State of Utah
Department of Environmental Quality

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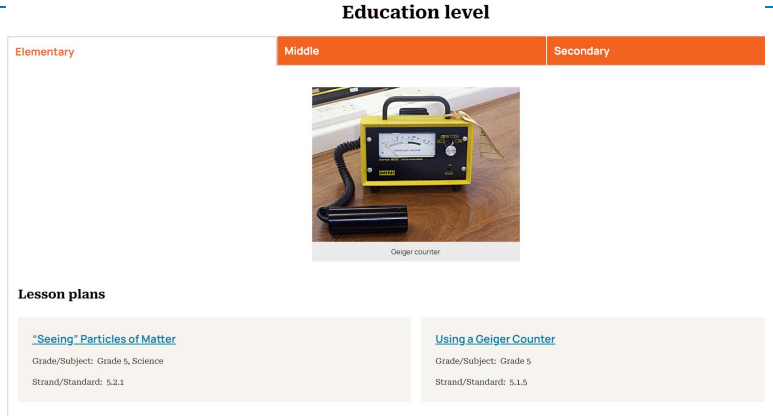
IEA Presentation
UPDATES FROM UTAH's
RADON PROGRAM
UTAH DEPARTMENT of
ENVIRONMENTAL
QUALITY

OVERVIEW of Presentation

- Share Utah's Radon Curriculum
- Encourage science teacher involvement
- Two Science Teacher Associations in your State
  - Utah Science Teacher Association
  - STEM Action Center
- Tool Kits for Teachers

Radon Curriculum

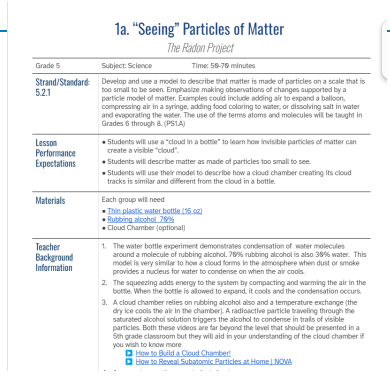


- 8 Lessons Follow SEED Standards
- 4 lessons for 5-8th grade
- 4 lessons for 9-12th grade
  - One lesson is specifically for Radon Poster Contest participation
  - https://drive.google.com/drive/folders/1Q6RYaF81z9qxPNbvQjdWuRff30fa9rn

All of the lessons have an interactive component and a worksheet!

5th Grade Lesson Plans

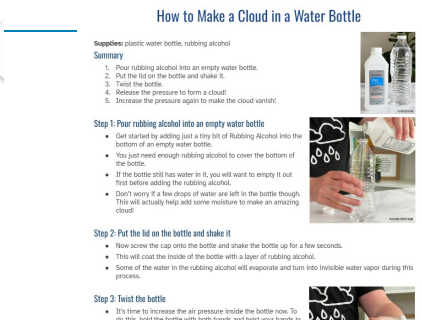
- Seeing Particles of Matter
- Using a Geiger Counter
  - Lessons have interactive component
  - Lessons have a student worksheet



1a. "Seeing" Particles of Matter

The Radon Project

Grade 5	Subject: Science	Time: 59-79 minutes
Strand/Standard: 5.2.1	Develop and use a model to describe that matter is made of particles on a scale that is too small to be seen. Emphasize making observations of changes supported by a particle model of matter. Examples could include adding air to expand a balloon, compressing air in a syringe, adding food coloring to water, or dissolving salt in water and evaporating the water. The use of the terms atoms and molecules will be taught in Grades 6 through 8. (PS1.A)	
Lesson Performance Expectations	• Students will use a "cloud in a bottle" to learn how invisible particles of matter can create a visible "cloud". • Students will describe matter as made of particles too small to see. • Students will use their model to describe how a cloud chamber creating its cloud tracks is similar and different from the cloud in a bottle.	
Materials	Each group will need • Thin plastic water bottle (16 oz) • Rubbing alcohol 79% • Cloud Chamber (optional)	
Teacher Background Information	1. The water bottle experiment demonstrates condensation of water molecules around a molecule of rubbing alcohol. 79% rubbing alcohol is also 39% water. This model is very similar to how a cloud forms in the atmosphere when dust or smoke provides a nucleus for water to condense on when the air cools. 2. The squeezing adds energy to the system by compacting and warming the air in the bottle. When the bottle is allowed to expand, it cools and the condensation occurs. 3. A cloud chamber relies on rubbing alcohol also and a temperature exchange (the dry ice cools the air in the chamber). A radioactive particle traveling through the saturated alcohol solution triggers the alcohol to condense in trails of visible particles. Both these videos are far beyond the level that should be presented in a 5th grade classroom but they will aid in your understanding of the cloud chamber if you wish to know more How to Build a Cloud Chamber! How to Reveal Subatomic Particles at Home | NOVA	



