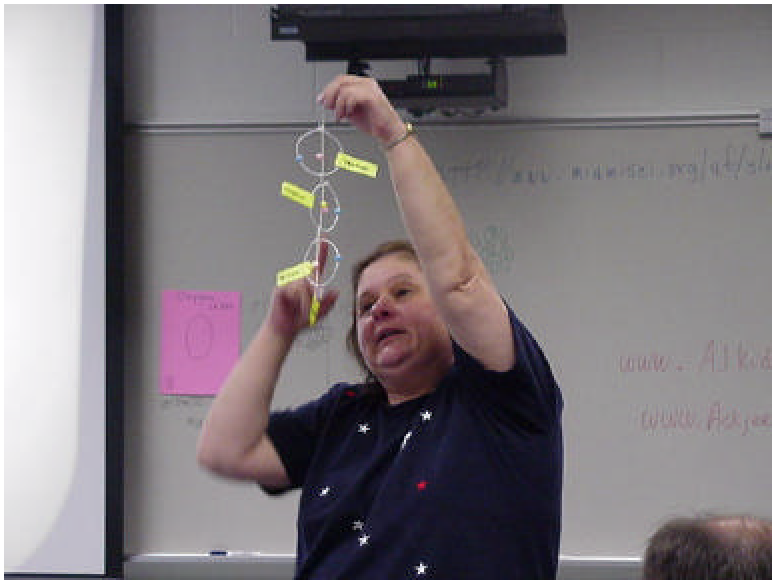

Created by:
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May, 2000
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Topic/Title: **History of the Understanding of the Atom**
Type: Lecture
Intent: Introductory
Standards Addressed: 5.1, 5.2, 5.3, 5.4, 5.8
Grade: 4-8
Estimated Time: 1-2 class periods of 30-40 min.
Content knowledge: How the current theories about the atom were devised and how technology affected the way people viewed the atom.

Part 1:
The topics to be discussed are:

Early Chinese scholars suggested that all things were made of earth, fire, water, air, metal, and wood.
Greeks thought all things were made of only four materials: earth, fire, water, and air.
More than 2000 years ago the early Greek model developed by the philosopher Democritus concluded that matter could not be divided into smaller and smaller pieces forever. Eventually the smallest piece would be obtained. He called the smallest piece of matter an atom. The word atom comes from the Greek word atomos, meaning "not to be cut" or "indivisible.* (TRANSPARENCY – Introduction to Atomic Theory)

Part 2:
Lab: Cutting paper to discuss concept of an atom.

Part 3
Lab: Dough Balls

Topic/Title: Dough Balls
Type: Teacher-guided
Intent: Extension
Standards Addressed: 5.2, 5.3, 5.4
General Info: Proposed Grade 4-8
Estimated Time: 30-40 min.
Process Skills: Observations, inferences

DOUGH INFERENCE BALLS
It is often beneficial to provide opportunities for elementary school children to make inferences. Allow the students to practice making inferences using this hands-on science activity. To introduce the lesson, tell the students they are scientists getting information about unknown atoms. Their task is to find out what is in the center of each atom. They may "drill" with their toothpick probes, but they may not "open" any atom or dig a "hole" to see what is in the atom. Tell them they will be making inferences to determine what is inside their atom.

Made DOUGH with 2 tablespoons vegetable oil (can substitute wheat paste or Elmer's Glue in same amount so it won't harden easily.); 2 c. flour; 1 c. salt; 2 c. water; 2 tablespoons vegetable oil; 2 tsp. cream of tartar. Mix all together. On medium heat, stir until mixture forms a ball. Dump on counter and knead 1 min. You may color it with food coloring. Wrap in plastic bag or plastic wrap to keep airtight. Refrigerated it can last up to a week, but it will harden when exposed to the air.

Using the dough, form small balls. Inside each ball, hide some small object such as a penny, an eraser, a piece of a straw, a small cork. (Do NOT use candy or anything that dissolves.) To identify the balls, either put them on numbered pieces of paper or color code them. I usually put six different colored balls containing six different objects in a plastic bag for a group of six children, but you can use as many children/objects as you would like in a group.

