.
4) Tell the children to find carbon in the Table of Elements. Write the atomic number, symbol and atomic weight of carbon from the Table of Elements, on the board to illustrate how to use the Table of Elements. Write on the board that, “Atomic Number = number protons”. Ask the children how many protons carbon and oxygen have in their nucleus.
5) Explain that the weight of an atom or element is given in units called Daltons; protons and neutrons weigh about 1 dalton, and electrons weigh so little we don't usually even count them. Write on the board that, “Atomic Weight = number protons + number neutrons.” Ask the children, “so if you know the Atomic Weight and the Atomic Number, how do you find the number of neutrons?” After the discussion, write on the board that, “number neutrons = Atomic Weight – Atomic Number.”
6) Inform the students that the number of electrons is usually equal to the number of protons. Have a few children come up to the board to determine the number of protons, neutrons and electrons in carbon and other select elements. Guide the children through an explanation of their logic using words and the board.



7) Hand out the baggies with the carbon model equipment (clay and toothpicks) to the children. Write the key for the color of the clay spheres on the board. Lead the children through the making of a model of a carbon atom with clay by putting the Atomic number (from the Table of Elements) of clay protons, and the calculated number of neutrons together to form the nucleus. Next attach six electrons by toothpicks to the nucleus. When complete have the students put all of their models near each other on one table or surface and ask them what they have created with all these bunched up carbon atoms. Then show them the piece of charcoal. Ask them if the actual atoms in charcoal are the size of their model carbons.
8) Ask the students, "how many carbon atoms are in the piece of charcoal?" (Estimate coal weight ~24 grams = 2 moles = 12 time 10^{23} ~ a trillion trillion atoms). To give the children an idea of how many particles this is, ask them if you made a tower of a trillion trillion 5 cm tooth picks, how many times could you go back and forth to the sun? You would go back and forth to the sun 150 billion times! Discuss how small each atom must be in the charcoal. Ask the children how a trillion trillion atoms fit inside such a small piece of charcoal, concluding the atoms must be very very small.
9) Ask for students to describe the zinc atoms that make up a penny in words. Lead them through the use of the Table of Elements and discuss the differences between the penny and charcoal as we sense them, and write the number of protons, neutrons and electrons on the board. Note how different zinc and carbon are in our reality. Ask the children what makes a penny and charcoal so different. Lead them to conclude that the elements that make them up (zinc and carbon) are different, meaning they have different numbers of protons, neutrons and electrons in their atoms.
10) Have selected students take off the electrons still attached to the toothpicks of two carbon atom models, and place them neatly on the table or desk in front of them. Then ask these students to hold up the two nuclei with 6 protons and 6 neutrons in each and have them undergo "nuclear fusion". Next have these students stick the 12 electrons on toothpicks into the fused nucleus and ask the rest of the class, "what have these students made?" Guide the students when necessary to the conclusion that Magnesium was made.
11) Emphasize to the children that it is the number of protons, irrespective of the number of electrons and neutrons, that determines the name of an atom/element. Propose some electron, neutron, and proton numbers for an atom that are not necessarily real. Ask different children to tell you which element you have described.

Table of Elements lesson highlights checklist

- ☐ Discuss the source of the differences in objects in the universe, including coal and penny
- ☐ Distribute Table of Elements
- ☐ Describe and draw an atom and discuss the use of scientific models
- ☐ Use Table of Elements to calculate # (1) protons, (2) neutrons and (3) electrons
- ☐ Students construct clay models of Carbon
- ☐ Discuss number of carbon atoms in charcoal
- ☐ Compare zinc (penny) and carbon: penny and charcoal different because atoms are different
- ☐ Atomic fusion using clay carbon models
- ☐ Hypothetical atom identification: # protons determines atom in Table of Elements