

# Nuclear Science Syllabus

## Day 1

- Introductions, safety, honor code, etc.
- Pre-test
- Early history of radiation (through Curies' work)
- Atomic structure
  - Early models of the atom
  - The Rutherford experiment
  - The Bohr model

## Day 2

- The Periodic Table and isotopes
- Radiation and radioactivity
  - the electromagnetic spectrum
  - stability of atoms
  - $\alpha$ ,  $\beta$ ,  $\gamma$  radiation and their properties
  - nuclear decay equations I

## Day 3

- Radiation and radioactivity (cont'd)
- Half life
- The Geiger counter and measurement
- Background radiation
- Activity: Measuring nuclear activity around campus
- Activity: Half life simulation
- Activity: Cloud chambers

## Day 4

- Biological Effects of Radiation
  - Biology background (somatic vs. germ cells)
  - Potential damage
- Radiation Safety
- Activity: Shielding
- Medical applications
  - Chemotherapy

## Day 5

- Medical applications (cont'd)
  - Isotopes for diagnosis
  - Radiation treatment
- Irradiation of food
- Medical imaging (X-rays, CAT scans, PET, etc.)
- Activity: Students choose independent research topics and begin background research

## Day 6

- Nuclear properties
  - Discovery of the neutron, neutron physics
  - Mass and abundance of nuclides
  - Relate atomic properties to nuclear properties
- Neutrinos
- Nuclear decay equations II
  - Conservation laws (i.e., mass and energy)
  - Review nuclear decays and radiation
  - Decay equations with energy

## Day 7

- Nuclear fission and the history of the atomic bomb I
- Activity: Mousetrap and bouncy ball fission chain reaction

## Day 8

- Nuclear fission and the history of the atomic bomb II
- Dirty bombs
- Science, society and ethics: the atomic bomb

## Day 9

- Nuclear power plants
  - How power plants work in general
  - Activity: Build a motor
  - Nuclear reactors
  - Safety and disasters

## Day 10

- Nuclear waste
- Nuclear power (including sources of power and world sustainability)
- Activity: Debate on the use and proliferation of nuclear power

## Day 11

- Nuclear fusion
- The fusion (hydrogen) bomb (including history)

## Day 12

- Fusion reactors
- Stellar fusion
- Nuclear astrophysics

## Day 13

- Nuclear astrophysics (cont'd)
- The standard model and particle physics
- Big bang cosmology and nucleosynthesis
- Cosmic microwave background

**Day 14**

- Post-test
- Activity: Student Research Presentations

**Day 15**

- Activity: Continuation of Student Research Presentations
- Wrap-up