Using a toothpick as a probe, each child tries to figure out what is in the dough balls. The children may not "dig" a hole or expose any part of the contents of the balls. They must make an inference based on what they "feel" with the toothpick.

After making their own inferences, allow the children to work with their group and make an inference based on the group's consensus. Tell the students that all scientists share their work with their co-workers when they make a discovery. They work with other scientists to test their discoveries.

Allow all the groups to discuss their inferences in class. Compare this part of the activity with a science conference or symposium where the scientists share their findings with scientists from all over the world. Then open the balls one at a time to expose the contents. I usually do not open one color coded ball because it helps the students realize what scientists feel like when they can't find out whether or not their hypothesis is correct.

Part 4 :
In 1803, chemist John Dalton performed a number of experiments in meteorology. He discovered that gases combined as if they were made of individual particles. These particles were the atoms of Democritus. The basic ideas in his atomic theory were:

1. All elements are composed of atoms. Atoms are indivisible and indestructible particles.
2. Atoms of the same element are exactly alike.
3. Atoms of different elements are different.
4. Compounds are formed by the joining of atoms of two or more elements.*

In 1897, English scientist J. J. Thomson was studying the passage of electric current through a gas. The gas gave off rays that were negatively charged. The gas was known to be made of uncharged particles so he developed what is known as the “plum pudding” model. According to Thompson's atomic model, the atom was made of a pudding-like positively charged material throughout which negatively charged electrons were scattered, like plums in a pudding. * (TRANSPARENCY)

In 1908 English physicist Ernest Rutherford fired a stream of tiny positively charged particles at a thin sheet of gold foil (he made the foil as thin as he could but it was still ~2000 atoms thick). Most of the time the positively charged bullets went straight through the foil. Sometimes they bounced off something in the atom. He came to the conclusion that most of the atom was empty space and that there was a positively charged center of the atom which he called the nucleus. He reasoned that all the atoms positively charged particles would be contained in the nucleus. The negatively charged electrons are scattered around the nucleus around the atom edge.* (TRANSPARENCIES)

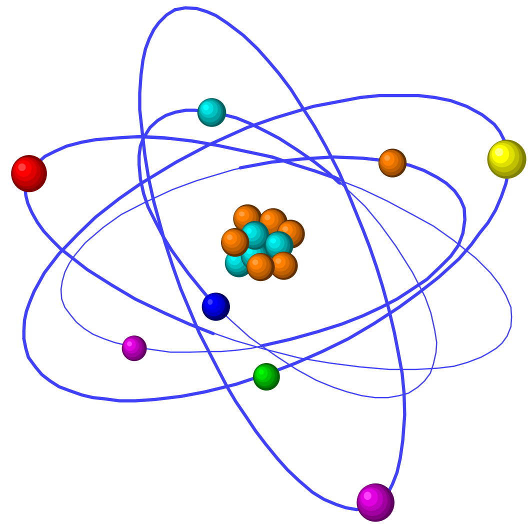
Part 5:
Lab: Rutherford’s Experiment – Learning Activity 1-1 Atomic Bowling

Part 6:
In 1913 Danish scientist Niels Bohr proposed that the negatively charged electrons were held in the atom by the attraction between them and the positively charged nucleus. In Bohr’s atomic model electrons moved in definite orbits around the nucleus, much like planets that circle the sun. These orbits, or energy levels, are located at certain distances from the nucleus.*

Orange demo: use an orange to compare orange peel to the area where the electron cloud is in an atom.

According to the modern atomic model, an atom has a small positively charged nucleus surrounded by a large region in which there are enough electrons to make the atom neutral..*
Scientists all around the world have contributed to the most widely accepted theory of the atom used today. As technology improved, scientists were able to better understand the atom. Each time new technologies developed more was discovered about the atom. *

*Note: This information * was taken from <u>Matter: Building Block of the Universe</u> Prentice Hall Science 1993 P. 86-90..



Topic/Title**: Ions**
Type: Teacher Directed
Intent: Introductory
Standards Addressed: 5.1, 5.8
Grades: 4-8
Estimated Time: 30-40 minutes
Content: Positive and Negative Ions

Use the premise of the happy party at the house of Chlorine Atom in order to explain the concept of ions.

