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School District: Glen Rock, NJ

Lesson Plan: Radiation Decay

Grades: 4,5,6,7,8

Overview: Decay of alpha and beta particles (transmutation)

Objectives: How transmutation causes elements to change. Describe and contrast alpha, beta, and gamma decay.

Materials & Resources: stick on labels

Evaluation: Each student will be able to:
- Describe the three types of radiation decay
- State what is the penetrating power of each type
- Research and find the scientific symbols and their origins for alpha and beta particles and gamma rays.
- Research the effects of radiation on parts of the body
- Research the effects of radiation on organelles of the cell.

Procedure:
Introduction of lesson: students are to understand:
- Discovery of atom
- Structure of atom
- Periodic table

Review vocabulary:
- Radiation is energy given off in the form of small particles or waves. It is present whenever energy moves from one place to the other. Atom and molecules give off radiation to dispose of excess energy.

- Radioactivity is the release of high-energy particles by radioactive elements. Elements with atomic numbers greater than 83 are radioactive. All isotopes of these elements are radioactive. Radioactive elements have unstable nuclei, caused by an imbalance **[unstable ratio]** in the number of protons and neutrons, that spontaneously change **[eventually]** to a more stable element. While undergoing change, the atom is releasing one **[or more]** of the basic types of ionizing radiation: alpha particle, beta particle, or gamma ray.
- Radioactive decay is the spontaneous breakdown of an unstable atomic nucleus.
- Transmutation is the process by which the nucleus of an atom changes so that a new element is formed.
- Alpha particles are actually helium nuclei (two protons and two neutrons). Relatively large in size, they collide readily with matter and lose energy quickly. They have little penetrating power and can be stopped by the first layer of skin or a sheet of paper.
- Beta particles are fast moving electrons ejected from the nucleus. That's right, I said the nucleus – but there are no electrons in the nucleus. Here's what happens: if there are too many neutrons in a nucleus (like in radioactive elements), the neutron decays. The neutron turns into an electron and a proton. The proton remains in the nucleus while the electron is ejected from the atom. Beta particles are much smaller than alpha particles and can penetrate up to 1 or 2 centimeters of water or human flesh. They can be stopped by a sheet of aluminum a few millimeters thick. They are considered not very penetrating.
- Gamma ray is a high-energy, high frequency wave emitted by radioactive nuclei. They are the most penetrating form of radiation. They can pass through living tissue. They can be shielded by thick lead or other dense material.

Role Play of Radiation Decay:

Materials: 21 stick on labels: 7 labeled "proton", 7 labeled "neutron, 7 labeled "electron"

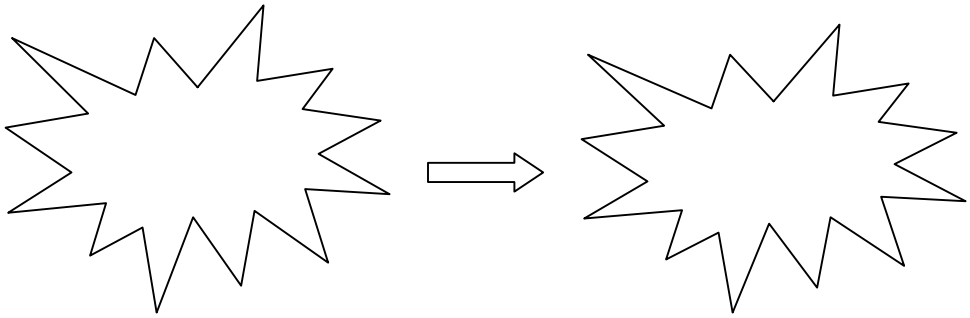
Set the Scene: Assume you are using the radioactive element, americium-241. This element has 95 protons, 146 neutrons, and 95 electrons. It is used in smoke detectors. We do not have 336 students to represent all of the subatomic particles of the atom; thus we will use a small handful of students to simulate what happens during radiation decay.

Starting Positions:
- 6 students with a proton label and 7 students with neutron labels stand in the middle of class representing the nucleus.
- 6 students with electron labels revolve around perimeter of class representing the electron cloud.

Role-play directions:

Alpha decay

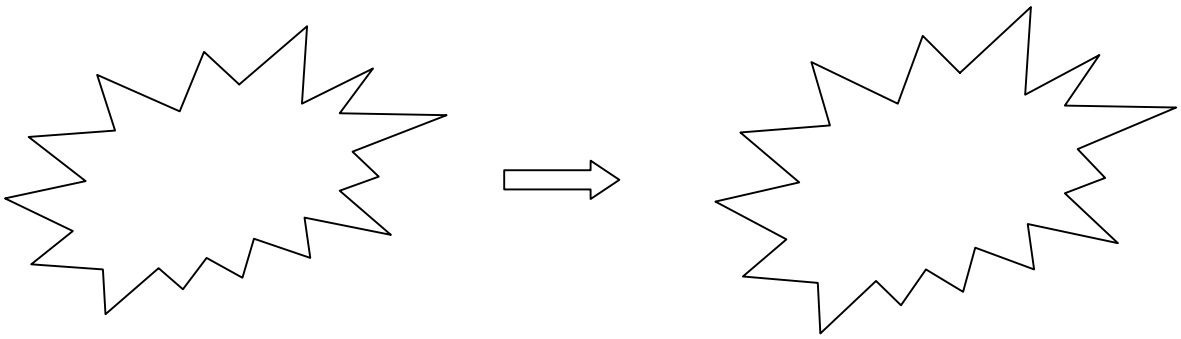
- Assume starting position.
- Two proton students and two neutron students exit the nucleus and exit atom.



Americium (Am–241) ⇨ Neptunium (Np-237) + ejected alpha particle

Beta Decay

- Assume starting position.
- One neutron student changes into one proton and one electron. Replace neutron label with proton label. Bring in additional student and adhere electron label. Proton student stays in nucleus while electron student exits atom.



Americium (Am-241) ⇨ Curium (Cm-241) + ejected electron

Gamma Decay

Alpha and beta decay are almost always accompanied by gamma decay. Gamma decay is the release of energy in the form of gamma rays. Gamma rays are electromagnetic waves of very high frequency and high energy.