



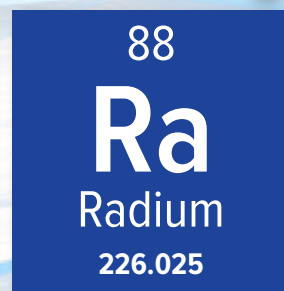
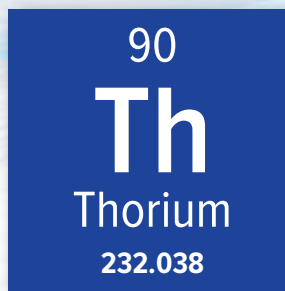
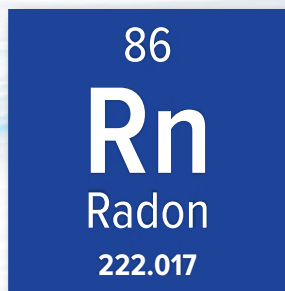
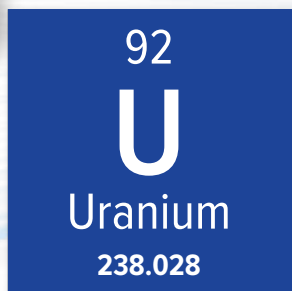
# RADIATION AND YOU

## CLOUD CHAMBER

What human-made sources of ionizing radiation are there? How do they compare to natural sources? Expand your understanding of this phenomena by watching the **Radiation Cloud Chamber video** and answering the questions below!



Or visit <https://www.youtube.com/watch?v=QsevaUxE3EE>



*There are currently 118 elements known to science and 37 of them are naturally radioactive, including the above elements.*

## RADIATION

**Radiation** is energy emitted from an unstable atom as particles or rays. **Ionizing radiation** is energy strong enough to eject electrons from an atom, charging or ionizing the atom. This fascinating natural phenomenon can be observed in a cloud chamber. **Cloud Chambers** are devices that create artificial clouds for experimentation, but they double as particle viewing chambers illuminating the typically invisible pathways of radiation. In physics, **particles** are the miniscule objects that make up matter like protons, neutrons, and electrons.





# VIDEO QUESTIONS

While watching the radiation cloud chamber video, listen for the answers to the following questions:

1. Who created the first cloud chamber?
2. What are cloud chambers used to detect?
3. What kind of radiation was first detected in the cloud chamber?
4. Why is some dinnerware from the 1930s-1950s radioactive?
5. What particles make up alpha radiation?
6. What kind of trail does alpha radiation cause?
7. What is the charge of beta radiation?
8. Do beta particles have lower or higher energy than alpha particles?
9. What causes long, straight trails in the cloud chamber?
10. What radioactive isotope is found in Brazil nuts?



## SCIENTIFIC METHOD

Use this section when prompted to pause by the video. Write any questions or hypotheses you have about ionizing radiation. If your question isn't answered in the video, do some independent research!

### FUN FACT

Because dry ice is frozen CO<sub>2</sub> (carbon dioxide), it doesn't turn into a liquid. When it warms up, it goes straight from a solid to a gas. This process is known as sublimation, so we don't say dry ice melts or evaporates — rather it sublimates.

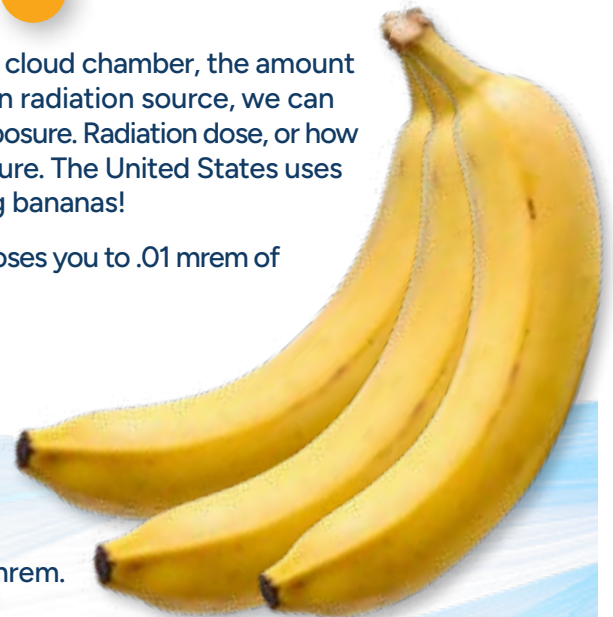


# BANANA MATH

Despite the impressive trails that occasionally shoot off bananas in the cloud chamber, the amount of radiation is extremely small and poses no health risks. As a common radiation source, we can use bananas as a scale to compare to other forms of ionizing radiation exposure. Radiation dose, or how much ionizing radiation your body absorbs, varies based off your exposure. The United States uses millirem (mrem) to measure radiation dose, but you will convert it using bananas!

Eating one banana (which we'll call a Banana Equivalent Dose or BED) exposes you to .01 mrem of radiation. Use this ratio, 1 BED = 0.01 mrem, to solve:

1. One full-body CT scan = \_\_\_\_\_ BED or 1,000 mrem.
2. Receiving a dental X-ray = 200 BED or \_\_\_\_\_ mrem.
3. Eating 5 Brazil nuts = 25 BED or \_\_\_\_\_ mrem.
4. Annual radiation from natural sources = 31,000 BED or \_\_\_\_\_ mrem.
5. Radiation from a one-hour airplane flight = \_\_\_\_\_ BED or 0.30 mrem.



## FUN FACTS

Charles Wilson first experimented with cloud formation in a lab in 1895. Cloud chambers would continue to be used for scientific inquiry into the 1950s.

There are many models of cloud chambers, the original being an expansion cloud chamber, also called the Wilson Cloud Chamber. The video showcases a diffusion cloud chamber.

Charles Wilson, with Arthur Compton, won the Nobel Prize in physics in 1927 for the invention of the cloud chamber. Friends and colleagues called him C.T.R. in reference to his middle names, Thomson and Rees.

Many physicists owe their discoveries to Charles Wilson and his cloud chamber.

During the Manhattan Project, scientists at Los Alamos used a cloud chamber in the development of the implosion bomb.

## CRITICAL THINKING

Use outside knowledge to try and answer these questions.

1. What are the phases of matter?
2. What kind of phase change does the ethyl alcohol go through in the cloud chamber?
3. Why was uranium purposely used in vintage dinnerware?
4. Why are some plant-based foods radioactive?
5. How is ionizing radiation used today?

# ANSWERS

## VIDEO QUESTIONS

1. Charles Wilson.
2. Ionizing radiation.
3. Cosmic radiation.
4. It was crafted with a uranium glaze.
5. Two protons and two neutrons.
6. Short, straight trails.
7. Negative.
8. Higher.
9. Gamma radiation.
10. Radium-226 (228 is also correct).



Charles Wilson

## BANANA MATH

1. One full-body CT scan = **100,000** BED or 1,000 mrem.
2. Receiving a dental X-ray = 200 BED or **2** mrem.
3. Eating five Brazil nuts = 25 BED or **0.25** mrem.
4. Annual radiation from natural sources = 31,000 BED or **310** mrem.
5. Radiation from a one-hour airplane flight = **30** BED or 0.30 mrem.



## CRITICAL THINKING

1. Solid, liquid, gas, and plasma.
2. Gas to liquid, known as condensation.
3. For its color, uranium was desired for making yellows, reds, and oranges.
4. Soil. Plants absorb many minerals from the ground they are rooted in and those growing in environments with radioactive minerals are more likely to absorb them.
5. X-rays, medical treatments, nuclear power, criminal investigations.