There is going to be a party at Chlorine Atoms' house.

Atomic number is 17. This means 17 protons (girls) in the nucleus (house). It wants 17 electrons (boys) to be a happy party.

Mass number 35 – This means 17 protons (girls) and 18 neutrons (parents) in the nucleus – parents don't give anyone a charge.

Boys line up on sidewalks (energy levels) waiting for the party to start:
K-2   L-8   M-7 = total 17

Mom removes one electron because he did not do his homework - too many girls = positive ion
He returns after doing homework
One more space on the sidewalk - One electron gets in line to crash the party = negative ion.

The closer the electron (boy) is to the house (nucleus) the harder it is to take him away.

Topic/Title**: Mass Number. Atomic Mass, Isotopes**
Type: Teacher Creative Dramatics, Teacher Directed
Intent: Introductory and Extension
Standards Addressed: 5.1, 5.8Cross Curriculum Areas: art
Grades: 4-8
Estimated Time: Part 1 - 2 periods of 30-40 minutes Part 2 –1 period or homework
Content knowledge: Mass Number. Atomic Mass, Isotopes

Part 1:
The students who receive a study guide to help them take notes about this topic. The teacher will have the corresponding study guide as an overhead transparency so that he/she will be able to help the students fill in their study guide.

Role-play – miniature scientists examines several oxygen molecules and discovers they all have the same number of protons -- they all have the same atomic number. However, on close inspection, it is discovered that they sometimes have a different numbers of neutrons.

From this role-playing experience developed the terms isotopes, mass number and atomic mass.

Part 2:
Isotopes of Hydrogen:
Using beads, string, and heavy wire, construct a mobile of 3 different isotopes of hydrogen. Discuss some uses of protium, deuterium and tritium. (1 period or take home project)

Each student will need:
3 yellow beads (neutrons)
3 pink beads (protons)
3 blue beads (electrons)
36 inches string
1 index card cut into thirds
marker or crayon

tape or stapler
3 pieces craft wire

DIRECTIONS:
1. Using the craft wire, make 3 circles with a blue bead (electron) on each one.
2. Attach the three circles to each other using the string. Knot the string at the top and bottom of each circle.
3. As you are attaching the string, knot the appropriate number of protons and neutrons in the middle of each "atom".
   protium – 1 proton
   deuterium – 1 proton, 2 neutrons
   tritium – 1 proton 2 neutrons
4. Use the index card to make labels for your isotopes of hydrogen.

Topic/Title**: Contamination Control**
Type: Teacher directed
Intent: Introductory
Standards Addressed:
Proposed Grade 4-8
Estimated Time – 1 period 30-40 min.
Content knowledge: How we prevent things from being contaminated by low level radiation

Radiation Versus Contamination

Radioactive material will emit radiation and it may be an external exposure hazard, but if it is properly contained, it is not a "contaminant". It is only when the radioactive material is where you DON'T want it that it becomes radioactive contamination.

Contamination is the spread of radioactive material to areas where its presence may not even be suspected and it may thus become an exposure hazard.

Contamination is the presence of uncontained (or loose) radioactive material in any place where it is not supposed to be, especially where its presence may be harmful or could allow it to be picked up and spread if disturbed by an outside agent. Contamination emits (<u>but is not</u>) radiation.

Imagine your students have a glitter fight in a microgravity environment. When we try to avoid contamination, we try to keep the glitter from getting inside our body or from coming in contact with our skin. We want to keep as much as the glitter in the confined area as possible.

TRANSPARENCY: <u>Contamination is radioactive material where we do not want it.</u> If some radioactive material leaked onto the floor, it would be called contamination. We do not want radioactive material on the floor where it could be tracked all over the place. We do not want radioactive dust in the air where we might breathe it into our lungs.

