

The logo for Energy Solutions Foundation features a stylized blue and yellow swoosh above the text. The word "Energy" is in a black serif font, "Solutions" is in a black italicized serif font, and "FOUNDATION" is in a blue sans-serif font.

Energy *Solutions*  
FOUNDATION

Alphas, Betas, Gammas,  
Oh My!

Energy Education Tools

A thick, dark blue horizontal bar with rounded ends, positioned at the bottom of the slide.

“Education is the most powerful  
weapon which you can use to  
change the world.”  
- *Nelson Mandela* -



The mission of the Energy Solutions Foundation is to promote math, science, and engineering education.

- We offer a merit based scholarship to 10th grade students in 9 states.
- We also produce three energy education tools that are intended for junior high and high school students:

## How to get an Education in Energy and Nuclear Energy.

**Free of Charge.**



As part of its commitment to education, the EnergySolutions Foundation has developed a new tool for educating Junior High and High School students on nuclear energy.

The Alphas, Betas, Gammas, Oh My! CD set contains nuclear energy lesson plans, labs, games and activities developed by top science teachers as well as two presentations created by the EnergySolutions training department: The Environment and the Generation of Electricity and Safe and Reliable Nuclear Energy.

This new tool is available, free of charge, to schools and other parties interested in learning about energy and nuclear energy.

Also available, free of charge, are two books on CD, *Nuclear Energy and the Use of Nuclear Materials* and *Nuclear is Hot! Everything You Wanted to Know about Nuclear Science But Were Afraid to Ask*.



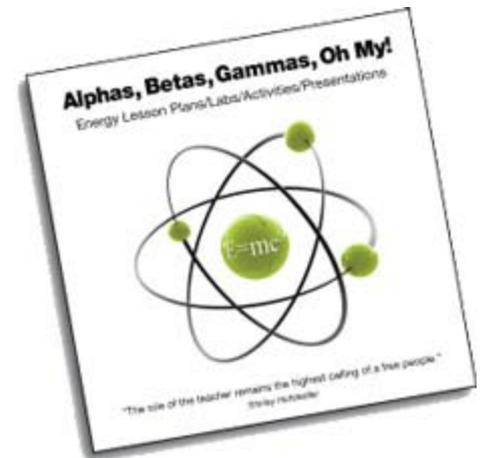
For a complete set, to take a tour of our Clive, Utah facility, or to schedule a speaker, call Pearl Wright at the EnergySolutions Foundation 801-649-2286 or email [pwright@energysolutionsfoundation.org](mailto:pwright@energysolutionsfoundation.org).



- Nuclear Energy and the Use of Nuclear Material
- Nuclear is Hot!: Everything You Wanted to Know About Nuclear Science But Were Afraid to Ask

- Alpha, Betas, Gammas, Oh My!  
Energy and Nuclear Energy Games, Activities  
and Presentations

- The material was created by  
a number of expert educators.



- Joe Andrade
  - Jeff Bates
  - Elizabeth McAndrew-Benavides
  - Curtis Craig
  - Dennis Fife, PhD
  - Al Hrynyshyn
  - Roger Mayes, PhD
  - Marc Mayntz
  - Duane Merrell
  - Mike McCracken
  - Ryan Rasmussen
  - Ty Robinson
  - David Sheffer
  - Brad Talbert
  - Necie Tarrant
  - Glen Westbroek
- Utah Science Center  
University of Utah  
Nuclear Energy Institute  
American Fork High School  
Utah State University  
Lake Ridge Junior High School  
Idaho National Laboratories  
Provo High School  
Brigham Young University  
Southern Nuclear Company, Plant Vogtle  
Provo High School  
Provo High School  
Rocky Mountain Elementary School  
Pleasant Grove High School  
Southern Nuclear Company  
Orem Junior High

## TABLE OF CONTENTS

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### POWER POINT PRESENTATIONS

#### The Environment and Electricity Generation

*The overall goal of this presentation is to introduce many different types of information concerning energy: Generation, use, environmental impacts, political considerations, etc.*

#### Self and Reliable Energy

*The overall goal of this presentation is to introduce to the student the role of Nuclear Energy in the entire energy production landscape: Generation, use, environmental impacts, political considerations, etc.*

#### The Atomic Nucleus – Discovery of Radioactivity

*Types and sources of radiation; the concept of half-life; calculation using carbon-14 to determine the age of a material.*

