ANS®
American Nuclear Society

Visualizing Radiation Cloud Chamber Kit

ANS Supports Students and Educators

The American Nuclear Society has created a set of programs bringing together a state-of-the-art nuclear science curriculum, some of the country's most qualified nuclear experts, and a suite of virtual and in-person experiences that make nuclear science accessible and exciting for students and teachers alike!

These programs include:

NAVIGATING™ NUCLEAR

A fact-based, contemporary curriculum developed by the American Nuclear Society in partnership with Discovery Education and the Department of Energy Office of Nuclear Energy.

NUCLEAR AMBASSADORS

ANS members who are specially trained in classroom interaction and presentation to bring personal experience and expertise to the classroom.

EDUCATOR TRAINING

In-person and virtual professional development opportunities, such as webinars and workshops to gain confidence and teaching strategies

PATHWAYS TO NUCLEAR

Virtual and in-person events that inspire students to pursue careers in nuclear science and technology.

Learn more about ANS's K-12 programs on our website—ans.org—and sign up to receive news and resources for in and out of the classroom.

ans.org/K12email

Activity

Visualizing Radiation with Cloud Chambers

Cloud chambers help students form a mental model of radiation that they can apply in the following Navigating Nuclear resources available at **ans.org/nuclear/navigatingnuclear**.

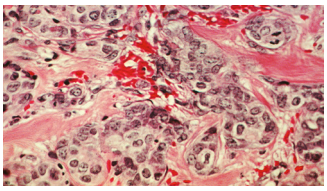
Radiopharmaceuticals

Realities of Radiation

Making Mosquitos SIT!

Exploring the Present and Future of Radioactive Decay

Decay Detectives: Art Forgery or Masterpiece?



Planting the "Seeds" for a Better Future for Cancer Patients

Materials

Included in the cloud chamber kit box are:

- 4 hinged plastic boxes
- 4 sheets of four felt pads
- 4 foam trays
- 4 thorium mantles
- Several rubber bands
- 4 small plastic bottles
- 4 flashlights with batteries *(if the flashlight doesn't light, open it and remove the plastic circle over the battery contacts)*
- Insulated gloves for handling the dry ice

Access resources:

ans.org/nuclear/k12resources/cloudchamber

You will also need

- **Visualizing Radiation PowerPoint**
- **Health Physics Society's Guidance** for the Use of Exempt Quantities of Radioactive Materials in the Secondary School
- CDC safe handling of **dry ice guidance**

You will need to provide:

- Alcohol
  - 91% isopropyl alcohol or ethanol to fill the small bottles.
- Dry ice
  - Preferred are sliced blocks, though pellets can be used if blocks aren't available, as you will only need enough to fill the foam trays to cool the plastic boxes. A web search for "dry ice suppliers" should indicate sources in your area.
- Pick up the dry ice as close as possible to the time of the activity. Store it in a foam cooler until needed; it will sublimate if left at room temperature, emitting carbon dioxide.
- Gloves for handling the thorium mantles, such as medical gloves.
- Safety glasses for yourself and the students.

Safety

You and the students should wear safety goggles throughout the activity. In addition to the regular laboratory safety rules, advise students of the following:

- Do not touch the dry ice.
- Wash hands thoroughly immediately after handling the thorium mantles.

Procedure

- Fill the small bottles with alcohol and check that the flashlights work.
- Pick up the dry ice. Store it in a foam cooler until use.

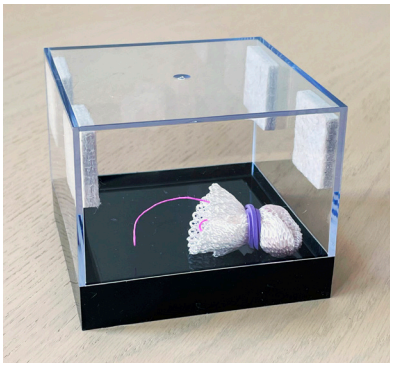
Set up

1. Set out the experiment materials prior to beginning. There are enough materials to construct four cloud chambers. Divide students into groups.
2. Begin the session by showing the PowerPoint to describe how cloud chambers work.
3. Stop at slide 6.