How to Make a Cloud in a Water Bottle

Supplies: plastic water bottle, rubbing alcohol

Summary

1. Pour rubbing alcohol into an empty water bottle.
2. Put the lid on the bottle and shake it.
3. Twist the bottle.
4. Release the pressure to form a cloud!
5. Increase the pressure again to make the cloud vanish!

Step 1: Pour rubbing alcohol into an empty water bottle

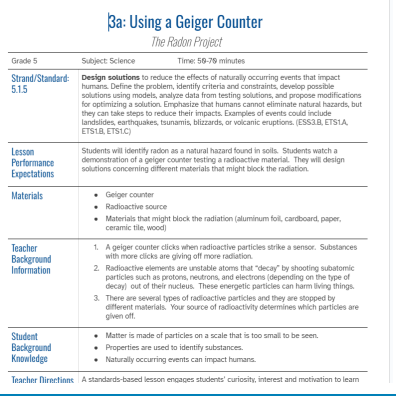
- Get started by adding just a tiny bit of Rubbing Alcohol into the bottom of an empty water bottle.
- You just need enough rubbing alcohol to cover the bottom of the bottle.
- If the bottle still has water in it, you will want to empty it out first before adding the rubbing alcohol.
- Don't worry if a few drops of water are left in the bottle though. This will actually help add some moisture to make an amazing cloud!

Step 2: Put the lid on the bottle and shake it

- Now screw the cap onto the bottle and shake the bottle up for a few seconds.
- This will coat the inside of the bottle with a layer of rubbing alcohol.
- Some of the water in the rubbing alcohol will evaporate and turn into invisible water vapor during this process.

Step 3: Twist the bottle

- It's time to increase the air pressure inside the bottle now. To



3a: Using a Geiger Counter

The Radon Project

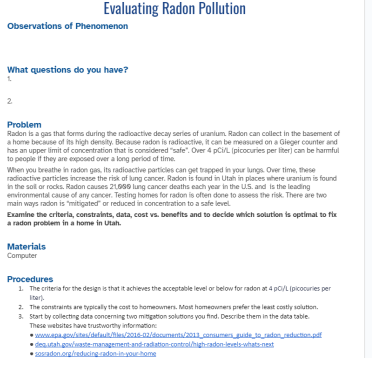
Grade 5	Subject: Science	Time: 59-79 minutes
Strand/Standard: 5.1.5	**Design solutions** to reduce the effects of naturally occurring events that impact humans. Define the problem, identify criteria and constraints, develop possible solutions using models, analyze data from testing solutions, and propose modifications for optimizing a solution. Emphasize that humans cannot eliminate natural hazards, but they can take steps to reduce their impacts. Examples of events could include landslides, earthquakes, tsunamis, blizzards, or volcanic eruptions. (ESS3.B, ETS1.A, ETS1.B, ETS1.C)	
Lesson Performance Expectations	Students will identify radon as a natural hazard found in soils. Students watch a demonstration of a geiger counter testing a radioactive material. They will design solutions concerning different materials that might block the radiation.	
Materials	• Geiger counter • Radioactive source • Materials that might block the radiation (aluminum foil, cardboard, paper, ceramic tile, wood)	
Teacher Background Information	1. A geiger counter clicks when radioactive particles strike a sensor. Substances with more clicks are giving off more radiation. 2. Radioactive elements are unstable atoms that "decay" by shooting subatomic particles such as protons, neutrons, and electrons (depending on the type of decay) out of their nucleus. These energetic particles can harm living things. 3. There are several types of radioactive particles and they are stopped by different materials. Your source of radioactivity determines which particles are given off.	
Student Background Knowledge	• Matter is made of particles on a scale that is too small to be seen. • Properties are used to identify substances. • Naturally occurring events can impact humans.	
Teacher Directions	A standards-based lesson engages students' curiosity, interest and motivation to learn	