### ACTIVITIES

#### Half a Life is Better Than None

*Understanding radioactive decay by using statistical methods to gather and compare data.*

#### Tearing Through Half Life

*Kinesthetic activity will help develop math, science and technology skills on a conceptual level that includes mathematical reasoning and science processing.*

#### Mock Senate Sub Committee Hearing

*Use accepted procedures to conduct an orderly and efficient debate in the form of a mock Senate sub-committee hearing to present a logical, realistic and convincing discussion regarding a current energy issue.*

#### Alphas, Betas and Gammas Oh, My!

*Understanding radioactive decay.*

#### Nuclear Popcorn

*Help students visualize the rate of radioactive decay.*

### GAMES

#### Power Production Old Maid

*Understanding power production and transmission.*

#### Energy Trivia

*Test the students understanding with questions from energy categories such as nuclear, biomass, Solar, Hydroelectric, Wind, Tidal, Geothermal, Fossil and Misc. The content of the questions covers a spectrum from capacity, methods, locations, conservation, etc.*

#### Radioactive Decay of Uranium-238

*Understanding the entire decay chain from U-238 to lead.*

### ADDITIONAL INFORMATION

#### Glossary

#### Additional Resources

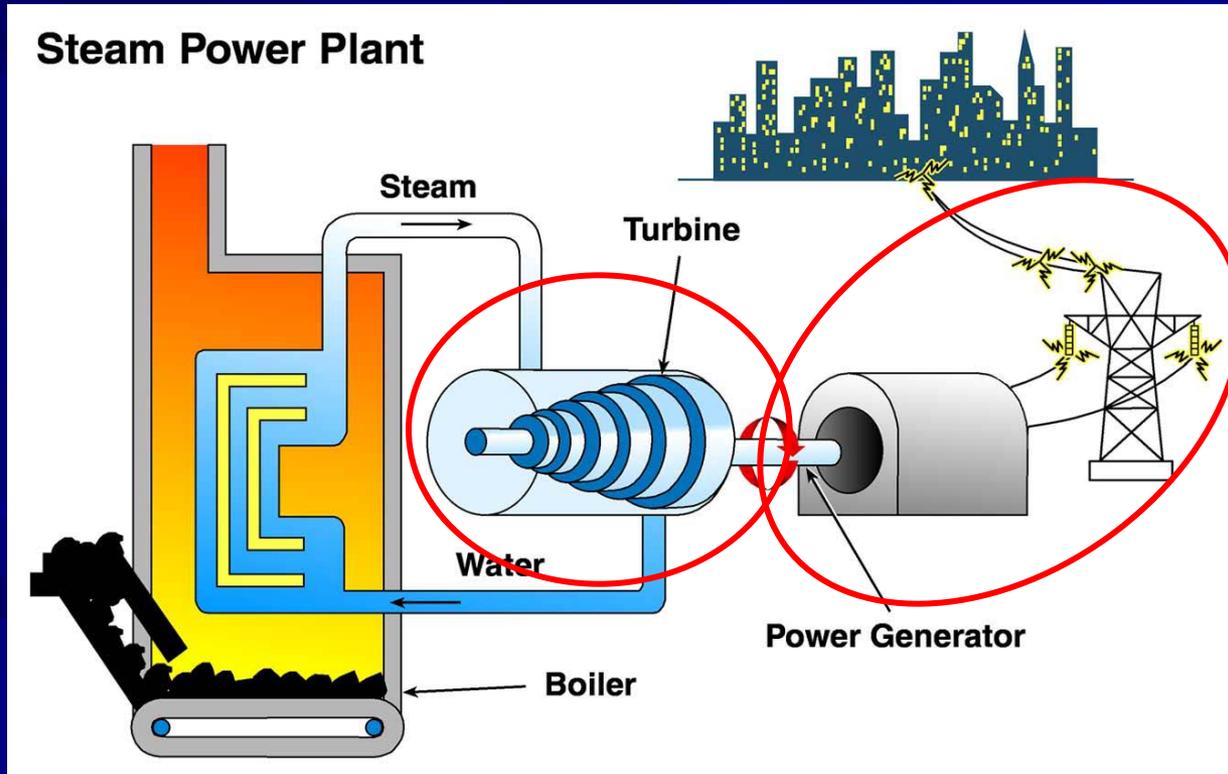
#### Energy Production Photo Library (included only on CD)