Contamination is a major concern to us because of the possibility it might get inside our bodies. This is a problem because:
   1) It increases the possibility of damage to the vital organs
   2) In some instances, it is retained by the body for long periods of time

There are many ways that contamination can get into the body:
   MOUTH - The most obvious way for contamination to enter the body is through the mouth. You may not eat, drink, or smoke in contaminated areas
   NOSE - Contamination in the air may be breathed in through the nose to the lungs.
   SKIN – A cut in the skin can allow contamination to enter the body. Some contamination can get into your body right through the pores of your skin. One radionuclide that does this is tritium, the radioactive isotope of hydrogen. This is why air-supplied suits are used in areas where high levels of tritium are present.

If contamination does get inside the body, the decay process will eventually cause the radioactive materials to disappear.

TRANSPARENCY: <u>Common Sense Rules to Protect Against Contamination</u>
   1) No smoking, drinking or eating in a contaminated area
   2) Wear your respirator properly
   3) Wear your protective clothing properly - put it on and take it off correctly
   4) Always monitor
   5) Protect yourself

The protective measures you should take when you work in a contaminated area are:
   - Appropriate and proper respiratory protection
   - Protective clothing
   - Plain commonsense

To Test an Area You are Not Sure is Contaminated:
Appropriate protective gloves (surgical gloves) should be worn when performing contamination surveys (DRY SWIPE TECHNIQUE or SMEARS) to prevent hand contamination. Gloves are usually unnecessary when surveys are performed in clean areas such as locker rooms, lunch rooms, or offices. **Maps or diagrams** should be used with a written notation on each swipe to identify the sample location.

Swipes should be separated to prevent cross-contamination and to prevent the spread of contamination from highly contaminated smears. Swipes are tested with a Geiger counter and if something registers, they are tested by other means.
All swipes and contaminated materials are placed in closed containers that are labeled radioactive material, the type of contaminant (iodine, cesium), and how much radioactive material.

To Test an Area Where Things are Contaminated:

Tools used in the contaminated area may be contaminated. They are color-coded to so they may be easily identified. Contaminated equipment and tools are bagged if they are leaving a contaminated area. Protective clothing helps to keep contamination from spreading.

Protective **coveralls** may be made of cloth, paper, rubber, or plastic. The best protective clothing in the world is useless if it is not worn properly. For low-level contamination paper coveralls are used. Since the paper coveralls are disposable, the outer coveralls can be disposed of as radioactive waste when the worker is ready to leave the contaminated area. Plastic coveralls are worn in wet contaminated areas, usually as the outer garment.

Coveralls should be the right size, the seams should be in place, and there should be no tears or holes. Small holes or openings can be taped with masking tape to prevent contamination from seeping into the coveralls, but coveralls with a large hole should not be worn. Tape should always be TABBED to make undressing easier.

Two sets of **shoe covers** may be worn. The inner shoe cover is usually made of cloth and taped to the coveralls. The outer shoe covers may be plastic for wet areas, heavy cloth with reinforced bottoms for dry areas, or they may be rubber overshoes. They must be in good condition and the proper size.

Respirators may be used when airborne contamination is present. Two major classifications of respirators are:

- Air purifying respirators - removes contaminants from the air in the working area by mechanically filtering out particulates by using fibrous materials.
- Atmosphere supplying respirators - provides a separate supply of oxygen – they furnish breathable air or oxygen from an uncontaminated supply - used with specific radionuclides such as tritium.

A **face piece** is one part of the respirator and is a tight-fitting enclosure over a portion of the face. The full face piece mask completely encloses the eyes, nose, mouth and chin. It is supported by a head harness that is attached to the face piece at five or six points or has an adjustable suspension attached to points at the temples. Another type is the under-chin type, which fits under the chin and encloses only the nose and mouth.

While there is the possibility of leakage through the filters of the respirator, that possibility is much less than the potential leakage around the facial seal. Because of this, the limitations placed upon respirators are based primarily on the ability to obtain an initial fit of the face piece and to maintain the quality of that that during wearing. The respirators are intended only for shaven faces where nothing interferes with the seal of tight-fitting face pieces against the skin.

The face pieces of the two types of respirators look basically the same, one piece is added to make them air purifying respirators and different connections are added to make them oxygen supplying respirators.

Air purifying respirators only remove a specific contaminant from inhaled air -- they do not supply oxygen.