7- 8th Grade Lesson Plans

- Properties of Radon Gas/Poster Contest
- Properties or Radon Gas
- The Mathematics of Radon
- Building a Basement
- Modeling Atoms
- Comparing Isotopes
- Evaluating Radon Pollution

9-12 th Grade Lesson Plans

- The Mathematics of Radon
- Comparing Isotopes
- Evaluating Radon Pollution



Evaluating Radon Pollution

Observations of Phenomenon

What questions do you have?

1.

2.

Problem

Radon is a gas that forms during the radioactive decay series of uranium. Radon can collect in the basement of a home because of its high density. Because radon is radioactive, it can be measured on a Geiger counter and has an upper limit of concentration that is considered "safe". Over 4 pCi/L (picocuries per liter) can be harmful to people if they are exposed over a long period of time.

When you breathe in radon gas, its radioactive particles can get trapped in your lungs. Over time, these radioactive particles increase the risk of lung cancer. Radon is found in Utah in places where uranium is found in the soil or rocks. Radon causes 21,999 lung cancer deaths each year in the U.S. and is the leading environmental cause of any cancer. Testing homes for radon is often done to assess the risk. There are two main ways radon is "mitigated" or reduced in concentration to a safe level.

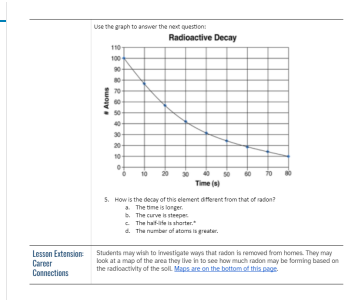
Examine the criteria, constraints, data, cost vs. benefits and to decide which solution is optimal to fix a radon problem in a home in Utah.

Materials

Computer

Procedures

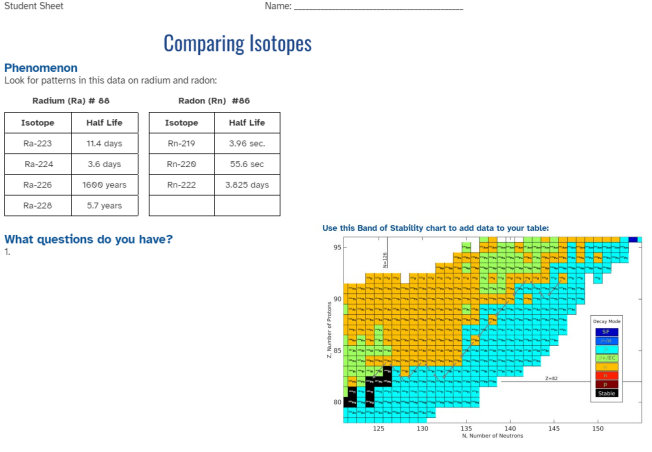
1. The criteria for the design is that it achieves the acceptable level or below for radon at 4 pCi/L (picocuries per liter).
2. The constraints are typically the cost to homeowners. Most homeowners prefer the least costly solution.
3. Start by collecting data concerning two mitigation solutions you find. Describe them in the data table.
   These websites have trustworthy information:
   - www.epa.gov/sites/default/files/2016-02/documents/2013_consumers_guide_to_radon_reduction.pdf
   - deq.utah.gov/waste-management-and-radiation-control/high-radon-levels-whats-next
   - sosradon.org/reducing-radon-in-your-home



Use the graph to answer the next question:

5. How is the decay of this element different from that of radon?
   a. The time is longer.
   b. The curve is steeper.
   c. The half-life is shorter.*
   d. The number of atoms is greater.