# The Environment and the Generation of Electricity

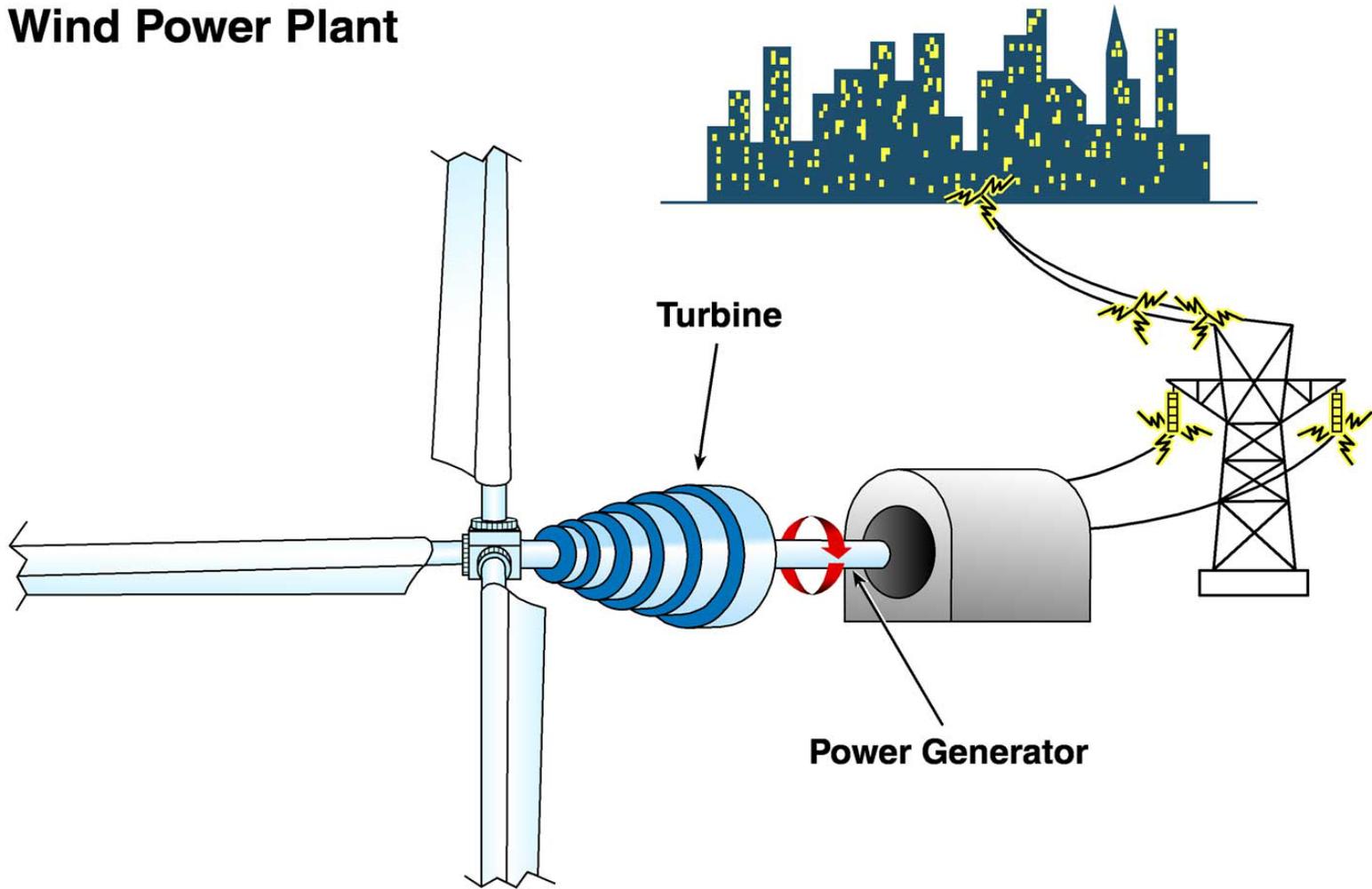
Creating the next generation of  
mathematicians, scientists, and engineers for  
America's future...

# Energy Production

- Energy is produced when:
  - A turbine is turned
  - Electricity is generated



# Wind Power Plant



# Safe and Reliable Nuclear Energy

Creating the next generation of  
mathematicians, scientists, and engineers for  
America's future...

