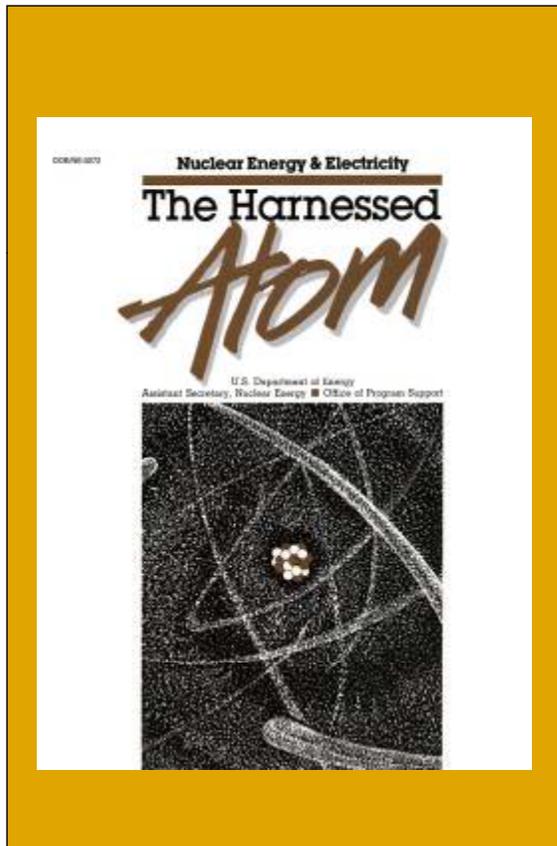


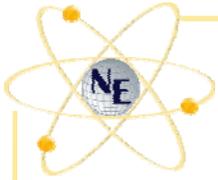
# The Harnessed Atom

*High School Honors Edition*



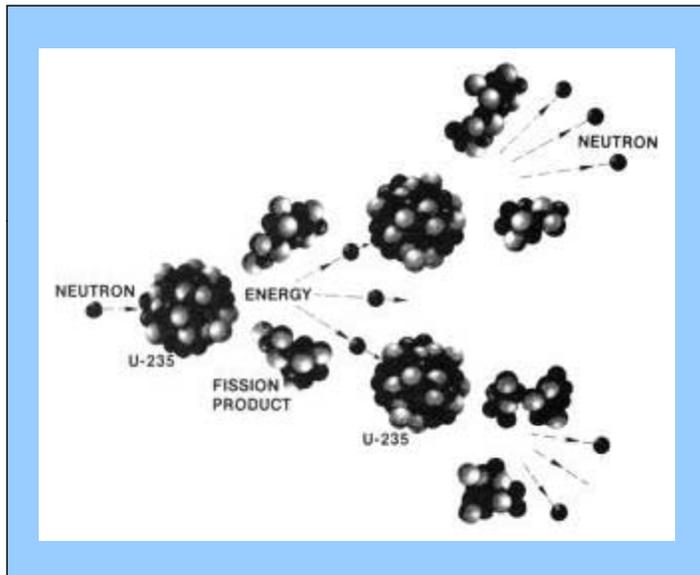
## The Original Harnessed Atom

- ⌚ Science educational curriculum developed 20 years ago by DOE Office of Nuclear Energy for junior high classrooms
- ⌚ Includes a Teacher's Guide, Student Reader, experiments and activities, and a video in mini-CD format (originally a filmstrip)
- ⌚ Though designed for junior-high age students, it tested successfully on non-science major students through Junior College level
- ⌚ 10,000 classroom sets produced by DOE



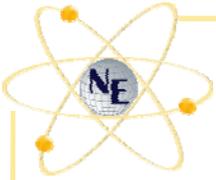
# The Harnessed Atom

## *High School Honors Edition*



## The Harnessed Atom's History

- ⌚ Used by over 1.5 million students and translated into at least 4 foreign languages
- ⌚ Recommended or promoted by leading teacher associations—NSTA, ASCD, NEA
- ⌚ Called “the gold standard” in nuclear educational material by ANS PA staff
- ⌚ Widely reprinted by utilities, school systems, private sector, and other countries