Lesson Extension: Career Connections	Students may wish to investigate ways that radon is removed from homes. They may look at a map of the area they live in to see how much radon may be forming based on the radioactivity of the soil. Maps are on the bottom of this page.



Student Sheet Name: _____

Comparing Isotopes

Phenomenon

Look for patterns in this data on radium and radon:

Radium (Ra) # 88

Isotope	Half Life
Ra-223	11.4 days
Ra-224	3.6 days
Ra-226	1600 years
Ra-228	5.7 years

Radon (Rn) #86

Isotope	Half Life
Rn-219	3.96 sec.
Rn-220	55.6 sec
Rn-222	3.825 days

What questions do you have?

1.

Use this Band of Stability chart to add data to your table:

How will Utah Promote Radon Lessons

- Utah Science Teacher Association

  Most states have science teacher associations

- STEM Conferences
- Request to give presentations at the Conferences – FREE
- Be a Vendor at the Conferences – Minimal Cost $150

  Goal is to get Science Teachers emails – giveaways’

Teacher Kits in Tool Box

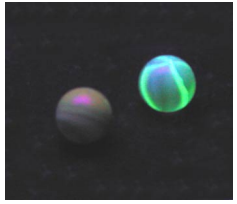
Geiger Counter

Radiation button sources

Marbles

Fiesta Ware

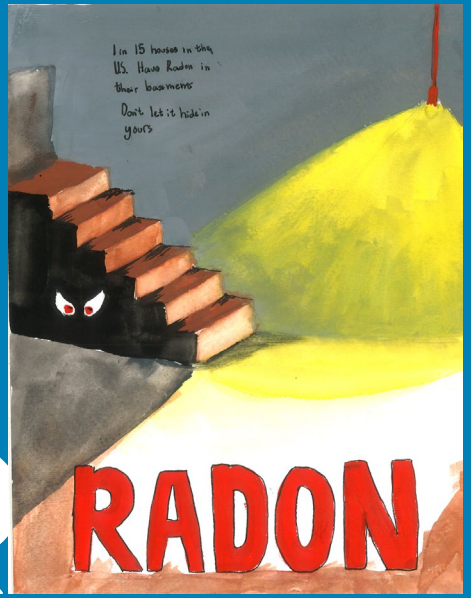
Lantern mantles



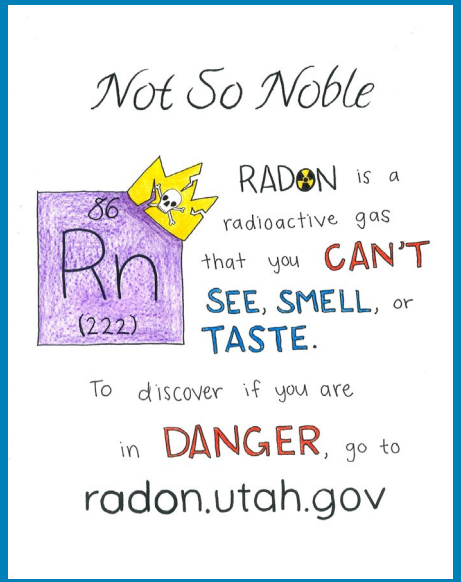
Environmental Justice & Radon

- The EJG2G Grant will assist:
- Low-income, rural & tribal nations with radon testing & mitigation
  - Community Partner = Utah Radon Coalition

QUESTIONS??


1 in 15 homes in the US. Have Radon in their basements
Don't let it hide in yours
RADON


Keep your house clean from radon!


Not So Noble
86
Rn
(222)
RADON is a radioactive gas that you CAN'T SEE, SMELL, or TASTE.
To discover if you are in DANGER, go to
radon.utah.gov