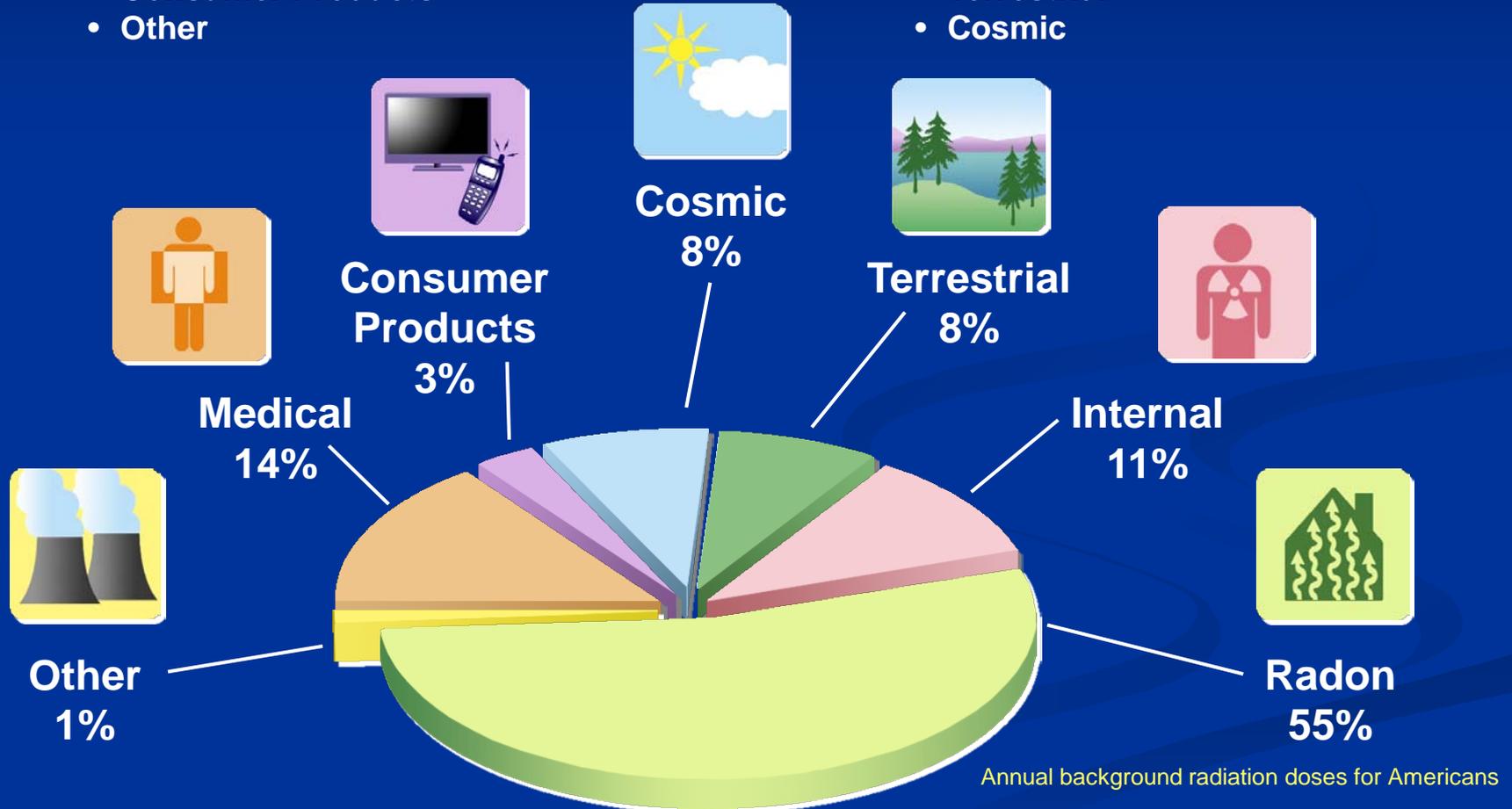
# Sources of Radiation

## Man Made Radiation Sources – 18%

- Medical X Rays
- Nuclear Medicine
- Consumer Products
- Other

## Natural Radiation Sources – 82%

- Radon
- Internal
- Terrestrial
- Cosmic



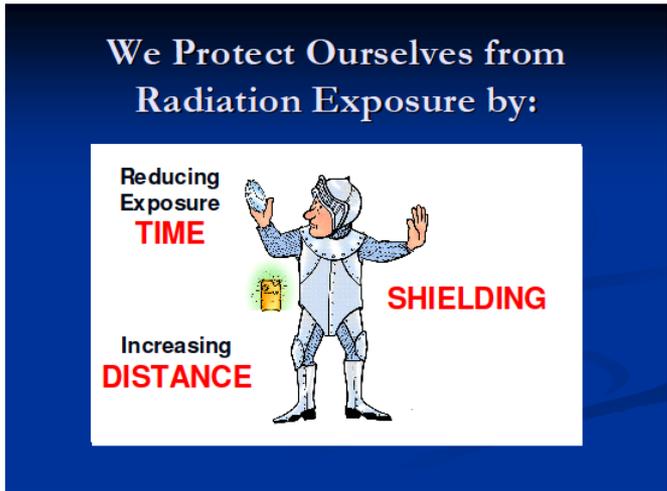
# We Protect Ourselves from Radiation Exposure by:

Reducing  
Exposure  
**TIME**



**SHIELDING**

Increasing  
**DISTANCE**



We protect ourselves from radiation exposure by: Time – Distance – Shielding

How do we protect ourselves from radiation exposure?

Shielding

*OPTIONAL (TIME DEPENDENT ACTIVITY) Use a piece of paper, aluminum foil, lead plate, to demonstrate shielding effects. This ties to slide 9 with the demonstration of decay and the penetration abilities of certain types of radiation.*

Time

We reduce exposure by limiting the time we are exposed

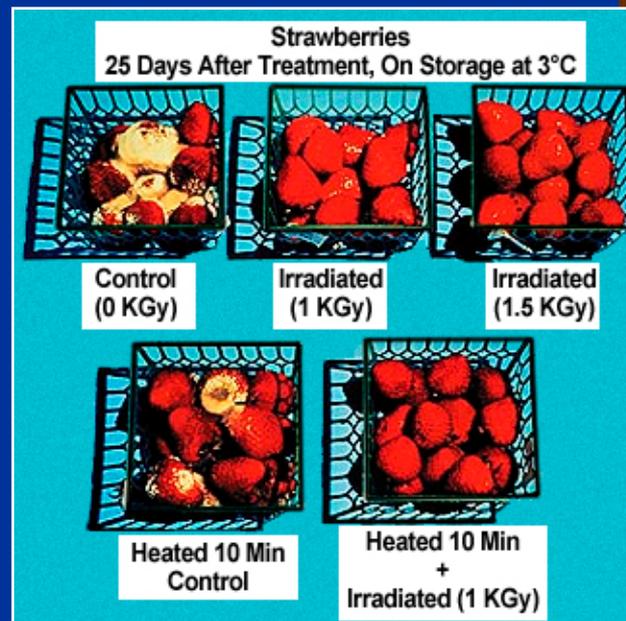
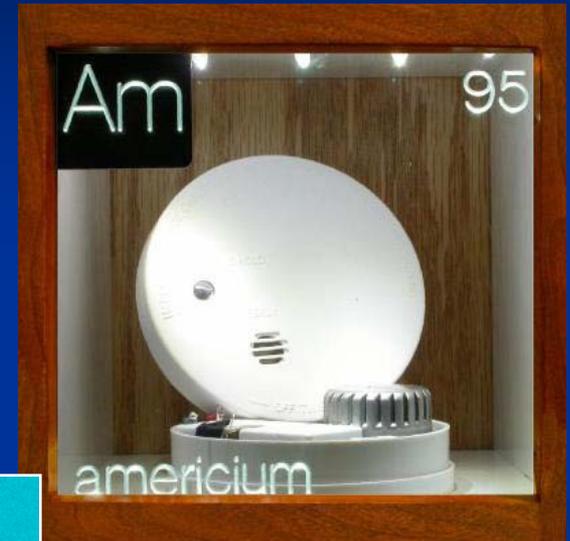
Distance

We reduce exposure by increasing the distance from the source

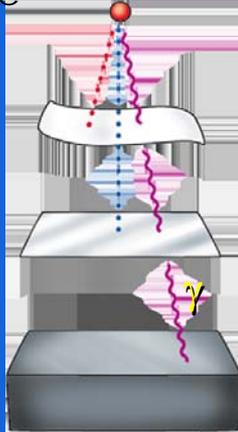
The more ways we protect ourselves the better.

