



TITLE

SUB TOPIC

AUTHOR

Time Frame:	Standards:
2 – 55 min. class periods	6.S.2.1.1 Compare and contrast the differences among elements, compounds and mixtures. (620.01.a) 8-9.PS.2.5.1 Explain how chemical reactions may release or consume energy while the quantity of matter remains constant. (650.03a) 8-9.PS.2.4.1 Describe the properties, function, and location of protons, neutrons, and electrons. (650.01a)
Objectives:	
The middle level students will be able to identify types of radiation by their characteristics and understand the shielding requirements to be protected from each type. They will demonstrate this by completion of the assigned material to 85%.	
Background Information:	
The back ground is in the pages of the website howstuffworks.com. They have a great explanation of radiation type both ionizing and non-ionizing. So if you have a lot of background it will be a quick review and if you do not have the basics it will be lesson on radiation. The web site also explains nuclear fission and fusion. These two concepts are important to this lesson.	
Background Information:	
Background Information:	
Materials:	
Some tissue paper or Kleenexes A ping pong ball A large marble (or any ball that is smaller than a ping pong ball but with greater mass, super ball or bouncy ball) A ¼ inch metal ball bearing (or any small heavy ball)	
Materials:	
Procedure:	
Lesson Outline: Starter activity (7-10 min.) Direct Lecture: Radiation types(15 min.) Internet graphics and video (25 min.) howstuffworks.com Nuclear power and fission Pro vs. Con Activity (15 min.)	



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Direct Lecture: Nuclear fission in a reactor (20 min.)

Nuclear Medical uses: (15-20 min.) howstuffworks.com Nuclear medicine topic

Final Group Project: Radiation Friend or Foe (30 min.)

Starter activity: The ball drop to simulate radiation activity and penetration.

Lead information: there are three basic types of nuclear ionizing radiation emitted by uranium as it fissions Alpha, beta, and gamma. The ping pong ball big, light, and slow is like alpha. The marble smaller, heavier, and faster is like beta. The ball bearing heavy, fast, and small is like gamma.

Take one tissue wet the middle slightly and drop the ping pong ball from about 12 inches on to the center of the tissue. The tissue will hold the ping pong ball. Alpha is big and slow and will not penetrate very far, in fact a sheet of paper can protect us from the radiation.

Our clothing is a good protection, but if we get it inside us then the problems begin.

Next drop the marble from the same height and hopefully it tears through the one sheet but if you use three or four it will hold and not tear (make sure the centers are slightly wet just like last time). It takes more to shield us from beta because it is faster even though it is smaller than the ping pong ball. It penetrates deeper. More of a problem for us more clothing or shielding is needed to protect us from it.

Lastly the metal ball will tear through the four tissues but if you use some metal (lead) a sheet of aluminum foil with the tissues or some concrete (book) it holds and protects us from the radiation getting inside us where it would do some damage to our cells. Gamma type radiation can pass right through many materials and penetrate into our bodies. We must have enough of the right materials to protect us from the gamma particles that are given off as nuclear energy is used to make electricity.

Relate the ball sizes and falling speed to the different radiations. Help them to understand that the more penetrating the radiation is the more damage it can do to our cells.

Direct Instruction: Lecture

Size: Even though we show in the starter activity that the alpha is like a ping pong ball. In reality they are much smaller, so small that you can not see them even with a microscope. However they still have different sizes. The alpha type is larger than the others by a long ways. The other two are a lot smaller than alpha.

Penetration and shielding:

Alpha is a problem if inhaled or swallowed. But our skin can keep it from penetrating into our bodies. Other things like clothing, paper, concrete, and glass can protect us.

Beta is more of a problem because it can penetrate some into our exposed skin. It is like a sun burn. The sun does not burn through our clothes but if we have exposed skin it will burn us after while. Some of the radiation from the sun is beta type. But again a thick suit or a concrete wall or some metal can protect us from beta type radiation.

Gamma is the biggest problem because it can penetrate through many of the common materials we normally use. It is very small and very powerful. It can go through clothing or a thick suit. But lead metal a couple inches thick can stop most of it. We use thick concrete walls and lead plating at Nuclear Power Plants to stop radiation from getting to



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the environment. Gamma is the type of radiation they use at the Doctor's office to x-ray a broken bone or take an x-ray of your teeth. It penetrates through your skin to make your bones visible on the x-ray film.

There are other types of radiation but these are the most common types we have in the fission of Uranium as it makes steam and then electricity. That is the reason that we will just study these types.

Pro vs. Con

Give the students the list of items about nuclear energy and radiation and have them group them either as Pro (good things) or Con (bad things). Give them a group and let them work in their groups for a few minutes putting the items in the pro or con category. Then go around the room and allow the groups to place one in a category and then discuss if it is in the right place and why they think it ends up in the pro or con group.

Nuclear fission:

This is actually very simple. Uranium is one of only a few of the element that will fission (break a part into smaller atoms) naturally. What we have learned is that in a reactor where the Uranium is enriched it will sent out neutrons as it decays in its normal half life process. If one of these neutrons hits the nucleus of a uranium atom it will split (fission) the nucleus a part into two smaller atoms and some more neutrons. These new neutrons can now go out and hit other nuclei and split them and the reaction goes forward until all the atoms are split or they stop hitting the nucleus with the neutrons. This forward going reaction is called a chain reaction and it will go forward to completion in a reactor if not controlled.

Final Group Activity:

Each group is to go home and for homework find as many uses for radiation that they can. There are many things that it is used for (for example it is used to sterilize some fresh fruit before it is sold in the grocery store). Tell them they are going to have a contest with the other groups in the class. That essentially the group with the most uses for radiation will win. Tell them they will have to document the use so to print the stuff off the internet or take good notes as to who said it was a use. Encourage them to make plans as a group so each person has a job to help the group be competitive.

Now in the activity there are a number of ways that you can run the contest. You can throw out the ones that other teams have and just count the unique answers that only one team has or count them all from each team. Give out a prize to the winning group.

Assessment:

Additional Content:

howstuffworks.com has topics for Nuclear power, uranium fission, nuclear medicine, and radiation.



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References:

Energy for Educators

Bringing Energy to the Classroom