Construct the cloud chambers

Have each group collect materials and bring them back to workstations. Each group should receive one each of the following:

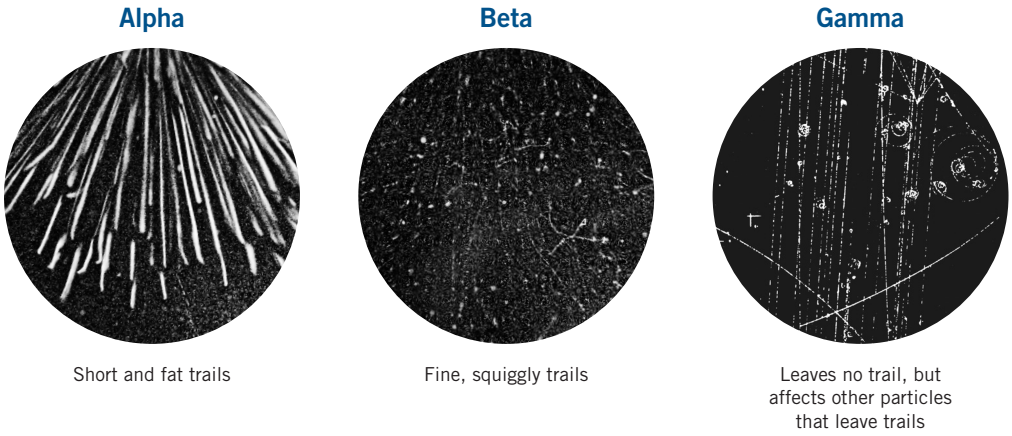
- Plastic box
- Felt pads
- Bottle of alcohol
- Thorium mantle
- Rubber band
- Flashlight



1. Place a flat piece of dry ice on the foam tray, ensuring it is large enough for the entire black bottom of the chamber to be in contact with the dry ice. Try to make an even surface for the cloud chambers to sit on.
2. Distribute one tray to each student group.
3. Open the plastic box and stick a felt pad in each corner near the top of the clear chamber.
   - Saturate each felt pad with alcohol.
   - Bind the thorium mantle into a small package using the rubber band, place it into a corner of the black bottom of the chamber, and close the chamber.
   - Place the cloud chamber on the dry ice as flatly as possible.
   - Open the plastic box and stick a felt pad in each corner near the top of the clear chamber.
   - Saturate each felt pad with alcohol.
   - Bind the thorium mantle into a small package using the rubber band, place it into a corner of the black bottom of the chamber, and close the chamber.
   - Place the cloud chamber on the dry ice as flatly as possible.
4. Proceed to slide 8, then slide 9.

5. Turn off the lights in the room and shine the flashlight through the cloud chamber to make the trails easier to see.
   - Trails should begin a few minutes after placing the closed cloud chamber on the ice.
   - There may be a "sweet spot" in the chamber where the trails are easier to see.
   - One or more of the cloud chambers may take longer to start showing trails.
6. Continue the activity until all students have had a chance to view a working cloud chamber.

View of particles in the cloud chamber



Wrap-up

1. Ask students what uses they think there are for the different types of radiation based on what they observed.
2. Ask students why they think alpha radiation is ideal for implanting in a tumor inside the body. *Sample answer: It's powerful, but doesn't travel far.*
3. Ask students why they think beta radiation is used to measure thickness. *Sample answer: if something is too thin, the particles will go through it.*
4. Ask students why we can study galaxies that are light-years away. *Sample answer: We can detect gamma rays because they travel far.*
5. End the presentation with the final slide. Allow them to continue observing the cloud chambers.
6. End by inviting students to help put away the materials by bringing their cloud chambers to a select location while you gather the trays of dry ice.

Trouble shooting your cloud chamber

Occasionally, cloud chambers can be challenging to get started. Here are a few things to check if you find your cloud chamber isn't producing decay trails.

- Make sure the bottom of the chamber is well seated on the dry ice. Preferred forms of ice are sliced blocks. Tell your dry ice supplier the purpose for the ice; they should be able to steer you in the right direction.
- Use the highest concentration of alcohol available. Highly concentrated isopropyl or ethanol provide the best results. The 70% concentration commonly available may work, but not as reliably.
- Cloud chambers require a significant difference in temperature from the bottom and to the top to produce vapor. Rub your hands together to warm them and place your warm hand on top of the chamber. Hold it there for a while; try again if necessary.
- Alternatively, fill a small, unbreakable cup with warm water and rest it on top of the chamber until trails begin forming. Remove the cup once the chamber begins producing trails.
- Be patient. Some cloud chambers will produce trails almost immediately; others may take longer. Within 5-20 minutes you should have productive cloud chambers.

askanything@ans.org
ans.org

Sign up for news, events, classroom resources, and more!
ans.org/K12email

Note: The American Nuclear Society's Visualizing Radiation Cloud Chamber Kit contains exempt quantities of radioactive materials as defined by the Nuclear Regulatory Commission. All these sources produce minimal radiation dose and, when handled properly, do not pose a risk of contamination. For further information visit nrc.gov.