# Beneficial Uses of Radiation

- Smoke detectors – rely on a tiny radioactive source to sound an alarm when smoke is present
- Food sterilization and preservation



Radioactive Source



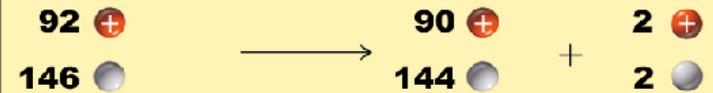
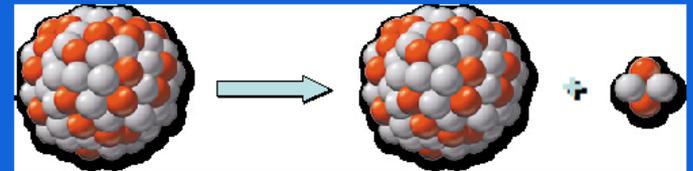
Paper

Aluminum

Lead

Unit of radiation exposure

$$\text{rad} = \frac{0.01 \text{ joule radiant energy}}{\text{kilogram of tissue}}$$



- Half a Life is Better than None
  - *Understanding radioactive decay by using statistics and data*
- Tearing Through Half Life
  - *Kinesthetic activity to help teach half life*
- Mock Senate Sub-Committee Hearing
  - *Debating for a better understanding*
- Alpha, Betas and Gammas, Oh My!
  - *Understanding the natural transmutation of elements through radioactive decay*
- Nuclear Popcorn
  - *Fun way to visualize radioactive decay*

## HALF A LIFE IS BETTER THAN NONE!

*(the true story of radioactivity)*



### Procedure:

1. The teacher assigns students a number from 2-12, which represents a radioactive element
2. \_\_\_\_\_ is your number assigned by your teacher. This is your "radioactive element" or you can create a name for your element.
3. Roll your pair of dice 36 times. Record the sum of the dice for each roll in the data table below. Remember to only make 36 rolls.

**TABLE 1:**

#### Data Table

Record your results by roll in the table below.

<b>ROLL</b>	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18		
Results																				
<b>ROLL</b>	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36		
Results																				

**TABLE 1A:**

#### Results Distribution

Record the number of times each number was rolled.

2 _____	5 _____	8 _____	11 _____
2 _____	6 _____	9 _____	12 _____
4 _____	7 _____	10 _____	

4. Now look at your completed data table. Shade in the boxes where you experienced a "half-life." (Meaning you rolled your number) How many times did you roll your assigned number? \_\_\_\_\_. How many half lives did your element experience? \_\_\_\_\_ (hint: these numbers are the same!)



- Glossary
  - *Energy and radiation terms*
- Resources
  - *Advocacy Groups & General Info*
  - *Energy Education*
  - *Government Departments*
  - *National Laboratories*
  - *National Science Education Standards*
  - *Professional & Trade Assoc.*

#### RESOURCES

##### ADVOCACY GROUPS & GENERAL INFORMATION

###### Alternative Energy News

Alternative energy news and information resources about renewable energy technologies. [www.alternative-energy-news.info](http://www.alternative-energy-news.info)

###### Citizens for Nuclear Technology Awareness

In 1991, a handful of citizens and a few companies in the Central Savannah River Area of South Carolina and Georgia banded together to form a nonprofit, grassroots organization that would be pro-nuclear and proud of it. We carry out educational programs to provide factual information about the benefits and risks of nuclear technologies and the Savannah River Site. [www.c-n-t-a.com](http://www.c-n-t-a.com)

###### Clean and Safe Energy Coalition (CASEnergy Coalition)

CASEnergy Coalition is an important voice in the public dialogue over current and future energy needs, particularly in addressing how nuclear power can contribute to America's energy security and economic growth. Their mission is to support the increased use of nuclear energy to ensure an environmentally clean, safe, affordable and reliable supply of electricity. Nuclear power enhances America's energy security and economic growth, helps attain cleaner air and improves the quality of life, health and economic well-being for all Americans. [www.cleansafeenergy.org](http://www.cleansafeenergy.org)

###### Energy Providers Coalition for Education (EPCE)

The EPCE is a group of industry representatives that develops, sponsors, and promotes industry-driven, standardized, quality online learning programs to meet the workforce needs of the energy industry. [www.epceonline.org](http://www.epceonline.org)

##### ENERGY EDUCATION TOOLS

**Get Into Energy** – has been developed and is managed by the Center for Energy Workforce Development (CEWD). CEWD is a non-profit organization with a mission of building alliances, processes, and tools to develop tomorrow's energy workforce. This site is designed to build awareness among students, parents, teachers, guidance counselors, as well as working adults who are considering a career change. This site is open to anyone and includes: videos, career information, and information for students, parents, and educators. [www.getintoenergy.com](http://www.getintoenergy.com)



## Q & A

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