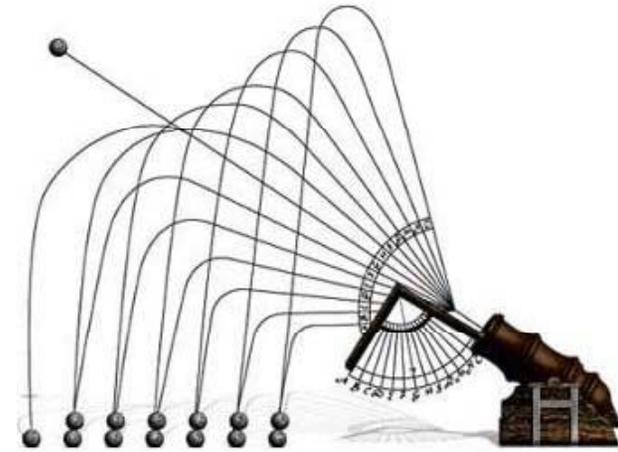


# The Harnessed Atom

## *High School Honors Edition*

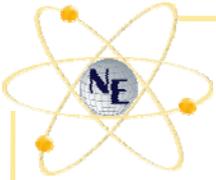
### What teachers told us

- ⌚ Students are being short-changed on essential information about nuclear science, health physics, and engineering
- ⌚ In major textbooks, still presented inaccurately or in biased language
- ⌚ Often skimmed over or not taught at all in high school physics classes
- ⌚ Many teachers feel ill-prepared to teach topic and do not have good classroom materials
- ⌚ ***Need a high school version***



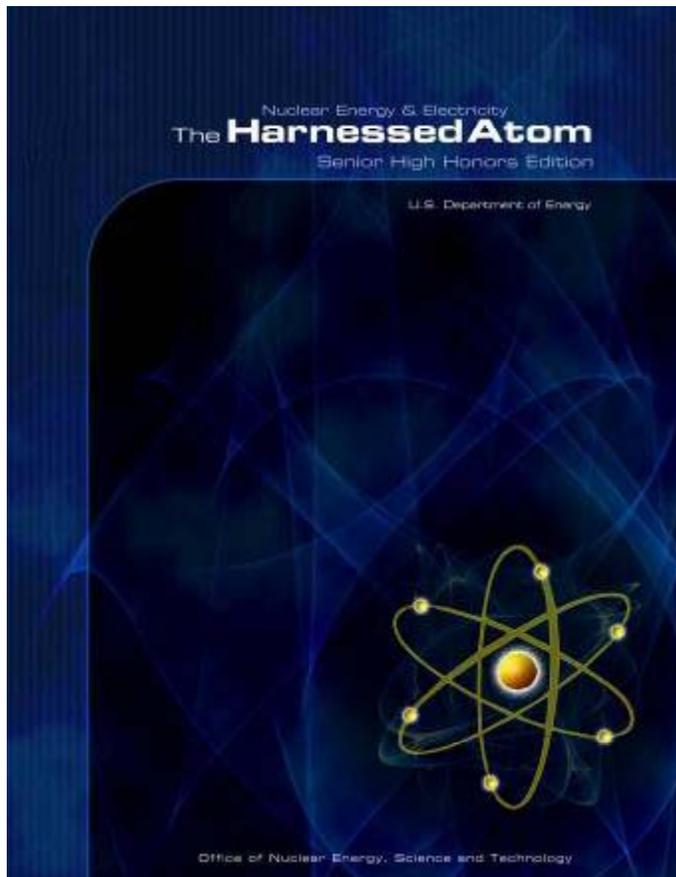
### **Typical high school physics does not include nuclear science**

- One Dimensional Motion
- Projectile Motion
- Forces
- Momentum
- Work-Energy
- Planetary Motion
- Electricity
- Magnetism
- Waves (water, sound, light)
- Optics
- Relativity



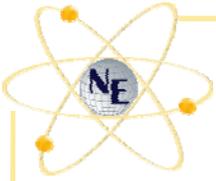
# The Harnessed Atom

*High School Honors Edition*



## Now, a Re-designed High School Curriculum...

- ⌚ For advanced students grades 11-12
- ⌚ Updated content and format
- ⌚ Worked with public school classroom teachers to review and validate through Pilot Test of the curriculum
- ⌚ '07-'08 Field Test of a revised edition in 5 regions across the U.S.
- ⌚ Afterwards, distribute curriculum nationally in partnership with Labs, academic institutions, public and private sector



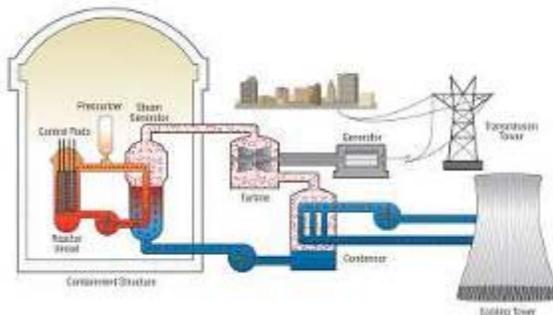
# The Harnessed Atom

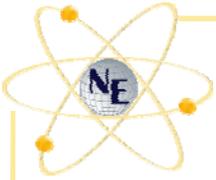
## *High School Honors Edition*



### The Curriculum...

- ⌚ Increases awareness at the pre-college level for students interested in sciences and engineering, nuclear engineering, and health physics
- ⌚ Helps high school students make more informed choices about college majors and career options
- ⌚ Supports Department of Energy mission to foster education and understanding of energy technologies and options