In the respirators, the flow of air is inward through a cartridge or canister and through an inhalation valve that prevents a back flow of air through the cartridge or canister during exhalation. An exhalation valve allows release of exhaled air to the atmosphere and prevents the flow of contaminated air into the face piece during inhalation.

Two sets of **gloves** may be worn - the inner gloves are usually liners. Outer gloves may be of cloth, plastic or rubber, and are taped to the coveralls.

The **surgeon's cap**, usually worn in low-level contamination areas, keeps contamination from collecting on the hair. The cap is centered on the head, then the hair is tucked under it. A **hood** is worn in highly contaminated areas to provide the necessary additional protection for the head. It must be taped at all openings.

If only one set of coveralls is worn, **dosimeters** may or may not be worn inside the clothes. If two sets of coveralls are worn, dosimeters are placed inside the first set so that they will not become contaminated.

Removing Protective Clothing

There may be two clean **step-off pads** to properly remove contaminated clothing. The first pad is used to remove highly contaminated clothing. Workers remove most of their protective clothing in the area between the pads, and the second step-off pad is used as a final check for contamination.

At the first step-off pad the worker turns his back toward the pad. Body movements during undressing can spread contamination in the forward direction, so, with the workers back toward the pad, contamination is directed toward the contaminated area.

Begin undressing by removing one outer shoe cover over the contaminated area and placing the clean foot on the step off pad. The process should be repeated for the other foot. The outer shoe covers are then placed in a nearby container.

Move to the area between the two step-off pads and remove all masking tape. Remove all protective clothing except the inner shoe covers in the area, always taking precautions to minimize the spread contamination.

To remove the surgeons cap, grasp the mask by its snout, pulling down away from the face, and then lift it up and over the head. Do not loosen the straps, because the gloves could contaminated air and face. Never try to wipe perspiration from the face with the coverall sleeves. This could contaminate the face.

Remove the outer gloves next. Grasp the outside of one globe with the other glove and pull it off the hand. Remove the second glove by inserting one finger inside the cuff, being careful not to touch the outside of the glove. Pull the glove inside out to get it off. Dispose of the gloves in the proper container.

Coveralls come off next. Be sure to remove the dosimeters so that they do not get discarded with the coveralls. **There may be an attendant with clean hands to take them off of you.** Remove the coveralls by inserting a hand inside to push the coveralls or each shoulder. (The hands are still in their clean inner gloves.) Shrug the coveralls off the shoulders, turning the coveralls inside out as they come off. Remember to touch only the inside of the coveralls.

Remove the inner shoe covers at the second step-off pad. Reach inside and peeled for shoe coveralls, being careful not to touch the outside of the shoe cover. Place the clean foot on the step off pad. Repeat the procedure for the second shoe cover. Be sure that the shoe cover is not held over the step off pad while it is being removed. The inner gloves are last. Since they are clean, they can be removed in any manner desired.

The final procedure is monitoring with the personnel frisker to make sure that the protective clothing has prevented contamination on your own personal clothes or on you body. Begin by placing the hands close to the detector. If the hands are clean, pick up the probe and monitor the shoes. Check the rest of the body by slowly passing the detector over it. Critical areas are the facepiece seal area, the hair, and any locations where tape was used. Take the time to use the frisker carefully to be certain no contamination is on you before leaving the area. If contamination is detected, someone should notify Radiation Protection so that they can assist you in the decontamination process.

Topic/Title**: Comics About the Atom**
Type: Teacher Creative Writing
Intent: Extension
Standards Addressed: 5.1, 5.3, 5.4, 5.8
Cross Curriculum Areas: art and creative writing
Grade: 4-8
Estimated Time: two 15 minute sections on 2 days
Content knowledge: the atom and related topics

Using vocabulary and concepts learned in this unit about the atom, create a comic strip about a character who is trying to teach, show, or use atoms, elements, etc. Make your comic strip neat and colorful. Use the whole of sheet of paper for your drawings and captions. You may use crayons, markers, paint, glitter, or any other artistic media available. You'll be graded on your creativity, appearance of the comic strip (neat, colorful) and use of the vocabulary and concepts presented. Have fun!