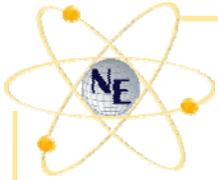
# The Harnessed Atom

## *High School Honors Edition*

This partnership is important

- ⌚ Connects public school educators, professional societies, DOE, research facilities, and private sector to strengthen the teaching of nuclear science
- ⌚ Helps students to become informed decision-makers on energy issues and policy as they become adult citizens
- ⌚ Perhaps most importantly: expands students' awareness of choices for college majors that they might overlook, including exciting career options in the nuclear engineering, nuclear medicine, health physics, research, and engineering



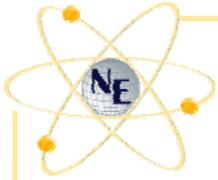


# The Harnessed Atom *High School Honors Edition*

What we hope the revised *Harnessed Atom* will accomplish in classrooms

- ⌚ Strengthen teaching of fundamental nuclear science concepts
- ⌚ Provide critical thinking experiences for students
- ⌚ Teach basic science of energy production, thermodynamics, radiation, nuclear reactions, and nuclear energy
- ⌚ Provide clear, unbiased information on nuclear topics





# 10 Days, 10 Chapters

- 1) Energy, Science, and Society
- 2) Generating Electricity
- 3) Atoms and Isotopes
- 4) Radiation
- 5) Nuclear Reactions
- 6) Nuclear power
- 7) By-products and Waste
- 8) Risk and Probability
- 9) Energy Decision-making
- 10) Review



## Cloud Chamber Trails

*Indirect observation of subatomic particles:  
seeing is believing*

### Radioactivity

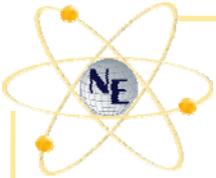
	<p><b>Alpha Decay</b></p> <p>(alpha particle)</p>
	<p><b>Beta Minus Decay</b></p> <p>(beta particle)</p>
	<p><b>Beta Plus Decay</b></p> <p>(beta particle)</p>
	<p><b>Gamma Decay</b></p> <p>(gamma ray)</p>

before      after

Radioactive decay transforms a nucleus by emitting different particles. In **alpha** decay, the nucleus releases a  ${}^4_2\text{He}$  nucleus—an alpha particle. In **beta** decay, the nucleus either emits an electron and antineutrino (or a positron and neutrino) or captures an atomic electron and emits a neutrino. A positron is the name for the antiparticle of the electron. Antimatter is composed of antiparticles. Both alpha and beta decays change the original nucleus into a nucleus of a different chemical element. In **gamma** decay, the nucleus lowers its internal energy by emitting a photon—a gamma ray. This decay does not modify the chemical properties of the atom.

Experiments with radioactive material teach an important lesson: These materials can and must be handled safely

- Geiger counters and background radiation
- Handling sources including gas light mantles, uranium ore, luminous watches, smoke detectors



## Walking around Penn State after the tour of the reactor

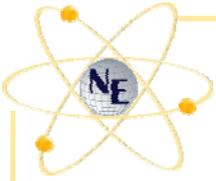
Mr. Mario Iasella, AP Physics, Pittsburgh Public Schools

“Ben was extremely excited and said ‘Mr. Iasella, you’ve messed everything up! I was planning to travel, take off from school, but this stuff is really cool. I want to know how it all works! I never would have thought I would have liked physics in the beginning of school.’”

“Teachers never quite know what topics will light a fire for individual students. These 2 students are going to Penn State in nuclear engineering. Without this unit, they would never have considered it.”

“2 out of 70 at Schenley High School.  
Seems small? Typically only 2-5 would even consider engineering or science.”





# The Harnessed Atom

*High School Honors Edition*



This is a partnership where everyone wins

- ⌚ Strengthens teaching of fundamental nuclear science concepts at the high school level
- ⌚ Industry and academic institutions benefit because students are better prepared
- ⌚ Teachers gain valuable teaching resources
- ⌚ Students gain knowledge of nuclear science, energy technology, and of career options that will help them far beyond high school